International Symposium
on

Innovations in Horticulture for Nutritional Security, Conserving Biodiversity and Poverty Alleviation

October 16-18, 2014

Souvenir & Abstracts

Organized by
Department of Applied Plant Sciences (Horticulture)
School for Biosciences and Biotechnology
at
Babasaheb Bhimrao Ambedkar University,
Vidya Vihar, Rae Bareli Road, Lucknow

in collaboration with
Indian Society of Horticultural Research & Development
Dehradun

BABASAHEB BHIMRAO AMBEDKAR UNIVERSITY
LUCKNOW
प्रज्ञा शील करुणा
ESTABLISHED 1996

INDIAN SOCIETY OF HORTICULTURAL RESEARCH & DEVELOPMENT
1969

Sponsored by

National Horticultural Board

NABARD

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Published By

Vice Chancellor, Babasaheb Bhimrao Ambedkar University, Vidya Vihar,
Rae Bareli Road, Lucknow-226 025

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Acknowledgements

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Research Scholars : Namrta Singh, Pawan Kumar, Shreesh Gautam, Abhishek Singh & Navaldey Bharti

Administrative Support : Vinay Kumar

Published on

October 16-18, 2014 for International Symposium on Innovations in Horticulture for Nutritional Security, Conserving Biodiversity and Poverty Alleviation – 1st SYMPHORT–2014

Printed at Army Printing Press, 33 Nehru Road, Sadar, Lucknow-226 002 Tel : 0522-2481164

बाबासाहेब भीमराव अम्बेडकर विश्वविद्यालय
(केन्द्रीय विश्वविद्यालय)
विद्या विहार, रायबरेली रोड
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Prof. Ranbir Chander Sobti
Vice Chancellor

No. : VCS/14
Date: 13.10.2014

Message

It gives me immense pleasure to know that the Department of Applied Plant Science (Horticulture) is organizing 1st International Symposium on the theme "Innovations in Horticulture for Nutritional Security, Conserving Bio-diversity and Poverty Alleviation" from 16-18 October 2014 at Babasaheb Bhimrao Ambedkar University, Lucknow.

Horticulture sector encompasses fruits, vegetables, floriculture, medicinal and aromatic plants, mushroom, spices and plantation crops and has witnessed phenomenal growth in production and productivity during last two decades. Resultantly, horticulture in India is recognized as one of the fastest growing sector in the world. The production during 2012-13 (268.84 MT) has surpassed the food grain production (255.36 MT) for the first time in the history of Indian Agriculture. Recognizing the potential of Horticulture, efforts were put through plan schemes both for technology generation and development. Investment in Horticulture during last three plan period has been rewarding in terms of increased production, productivity, availability and export of horticulture produce, which has further attracted private investment. In order to achieve faster and inclusive growth, mission mode approach for the development of Horticulture was targeted having clear strategies. Thus, organization of this event having participation of growers, scientists and government is timely to address the emerging issues.

The symposium is being organized at an appropriate time coinciding with the **World Food Day**. I am sure, the issues confornting the sector, particularly in the areas of productivity enhancement, supply of quality planting material by using innovative technologies in horticulture will receive the due attention during the deliberation of the symposium.

I compliment the organizing committee Department of Applied Plant Science (Horticulture) for organizing the symposium and for bringing out Abstract & Souvenir to mark the occasion.

I wisht the symposium all success.

(R. C. Sobti)

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Prof. R. B. Ram
M.Sc. (Ag.) Ph.D. (Hort.), B.H.U
Advisor to Hon'ble Vice-Chancellor
Babasaheb Bhimrao Ambedkar University,
Lucknow

Message

I am happy to learn that the Department of Applied Plant Sciences (Horticulture) is organizing 1st International Symposium on the theme "Innovations in Horticulture for Nutritional Security, Conserving Bio-diversity and Poverty Alleviation", especially on the occasion of 'World Food Day' from 16-18 October 2014 at Babasaheb Bhimrao Ambedkar University, Lucknow.

Horticulture has emerged as one of the options for improving profitability and enhanced farm income per unit area can be extended to marginal land. Past investments in research and development of Horticulture has been rewarding in terms of increase production productivity, availability and export. It has happened due to concerted efforts of all those engaged in R & D of horticulture and active participation of the private sector and more importantly farmers of the country. The forthcoming challenge is the sustainability of horticulture growth to make the sector viable and attractive for the growers, industries and consumers. Despite, ample increase in production of horticultural crops during 2012-13 (268.84 million tonnes), the low productivity in several crops is still a challenge. Since, the land available for expansion of horticulture is limited, emphasis has to be laid on improving productivity to meet the future demands of the country and make horticulture more remunerative particularly to the small and marginal farmers. But the challenges ahead are more intense to meet the requirement of growing quality horticultural produce from declining land and water resources. Option available is to utilize science and technology to achieve projected growth of Horticulture.

Organization of this International Horticulture Symposium 2014 by Babasaheb Bhimrao Ambedkar University, Lucknow in collaboration with Indian Society for Research and Development (ISHRD), Dehradun is relevant and timely. I hope the Symposium will discuss and deliberate the various issues for accelerated growth of Horticulture, which will have catalytic impact on society in general and farmers in particular.

I convey my best wishes and compliments to the organizers of the Symposium for their efforts. I am sure, the Horticulture Symposium will be successful and fruitful.

(Prof. R. B. Ram)

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M. Y. Khan, *M.Phill., Ph.D.*
Dean Students' Welfare
Head, Department of Biotechnology
Dean, School for Biosciences & Biotechnology
Chief Coordinator, Centre of Innovative and Emerging Sciences

Message

I am happy to hear that the Department of Applied Plant Science (Horticulture), School for Biosciences and Biotechnology, Babasaheb Bhimrao University, Lucknow, is going to organise the first International Symposium in the department on Innovations in Horticulture for Nutritional Security, Conserving Biodiversity and Poverty Alleviation October 16-18, 2014.

It is indeed appreciable that in times of environmental fragility due to climate change which directly impacts agricultural production and food security this symposium is being organised. Exploring indigenous horticulture biodiversity and developing it as an enterprise will certainly ensure nutritional security and poverty alleviation.

The technical knowledge through this type of symposiums will also generate employment opportunities for the youth, rural populace as well as provide opportunities for inclusive growth of the society.

I wish the symposiums a grand success and delegates a comfortable stay in the city of Lucknow.

(M. Y. Khan)

About the symposium……

With the current governmental policies focusing on very fast urbanization, ignoring the depletion of the fertile arable lands, which would limit agricultural production significantly in the times to come, it is important to discuss and deliberate on issues of nutritional security using the indigenous biodiversity which grows in obscurity but which has the inherent potential to perform even under conditions of water, nutrient, climate and biotic stress and is a repository of bioactive compounds viz., tannins, organic acids, polyphenols, vitamins, etc These provide resistance to the body to combat disease conditions and are of significant importance.

It appears relevant to explore possibilities of horticulture contributing towards mitigating the deleterious effects of technological developments which may impact the environment and the society negatively. Indigenous flora, which grow in their niche areas, have a distinct capacity to contribute towards this and when the more favoured yet delicate cultivated species buckle under the impact of changing climate, it is these crops which could provide food as well as nutritional security. Thus, we need to understand the need to concentrate on indigenous flora and conserve biodiversity.

It cannot be denied that traditional crops have the inherent potential to perform under stress conditions and provide nutritional security. However, without a well developed program for industrial utilization of these crops they would continue to remain underexploited. Hence, it is important to develop entrepreneurial skills and innovative technologies which could subsequently help in poverty alleviation.

Thus, this International symposium was organized to deliberate and discuss Innovations in Horticulture to address issues of nutritional security through conservation of biodiversity (underutilized, indigenous crops?) and channelize our researchers and farmers towards developing Horticulture as an enterprise. A farmers session is also scheduled as a part of this symposium which has the following nine thematic sessions:

1. Conventional & non conventional approach for crop improvement and biodiversity conservation
2. Plant protection and biotic and abiotic stress management of horticultural crops
3. Precision farming: Protected cultivation and organic horticulture
4. Post-harvest handling, food technology and value addition in horticultural crops
5. Underexploited and exotic horticultural crops
6. Horticulture for environment and society
7. Horticultural crops as nutraceuticals and pharmaceuticals
8. Entrepreneurship for farmers, self employment and IPR
9. Innovative technologies in horticulture
10. Improvement in Production Technologies 00

The organizers are grateful for the immense response received from all corners of the country. Approximately 300 contributions have been received from Ladakh to Andamans and from Gujarat to Tripura from about 20 states of the country from the major organisations working in the field of Agriculture science viz the ICAR institutes : IARI, Various NRC, Project directorates, the CSIR institutes, SAU's, IIM, QCI, DRDO etc.

We wish the delegates a fruitful academic discourse and hope that we will be able to draw meaningful conclusions from the deliberation.

Organising Secretary
1st SYMPHORT-2014

About The Department of Applied Plant Science (Horticulture)

Horticulture has been a subject of study in the university from its very inception in the year 1996. It was taught as a PG diploma in Horticulture in 'Seed and Nursery Production' under the Centre for Rural Technology (CRT) of a one year duration from academic session 1997-98. Subsequently the foundation of the Department of Applied Plant Science under the School for Bio-sciences and Bio-technology was laid w.e.f. academic 2001-02 when this PG Diploma course was upgraded to Master Degree Programme in Horticulture. The Ph. D. programme in Horticulture began from the academic session 2003-04. With the emphasis towards vocational studies increasing, the department has started a Bachelors in Vocational Studies in Floriculture and Landscaping from 2014-15.

The number of students enrolled during the period 2012-13 in Master Degree Programme and Ph.D. Degree programme are 40 and 05, respectively.

For conducting experiments/Research trials, the department is equipped with a Horticultural Research Farm (10.0 acre) and bolh PG as well as Research Laboratories. Protected cultivation structures viz., fiber glasshouse, poly house, shade net house and wire net house, along with a state of the art microirrigation systems viz., microsprinkler, fogger and drip irrigation are installed with a view to educate the students about modern techniques in horticulture as well as to promote research on these aspects. Additional area is under process of development as a floriculture research block.

Besides this, the Department organizes regular seminars on a weekly basis, especially for the final year (IVth semester) students, in order to enhance their orientation /communication skills and to create general awareness amongst them on different aspects of Horticulture. The department also encourages to students for attending/ participating in the seminar, conference, workshop, exhibition, farmers' fair etc. on Horticultural crops. Annually tours are conducted for the students of the department to 'Flower Shows' organized by national institutes like NBRI, CIMAP, IISR and Directorate of Horticulture U.P. Government at Raj Bhawan, to fruit nurseries viz., Progeny orchard, Mallihabad and Mango Show/Showcasing of Agricultural Technologies/innovation through exhibition CISH, Lucknow.

At present department comprises five faculty members comprising one Professor, two Associate Professor and two Assistant Professor, respectively.

Objectives

- Teaching and research in all the streams of Horticulture viz., fruits, vegetables, flowers (ornamental) medicinal and aromatic crops in the field of agriculture through teaching, research, training, extension etc. at the M Sc and Ph D levels.
- To undertake the basic and applied research for developing strategies to enhance productivity and utilization of horticultural crops especially for the development of socially and economically depressed segment of society.
- Dissemination of technologies developed to farming community through various methods.
- Studies on prolonging post harvest storage, methods for new and better quality products, marketing and economics.
- To act as a repository of scientific information relevant to horticulture.
- To collaborate with relevant national and international agencies
- Landscaping programme (through bio-aesthetic planning) of the university campus and development of green belt.

Our Vision

- To develop the department as Centre of Excellence by adopting Hi-tech Horticulture viz., Drip- Irrigation & Fertigation, Tissue Culture (Micro-propagation), Sustainable Agriculture/Organic Farming, Bio-fertilizer etc.
- To explore the possibility of MOU's with various reputed institutes.
- To exploit the underutilized Horticultural crops for nutritional security and poverty alleviation.

A. Placement History (during 2009-2010 to 2013-2014)

Session	No. of Students placed in Private Sector	No. of Students placed in Private Sector	No. of Students placed in Govt. Sector	Total	No. of PG students qualified		
					JRF	NET	Ph.D.
2009-10	04	05	N/A	09	04	13	04
2010-11	01	02	04	07	04	03	04
2011-12	02	03	03	08	05	02	05
2012-13	03	02	03	08	05	01	05

B. List the organization where the majority of students have been recruited

(a)	PRIVATE SECTOR	:	**Seed Companies, Agri Chemicals Corporation eg. Dhanuka etc.**
(b)	PUBLIC SECTOR	:	**Various Bank i.e. CANARA Bank, Bank of India & SBI etc.**
(c)	GOVERNMENT SECTOR	:	**SSC, ICAR, Agriculture Extension Officer, Bihar, Rural Horti. Ext. Officer, MP, Research Associate in Various Institute eg. CIMAP, IISR, CISSR, SMS in KVKs in Agriculture Universities, Higher Education & Remote Sensing etc.**

C. Events Organised by the Department

(a) National Conference

Year	National
2008-09	01 (Sustainable Horticultural Research in India: Perspective, Priorities and Preparedness was organized on April 14-15, 2008

(b) Special Lecture Series

Year	Special Lecture
2009-10	**Special Lecture: 03** 1. Special Lecture serious on Recent Advances in Horticulture, Lecture Present by Prof. Shiv Raj Singh, Director, Institute of Agriculture Research Institute, BHU, Varanasi and Dr. Rajbir Singh Rathore, Deputy Director General (Horticulture), U.P. Council of Agricultural Research, Lucknow 2. Special Lecture Series was organized by the department on November 30, 2009 and lecture was delivered by Dr. S. K. Singh, (Senior Scientist, I.A.R.I., Pusa, New Delhi) on the topic "Diversification of Horticulture through Fruit Production". 3. Krishak Gosthi on "Audhyanik Phaslon Ke Sasya Takniken" was organized on 11th November 2009 and the departmental faculty and experts from premier institutes addressed the problems of the farmers in the Gosthi.

Year	Special Lecture
2012-13	**Special Lecture: 05** 1. Lecture on "Technological interventions for enhancing temperature fruit productivity" by Dr. M. K. Verma, Senior Scientist, IARI, Pusa New Delhi on 16/05/2013. 2. Lecutre on " Fruit based diversified cropping system for arid regions" by Dr. O. P. Awasthi, Principal Scientist, IARI, Pusa New Delhi on 16/05/2013. 3. Special Lecture on "An overview of Horticulture Crops" by Dr. A. K. Singh, Head, Division of Fruit Science. IARI, Pusa New Delhi on 30/05/2013 4. Special Lecture on "Cabbage: An overview of seed production in cole crops in India" by Dr. S. R. Sharma, Ex-Director, IARI, Katrain, Kullu Valley, Himanchal Pradesh on 31/05/2013. 5. Special Lecture on "An overview of vegetable crop production" by Dr. Preetam Kalia, Head, Division of Vegetable Science, IARI, Pusa New Delhi on 31/05/2013
2014	**Workshop :** 1. A Two Day Workshop on women on "Use of post harvest management techniques in horticultural crops on 31st March - 1st April 2014.
2014	**Special lecture Series :** Two special lecture by Prof. A.N. Mukhopadhyaya and Dr. H. Ravisankar
2014	**1st Alumini Meet of DAPS**
2014	**1st Hort Quiz**

About Indian Society of Horticultural Research & Development (ISHRD), Chaubattia (Uttarakhand)

Indian Society of Horticultural Research and Development (ISHRD), formerly known as Hill Horticulture Development Board (HHDB), is registered under the Societies Registration Act XXI, 1860, was established in March 1969 with a view to promote inter-disciplinary research in the field of horticulture and provide a forum for expressing views on policies and programmes relating to horticultural research and development. ***Progressive Horticulture, an official scientific publication of ISHRD, is a peer reviewed journal published since the year 1969. Presently the journal is published twice every year (in the month of March & September). Original contributions, covering fundamental and applied research, relating to various disciplines of horticultural crops, post harvest management, biotechnology, diversification, policy issues, trade, market, case studies related to horticultural issues are considered for publication. Review articles, summarizing the existing state of knowledge in horticultural research, are published by invitation only.*** Thesis research, book reviews, notifications, events, etc. can also be submitted for publication. The manuscript of reviews, research articles and short communications should not exceed 15, 8 and 4 typed pages respectively, inclusive of tables and illustrations. Preference is given to the publication of thesis research in each issue. The manuscript should preferably pertain to the research work carried out during the last five years. Scientific norms and ethics should be followed while preparing the manuscripts. Once the manuscript is submitted for publication in Progressive Horticulture, it will assumed that manuscript has **not** been submitted, accepted, is under consideration for publication or has been published elsewhere, or has been otherwise rejected and necessary permission has been obtained from the competent authority for publication giving due credit to all concerned. As per policy of the journal, authors should be members of the society. No printed reprints will be supplied to the authors. Acceptance/ publication of article in Progressive Horticulture shall transfer the copy right to the ISHRD. The editorial board takes no responsibility for the facts or views/opinion expressed in the journal, which rests entirely with author(s) thereof.

PREPARATION OF MANUSCRIPT: The text should be typed in double space on A4 size format (21 x 29 cm) with 3 cm margin on all sides and in clear and concise English. The format for original research articles and short communications will be the same except that the latter require no headed sections. **TITLE:** The title of the article and authors name should be bold and in Sentence case, with full address of each author in running and email address of corresponding author. Any change of address should be given as a foot note. **ABSTRACT:** The abstract should not exceed 200 words in full paper and 50 words in short communication. It should be an informative digest of significant contents and conclusions. It should be suitable for indexing and abstracting. **KEY WORDS:** Immediately after the abstract, provide a maximum of 5 keywords in alphabetic order. Repetition of words used in the title should be avoided. **INTRODUCTION:** The introductory part should be (without heading) brief and to the point. It contain aim & importance of research work and pertinent updated review of literature. **MATERIALS AND METHODS:** The materials and methods should include important materials used, place and period of work and details of experimental techniques employed including statistical techniques. When the methods are well known, citation of standard work is sufficient. **RESULTS AND DISCUSSION:** The results and discussion should be combined to avoid repetition. It must include latest/ updated information/ references on the subject and proper discussion of the finding is essentially required. **Tables:** Each table should be on a separate sheet at the end of the paper, numbered in the order in which it appears in the text. Table should carry a short title and be numbered in Arabic numerals. All data reported must be subjected to appropriate statistical analysis. **ILLUSTRATIONS/ GRAPHS/ PHOROGRAPHS:** Illustrations should be relevant to the article and referred to in the text. Line drawings should be in Indian ink or laser print, of 10x15 cm dimension including legends and captions. Metric units of weights and measures should be used.

ACKNOWLEDGEMENTS: If required, the acknowledgements should come after Results and Discussion. The authors need not acknowledge authorities for providing facilities for research work. **REFERENCES:** References should be cited in the text in the form: (Saroj and Awasthi, 2006). The term etalico, should be used when there are more than two authors. The letters a, b, c, should be used following the year, to distinguish between two or more papers by the same author in one year. References at the end of the text should be arranged alphabetically and presented strictly as per the format of the journal. Submission of manuscripts, etc. revised and processing etc. for progress Horticulture, is Online and paperless.

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Programme

International Symposium on Innovations in Horticulture for Nutritional Security, Conserving Biodiversity and Poverty Alleviation: 1st SYMPHORT-2014

Date: 16th – 18th October, 2014

Venue: University Auditorium, BBA University, Lucknow

Day 1, 16th October, 2014

Timings	Event	
09.00-10.30 am	Registration	
10.30-12.30 pm	Inauguration	
12.30-1.00 pm	High Tea	
01.00-2.30 pm	Technical Session 1: Conventional & Non-conventional Approach for Crop Improvement and Biodiversity Conservation	
	Speakers	Topic
	Lead Lecture	
	Dr. B. Singh, IIVR, Varanasi	Vegetable diversity *vis*- a -*vis* nutritional security
	Dr. Shailendra Rajan, CISH, Lko.	On-farm conservation of tropical fruit tree genetic resources in India
	Oral	
	Dr. Maneesh Mishra, CISH, Lko.	Tailoring Fruit Crops through Recombinant DNA Technology
	Dr. M.K. Verma, IARI, New Delhi	Recent advances in temperate fruit crop improvement
	Dr. B. L. Attri, CITH, Srinagar	Evaluation of Garlic germplasm in Kumaun region of Uttarakhand
	Dr. Thimmappaiah	Assessment of Genetic Diversity in Cashew Varieties
	Prof. M. Y. Khan, BBAU, Lko.	Application of Biotechnological Tools for Enhancement for Crop Improvement
	Prof. R. B. Ram, BBAU, Lko.	Improvement of Mango Through Clonal Selection, Application, Mutation and Hybridization
	Dr. M.L. Meena, BBAU, Lko.	Recent Advances in Cole Crops
02.30–03.00 pm	Lunch Break	
03.15-05.45 pm	Technical Session 2: Plant Protection and Biotic and Abiotic Stress Management of Horticultural Crops	
	Lead lectures	
	Dr. Arun K Sharma NBAIM, Mau	Organic farming and Biofertilizers: the natural way to maintain soil health for sustainable agriculture
	Oral	
	Dr. Indu S. Sawant, NRC Grape, Pune	Use of micro-organisms to minimize fungicide use in grapes

	Dr. N. Rai, IIVR, Varanasi	Role of genetic resources for protection of biotic and abiotic stresses in tomato
	Dr. S.S. Singh, GBPUAT, Pant nagar	Holistic management of biotic stresses for commercial vegetable production
	Dr. A. K. Misra, CISH, Lko.	Guava wilt – a national problem and its management.
	Dr. Sangeeta Saxena, BBAU, Lko.	Silencing the Stress with Molecular Silencers
	Dr. C.P. N. Gautam, KVK, Kanpur	Effect of safer insecticides and botanicals against okra, leaf hopper, (amrasca biguttula biguttula ishida).
05.45-07.00 pm	**Poster Evaluation**	
07.15-08.15 pm	**Cultural Programme**	
08.15 pm	**Dinner**	

Day 2, 17th October, 2014

Timings	**Event**	
09.30-11.30 am	**Technical Session 3: Precision farming: Protected cultivation and Organic Horticulture**	
	Lead lectures	
	Dr. Balraj Singh, NRC on Seed Spices, Ajmer	Protected cultivation of horticultural crops in India: Potential, Challenges and Future Strategies
	Dr. Brahma Singh, Former Director DRDO, New Delhi	Protected Horticulture- an Indian Scenario
	Oral	
	Dr. R.A Ram, CITH, Srinagar	Approaches for on farm input and organic production of horticultural crops in India
	Dr. Jitendra Singh, MPUAT, Jhalawar	Organic Horticulture: Facets and Dimensions
	Dr. V.K. Tripathi, CSAUAT, Kanpur	High Density Planting: An approach for enhancing the fruit productivity
	Dr. Rajendra Singh, WTC, IARI, New Delhi	Sensors, liquid nutrition and precision farming for higher horticultural production
	Dr. S. D. Ramteke, NRC, Grape, Pune	Bio-efficacy studies of Chloremequat chloride (Lihocin 50% SL) in grapes.

09.30-11.30 am Parallel Session	**Technical Session 4: Post-Harvest Handling, Food Technology and Value Addition in Horticultural Crops**	
	Lead lectures	
	Dr. Lallan Ram, CIH, Nagaland	Post harvest handling, food technology and value addition in horticultural crops with special reference to NEH region

	Dr. J.S. Bal, PAU, Ludhiana	Recent Advances in Post-harvest Management of Fruits
	Dr. Bhagyalakshmi Neelwarne, CSIR-CFTRI, Mysore	Integration of Bio/Technologies for Sustainable Future
	Oral	
	Dr. Neelima Garg, CISH, Lko.	Value Addition of Mango Solid Wastes
	Dr. Ajay Kumar Sharma, NRC Grape, Pune	Value addition in grapes: Indian scenario
	Dr. Sanjeev Sharma, UPCAR, Lko.	Post harvest management and value addition in fruits and vegetables
	Dr.A.K. Pandey, CSJMU, Kanpur	Evaluation of Bael (*Aegle marmelos* Correa) Germplasm of Central Uttar Pradesh for Processing Industries
	Dr. Ramesh Kumar, CIPHET, Punjab	Effect of antibrowning and firming agents on quality of minimally processed pear
	Dr. A.K. Tiwary, BAU, Ranchi	Effect of packaging containers and wrappers on shelf life and ripening of mango fruits cv. Dashehari during storage period
	Dr. Ranjan Srivastava, GBPUAT, Pantnagar	Concrete and Absolute: Value Added Products from Tuberose flowers- A study of varietal response

11.30-12.00 noon **Tea Break**

12.00-02.00 pm	**Technical Session 5: Underexploited and exotic horticultural crops**	
	Lead lectures	
	Prof. Vishal Nath, NRC Litchi, Mujjafarpur	Under-Exploited Exotic Fruit Crops of India
	Dr. Sanjay Singh, CHES, Godhara, Gujrat	Genetic improvement of underutilized fruits and their conservation in semi arid ecosystem of Western India
	Oral	
	Dr. Shushil K. Shukla, CISH, Lko.	Underexploited and Exotic Horticultural Crops
	Dr. Ankur Agarwal, DIBER, DRDO, Haldwani	*Camelina sativa*: an underutilized and unexploited brassica for renewable biofuels
	Dr. Narendra Singh, DIHAR, DRDO, Leh	Study of indigenous leafy vegetables of cold desert- Ladakh (Jammu & Kashmir), India
	Dr. Deepa H. Dwivedi, BBAU, Lko.	Are we paying enough attention to our indigenous crops?

12.00-02.00 pm Parallel Session	Technical Session 6: Horticulture for Environment and Society	
	Lead lectures	
	Prof. D. Buddhi, SIET, Dehradun	Green Cold Chain Solution
	Prof. Hari Prakash, QCI, New Delhi	Role of good practices in Horticulture for the benefit of Environment and society
	Oral	
	Dr. Anil Kumar Singh, BHU, Varanasi	Floriculture in Peri-Urban Areas of India
	Dr. Prabhat K. Shukla, IARI, New Delhi	Evaluation of Newer Fungicides and Bio-Agents for Management of Mango Graft Rot
	Dr. M.C. Jain, CHF (MPUAT), Jhalawar	Effect and economic feasibility of plant growth regulators on yield of 'nagpur mandarin' (citrus reticulate blanco.)
	Dr. Ashutosh Mishra, CHF(MPUAT),Jhalawar	Evaluation of Chrysanthemum (Dendranthema grandiflora Tzevlev.) Varieties Under Sub-humid Condition of Jhalawar, Rajasthan
	Prof. Paras Nath, Fiji National University, Fiji	Horticulture Potential in Fiji Island

02.00-03.00 pm **Lunch Break**

03.00-5.00 pm	Technical Session 7: Horticultural Crops as Nutraceuticals and Pharmaceuticals	
	Lead Lectures	
	Dr. G. Lal, NRC, Seed Spices, Ajmer	Seed spices as rich nutraceutical crops
	Oral	
	Dr. Anup Raj, SKUAT, Kargil	Fruits of Russian olive (Elaeagnusangustifolia), an underexploited multipurpose tree from Kargil: a pack house of phytochemicals
	Dr. Shrawan Singh, ICAR, Port Blair	Genetic improvement and agro-techniques for nutritionally rich underutilized vegetables of Andaman and Nicobar Islands
	Dr. Amit Verma, Freii Univ. Germany	Phytates: Chemistry, Advantages and Disadvantages for Human Health and Nutrition
	Dr. Sapna Panwar, IARI, New Delhi	Marigold: A potential flower crop for nutraceutical and pharmaceutical industry
	Prof. Shubhini A. Saraf, BBAU, Lko.	Nutraceuticals: Pharmacokinetics and pharmacodyanamics

03.00-05.00 pm Parallel Session	**Technical Session 8: Entrepreneurship for Farmers, Self Employment and IPR**	
	Lead Lectures	
	Dr. S.K. Malhotra, Hort. Commissioner, New Delhi	Horticulture Technologies for Commercialization and Entrepreneurship
	Dr. Avinash Kumar, DRDO, New Delhi	IPR in R & D Management
	Dr. M.K. Awasthi, IIM, Lko.	Entrepreneurship for Farmers, Self Employed and IPR
	Oral	
	Dr. Naresh Babu, Directorate, RWA, Bhbaneshwar	Integrated nutrient management for enhancing yield and quality of fruits in banana cultivar G-9
	Dr. Sudhakar Pandey, IIVR, Varanasi	Intellectual Property Right and Trade Related Issues in Vegetable: An Overview
	Dr. T. Chaubey, IIVR, Varanasi	Morphological characterization of Tomato (*Solanum lycopersicum)* based on DUS descriptors
	Dr. Rajesh Kumar Singh, IISR, Lko.	Effect Of Irrigation Schedules And Nitrogen Levels On Potato Tuber Yield And Growth Cracks
	Dr. Gurupdesh Kaur, KVK, Amritsar	Income, Employment & Export Pattern of Traditional Phulkari Embriodery In Rural Punjab
	Dr. Sutanu Majhi, BBAU, Lko	Self-employment through drying and dehydration of flowers and foliages
05.45-7.00 pm	**Poster Evaluation**	
	GBM- ISHRD	
08.15 pm	**Dinner**	

Day 3, 18th October, 2014

Timings	**Event**	
09.30-11.00 am	**Technical Session 9: Innovative Technologies in Horticulture** **Farmers Interaction Session in Collaboration with KVK, IISR**	
	Lead Lectures	
	Dr. R.K. Pathak, ISHRD & Organic Hort., Mumbai	Indigenous Technologies: ARay of Hope For Sustainable Horticulture
	Dr. Ulrick Berk, German Asso. of Homa Therapy, Mühlingen Germany	Impact of Homa Organic Farming in mitigating soil, water and environmental crises

	Dr. S.K. Tiwari, CSIR-NBRI, Lucknow	Innovative Production System for Betelvine (*Piper betle* L.)
	Oral	
	Dr. S.N.S. Chaurasia, IIVR, Lko.	Recent Innovations in Nursery raising for vegetable crops
	Dr. O.P. Awasthi, IARI, New Delhi	Fruit based diversified cropping system for nutritional security in the arid regions
	Dr. Anant Bahadur, IIVR, Varanasi	Physiological and yield response of tomato plant grafted onto eggplant rootstock under water-logging condition
11.00-12.30 pm	**Poster Evaluation**	
12.30-02.30 pm	**Valedictory Function**	
02.30-03.30 pm	**Lunch Break**	
03.00 pm	**City Tour**	

Important Contact Numbers

Committee	Name	Contact No.	Student Volunteer	Contact No.
Reception	Prof. R.B. Ram	9415790511	Dr. Namrata Singh	945501171
Accommodation	Dr. M.L. Meena	9415061614	Mr. Shreesh Kumar Gautam	9125615587
Food/Transport	Dr. M.L. Meena	9415061614	Mr. Shreesh Kumar Gautam	9125615587
Registration	Dr. Sutanu Majhi	9450386042	Mr. Pawan Kumar	8858139879
Technical	Dr. Deepa H. Dwivedi	9452290810	Ms. Navaldey Bharti Mr. Abhishek Singh	8960218993 9935071595
City Tour	Dr. Sutanu Majhi	9450386042	Mr. Pranav Mishra	9760818194
Local Laision Officer	Dr. Sanjay Kumar			
Office Staff	Sri Vinay Kumar			9807715022

Contents

Lead Lectures

Technical Session 1 : Conventional and Non-conventional Approach for Crop Improvement and Biodiversity Conservation

L-1.1

Vegetable diversity *vis*-a-*vis* nutritional security

B. Singh, T. Chaubey and S. Pandey

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Vegetable production have made spectacular progress in recent years and touched a new height. In spite of the stride progress, per capita consumption of vegetable in India is only about 235 g/day/person, which is far below the minimum dietary requirement of 300g/day/person. Forty per cent of the world's malnourished children are in India and 60 per cent of Indian women are anemic. Vegetables possess tremendous medicinal and nutritive values; there exists an enormous potentiality in vegetable technologies in India to address the micronutrient malnutrition, often called "hidden hunger". The use of vegetable diversity existing in nature is a very powerful tool to overcome the problem of hidden hunger. More than 100 crops of vegetables are being grown in the country. The Indian gene center has rich diversity in genetic resources of vegetable crops, which is one of the 12 mega centers of diversity, is rich in plant wealth which includes 356 domesticated species of economic importance and 326 species of wild form/relatives. The major diversity are found in crops native to India *i.e.* brinjal (*Solanum melongena*), pointed gourd (*Trichosanthes dioica*), ridge gourd (*Luffa acutanguala*), sponge gourd (*L. cylindrica*), lablab bean (*Dolichus lablab*), ivy gourd (*Coccinia grandis*), snake gourd (*Trichosanthes cucumerina*), ash gourd *(Benincasa hispida),* cucumber (*Cucumis sativus*), bitter gourd (*Momordica charantia*) and many others. India is also considered as the secondary center of diversity for several other vegetable crops such as okra (*Abelmoschus esculentus*), chilli (*Capsicum annuum*), longmelon (*Cucumis melo* var. flexuosus) and snapmelon (*Cucumis melo* var. momordica). Equally rich diversity occurs in introduced crops like tomato (*Solanum esculentum*), Frenchbean (*Phaseolus vulgaris*), cowpea (*Vigna unguiculata*), brassicas, amaranthus (*Amaranthus hypochondricus*), bottle gourd (*Lagneria siceraria*), C*ucurbita* sp., onion (*Allium cepa*), garlic (*A. sativum*). Further, there are many crops which are grown in the country, but no systematic research has been executed on such crops. These crops are faba bean, lima bean, winged bean, clove bean, jack bean, sword bean, velvet bean, tree bean, chive bean, leek, welsh onion, broccoli, brussels sprout, chinese cabbage, celery, lettuce, globe artichoke, sweet corn, baby corn, asparagus, Indian spinach, *Chenopodium,* water leaf, drumstick, curry leaf, *Momordica cochinchinensis* and *Melorthia hetrophylla.* During last four decades, a total of 25,911 and 24888 accessions of various vegetables germplasm have been collected from different parts of the country by AICRP (VC) and NBPGR, New Delhi, respectively. Breeding for nutritional quality to develop new variety is impossible without diversity. Thus, it is obvious that plant genetic resources have played a vital role in the development of 734 superior varieties and hybrids of 41vegetable crops. In the present circumstances human civilization is facing a major threat of nutritional insecurity. The vegetables germplasm have significance in agriculture and food as well as nutritional security of the country. Majority of the population is suffering from various lifestyle diseases linked with deficiency of specific nutritional compounds. Thus the major challenge to the scientists is to provide nutritional security to the growing population. During last few decades hectic search is going to find out natural source of bioactive nutritional compounds. Some of the natural sources for bioactive compounds are fruits, vegetables, pulse, cereals, fish etc. Among them, vegetables are unique source of various bioactive compounds like vitamins, trace elements, antioxidants, dietary fibers, Poly-Unsaturated Fatty Acid (PUFA), which not only improve the state of health and well being, they also reduce the risk of various degenerative diseases such as cancer, cardiovascular disease, macular degeneration and ageing. Recently phytochemical in vegetables have attracted a great deal of attention mainly due to diseases caused as a result of oxidative stress and now it is used as protective foods.

L-1.2

On-farm conservation of tropical fruit tree genetic resources in India: A case study on mango

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India is one of the richest centers of diversity for tropical fruits and specially cultivated mango (*Mangifera indica*). Amount of genetic diversity conserved in orchards and home gardens significantly contribute to the country tropical fruit genepool. Compared to other ecosystems, home gardens and fruit orchards are diversity rich and they are well suited for *in situ* conservation of tropical fruits particularly in India. *Ex situ* conservation of tropical fruits like mango is difficult because of the recalcitrant nature of seed and can not be stored in conventional genebanks. Therefore, conservation needs to focus on the establishment of field genebanks which has both advantages and disadvantages can complement with *in situ* conservation method, effectively. Field genebanks may require high maintenance costs, large land area and limited amount of genetic variation can be stored with a vulnerability of natural and human disasters. Sustainable on-farm conservation is successful with collective efforts of farmers, communities, and national institutions for perceived benefits in terms of social, economic, and environmental services. Once it is understood that farmer management of local fruit diversity supports primary livelihood option, the cost of on-farm conservation becomes much cheaper than *ex situ* conservation. In the process, farmers not only gain social, economic and environmental benefits from local genetic resources but also enhance the evolutionary potential of such genetic resources. However, it is important to note that on-farm conservation can not be recommended as a universal practice nor is a feasible method in all circumstances; it has a place and time, as on-farm conservation can be transient and subject to change over the time and that provides the major link with *ex-situ* conservation. Since, on-farm diversity is the outcome of farmers' choices to select, modify and maintain it. Commercial varieties also influence diversity by influencing farmers' choices by the availability of new cultivars to farmers. On farm conservation is important for saving heirloom varieties of tropical fruits as these are heritage varieties that were passed down from one generation to another generation of gardeners/farmers, multiplied by asexual means. This includes old commercial varieties, antique, presently not grown on commercial scale, historically important commercial varieties that do not limit or restrict to a particular family or community. These are not open pollinated varieties in context of mango and many fruit crops. Trees of these varieties may not be in large numbers in orchards and being grown by few farmers thus requires strategy for conservation. There is a need for development goals, incentives and equity implications of the findings for designing a least-cost sustainable on-farm conservation strategy for important fruit crops. The paper deals with different aspects involved in on farm conservation including role of community based organizations in conserving mango varieties of Malihabad.

Technical Session 2 : Plant Protection and Biotic and Abiotic Stress Management of Horticultural Crops

L-2.1

Organic farming and biofertilizers: the natural way to maintain soil health for sustainable agriculture

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Sustainable agriculture involves the successful management of agricultural resources to satisfy changing human needs while maintaining or enhancing the environmental quality and conserving natural resources. The continuous decline in soil organic matter levels due to continuous cropping without recycling enough crop or animal residues, and insufficient application of nutrients has led to serious nutrient imbalances, impaired soil health and declining factor productivity. The role of microorganisms in sustainable agriculture is enormous. Microorganisms are among the most important organisms in the world, not only because of their influence on human and human-related activities but also, due to their vital roles in ecosystem functions. Worldwide microorganisms are potentially exploited to enhance the food grain production. Considerable progress has been made in the microbial exploration and utilization in India and it has been clearly demonstrated that these technologies are powerful tools for enhancing the application of microorganisms in improvement of crop health and production. Unawareness among farmers is one of the important limitations in spreading of these low cost technologies.

There is currently a gap of nearly 10 million tones of nutrients between what is taken out by crops and what is added through fertilizers and manures. In India about 355.67 – 507.836 m ton of crop residues are generated every year. Three fourth of the total residues are produced by three crops viz. rice, wheat and oilseeds. Apart from crop residues, process based residues contribute 146.932 m ton, forestry based residue (22 m ton) and agro based wood residues, 0.017 m ton. All these crop residues are the potential source of organic manure for use in agriculture. On an average, these crop residues contain 0.5% N, 0.2% P_2O_5 and 1.5% K_2O. Assuming that 50% of crop residues are utilized as cattle feed and fuel, the nutrient potential of the remaining residues will be 3.541 million tons of NPK per annum, which accounts for 25% of total NPK consumption in India. Thus there is an urgent need to recycle all available organics in a more efficient way and improve and expand biofertilizer usage. These are the only feasible and low cost and eco-friendly ways of improving nutrient supply and improving soil health on short and medium term basis. Also it has to be anticipated that the subsidies on fertilizers would be slowly but surely phased out. Since, fertilizer nutrient use efficiencies continue to be poor, therefore, continuous addition of nutrients under such poor efficiency scenarios is a waste of money and foreign exchange involved in importing some fertilizers. In many cases such nutrients are locked in unavailable forms in soils. Mobilizing such reserves through microbes is an urgent imperative. Hence it is now strongly realized that integrated plant nutrient supply systems involving a combination of biofertilizers is the only alternative to improve nutrient use efficiency, sustain crop production and improve soil health. Most of the work done in this area has focused on the use of individual beneficial soil microorganisms in crop production as microbial inoculants in the past. But now combined inoculations of mixed cultures of beneficial organisms is the rule rather than the exception. In mixed cultures, there is better interaction of the introduced compatible organisms based on the principle that greater the diversity and number of inhabitants, the higher the order of interaction and more stable the ecosystem. Based on these principles, attempts are being made to develop consortia of predominant compatible organisms isolated from the rhizosphere/ endorhizosphere and diverse ecological niche. There is need to develop and popularize the technology to utilize the consortia in combination with organic manures, crop residues and small doses of chemical fertilizers to sustain production of crops.

Technical Session 3 : Precision farming : Protected cultivation and Organic Horticulture

L-3.1

Protected cultivation of horticultural crops in India: Potential, challenges and future strategies

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With time it has been proved that protected cultivation is a better technology to enhance land productivity and quality of the produce by providing a logical and technical solution to manage the major biotic and abiotic stresses encountered under open field cultivation of horticultural crops specified to vegetables. The effectiveness of the technology has been observed world over. In the last decade, the area under protected cultivation in various parts of the world has increased exponentially in countries like China for adoption of various protected cultivation technology in different forms like mulching, use of temporary plastic walls in open fields, low tunnels, walk-in-tunnels, insect proof net houses, shade net houses and greenhouses etc. Presently, China is the world leader in cultivating horticultural crops under different protected conditions and the estimated area under protected cultivation has reached around 3.5 million ha and out of this area nearly 96 percent is only being used for cultivation of vegetables and for their hybrid seed production.

Although, a simultaneous growth to China has also been observed in the developing countries of Indian and African sub-continent for adoption of protected cultivation technology, but the success rate varied significantly because of poor correlation between the designs of various protected structures and prevailing agro-climatic conditions of the regions. The experience of greenhouse production or protected cultivation which emerged in Northern Europe, stimulated its development in other areas including the Mediterranean region, North America, Oceania, Asia and Africa, with various rates and degrees of success. It has been clearly established and proven that mere transportation or adoption of technology as such from Northern Europe to other parts of the World, irrespective of prevailing agro-climatic conditions was not a valid process. Each region and area actually requires further research, development, extension, training and new norms, procedures and methods of application to meet the region specific requirements for protected cultivation.

India being a country with diverse climatic regions have shown an overall growth of around 50,000 ha area under protected cultivation in the last two decades. The success rate of these technologies varied significantly depending upon the climatic conditions. In Northern India, these technologies faced high challenges for making them successful against the harsh climatic conditions. Whereas, in the mild climatic areas like that of Bangalore and Pune the success rate has been high. Basically the growth of this technology in the country happened mainly due to government policies providing handsome subsidies under the schemes launched under NHM, NHB, RKVY etc., but merely by the technical beauty of the technology. The technical knowhow for adoption of protected cultivation technology under Indian conditions was not to the level at the time of inception, with time research and development work carried out by various public sector institutions in collaboration with developed countries gradually reflected that for various Indian climatic conditions the technical designs of different protected structures needs modification suitable to the region specific needs.

But it sure that promotion of protected cultivation will not only going to help for creation of huge self-employments for unemployed educated youths but it will also increase the national economy by sale of high quality produce in domestic and international markets. Under the new era of FDI (Foreign Direct Investment) in retail, these kinds of models posses' high potential for enhancing the income of farmers opting for quality and offseason vegetable and cut flower cultivation through protected cultivation. Production of vegetable and cut flower crops under protected conditions provides high water and nutrient use efficiency under varied agro climatic conditions of the country. This

technology has very good potential especially in peri-urban areas adjoining to the major cities which is a fast growing market of the country, since it can be profitably used for growing high value vegetable crops like, tomato, cherry tomato, colored peppers, parthenocarpic cucumber, cut flowers like roses, gerbera, carnation, chrysanthemum etc. and virus free seedlings in agri- entrepreneurial models. But protected cultivation technology requires careful planning, attention and details about timing of production and moreover, harvest time to coincide with high market prices, choice of varieties adopted to the off season environments, and able to produce economical yields of high quality produce etc. Even though the application of chemicals for controlling biotic stresses is also low under protected structures which gives a high quality safe vegetables for human consumption. By using protected structures, it is also possible to raise offseason and long duration vegetables crop of high quality. Vegetable and cut flower farming in agri-entrepreneurial models targeting various niche markets of the big cities is inviting regular attention of the vegetable and flower growers for diversification from traditional ways of crop cultivation to the modern methods like protected cultivation.

The basis behind the successful implementation of protected cultivation lies on selection of suitable structures with suitable designs, cultivation models, crops and cultivars selection for protected cultivation are the fundamental variables that may significantly affect the success and economic return of the entire production system. The success of protected cultivation technology entirely depends upon four basic concepts *viz.,* what to produce, when to produce, how to produce and where to sell the high quality produce. The protected growers must know the two other basic options i.e., choice of crop or variety for its high economic potential/return and to develop the most suitable production system. Crop should be selected based on the existing structures, wide consumption, good adoption to unsteady climatic conditions and suitable long cultivation cycles. And while adopting the protected cultivation technology the following most important points viz., market requirement of the produce, distance from the market for the fresh produce, climatic conditions of the area, soil characteristics and quality of water, economic convenience, crop requirement, labour and skilled manpower requirement should be considered.

Major Challenges for Protected cultivation in India

- Lack of trained professionals and skilled manpower for designing, fabrication of protected structures thereafter, maintenance of the structures and for protected cultivation of various high value crops.
- Non-availability of region specific designs of protected structures for varied agro-climatic conditions.
- Lack of practical training institutions and advisory services in the area of protected cultivation.
- Fabrication of protected structure has come up as a big business, taking an opportunity small industries are sacrificing with the quality of material to be used to gain more profit and also lack of understanding of the quality of basic steel and cladding material used for fabrication of structures.
- Lack of availability of crop varieties and planting material specific to protected cultivation specifically with public sector institutions, its management practices etc. as the available planting material/seeds with private sector companies are too costly.
- Lack of demand driven cultivation without proper marketing strategy creates problem for proper disposal of the quality produce and farmers can't get low premium price, therefore cluster approach for taking up protected cultivation as a whole is required.
- Increasing threat of soil born fungus like Fusarium and root node nematodes for protected cultivation of vegetables.

Potential and Major strategies for adoption of protected cultivation technologies under varied agro-climatic conditions in India:

Protected cultivation technology has tremendous potential over and across the country under varied agro-climatic conditions. The most potential areas where high scale interventions are required to be promoted are as under:

1) Use of plug tray nursery technology on commercial scale for raising horticulture crops can come up as a big business
2) Large scale use of insect poof net houses for vegetable production and also for hybrid seed production of vegetables.
3) Large scale use of naturally ventilated greenhouses for crop cultivation under harsh conditions of arid and semi-arid region.

4) Large scale use of insect proof net houses and naturally ventilated green house for hybrid seed production in vegetables for increasing the overall profitability of the farmers.
5) Large scale use of plastic mulches for commercial vegetable cultivation under open fields and also under green houses and even under net houses.
6) Large scale use of micro-grafted technology for developing resistant plant material against soil borne problems.
7) Large scale cultivation of fruit crops like papaya, pomegranate under insect proof net houses.
8) Large scale application of low pressure drip irrigation system for managing an area of 1000-2000 sq. mts. area.
9) Open roof type high tunnels can be used commercially in northern parts of the country and even under temperate conditions it can be rewarding.
10) Large scale skill development of youth manpower in two ways following the Chinese model i.e., designing, fabrication and maintenance of protected structures and secondly the production management of crops under protected conditions
11) Large scale application of GAP procedure and standards for protected cultivation of crops like vegetables will help to catch international trade.
12) Government support must be extended for self-fabrication mode of temporary low cost structures like insect proof net houses, shade net houses, walk-in-tunnels and plastic low tunnels for the production of vegetables and flowers.
13) Large scale production and distribution of healthy vegetable and flower seedlings to the large section of growers on nominal price.
14) Government should support and promote protected cultivation in cluster approach especially in peri-urban areas of the country
15) Government should promote to develop input hubs for protected cultivation in multi-locations in PPP mode.
16) Protected cultivation has hitherto been promoted from the view point of more and more construction of greenhouses by providing subsidy however, there is need to link such subsidies with production system i.e. when the protected cultivation produce is sold/auctioned by the grower some of the subsidy may be realized to him at this level incentive as on.
17) All the protected cultivation clusters must be mandatorily clubbed with rain water harvesting infrastructure and facilities.
18) Suggest most suitable crop sequences for different protected structures and seasons based on research data.
19) Promotion of large scale mechanization in vegetable and flower cultivation by using raised bed makers, plastic laying machines, plastic low tunnel making machines, pipe bending machines for making walk-in-tunnels, drip lateral laying and binding machines
20) To establish convergence and synergy among various ongoing and planned government programmes in the field of protected cultivation development.
21) To ensure adequate, appropriate, time bound and concurrent attention to all links in production under protected conditions, post production on farm value addition, processing and consumption chain.
22) Use of solar energy for running drip system and up to some extent for running heating and cooling devices of the protected structures.

The future of protected cultivation in India is very vast but highly depending upon the technicality and recommendation of the technology implementation. It is believed that protected cultivation technology has to play a significant role under varied agro climatic conditions of the country as a means for sustainable crop intensification, vertical growth of the productivity leading to optimization of water and fertilizer use efficiency in an environment of water scarcity in addition to better control of product quality and safety, in line with the market demands, standards and regulations. In the near future, the first and most important requirement for the use of protected cultivation technology is for its large scale use for raising healthy planting material in all kinds of horticultural crops and secondly to use the technology for hybrid seed production of vegetables rather production of fresh food for better economic viability in the country and mostly in cluster approach. Further, for sustainability of the technology it is utmost important to develop a huge skilled manpower in form of youths in two sets, one set for designing, fabrication/ installation and maintenance of the protected structures and the other for crop production and management under protected conditions.

L-3.2

Protected horticulture- Indian scenario

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In India the horticulture sector presently contributes around 31% of the GDP and 38% of the total exports of agricultural commodities from about 14% of the area. The sector has vast potential to contribute to GDP and agriculture export by adopting protected cultivation in selected crops particularly the disease free nursery production using hi-tech greenhouses and off season production. The unimaginable contribution of plastics to protected horticulture coveringdifferent production structures, micro-irrigation, mulch, harvesting,packaging, transportation and storage is worth acknowledging besides being unfriendly to environment because of non-degradable nature.

Besides, sporadic efforts like Defence Research and Development Organization (DRDO) in Ladakh, protected cultivation technology in India for commercial production is hardly three decades old, whereas in developed countries, namely Japan, Holland, Russia, UK, China and others, it is about two century old.(Paroda, 2013). China is largest producer of vegetables where 80 % production of vegetables is from protected cultivation. India is second largest producer of vegetables but most of its vegetables are produced in open field where productivity is much less. Prevailing climate change leading to uncertain fluctuation in temperature, humidity, small farm holdings, rapid urbanization, reduced water availabilityand other production inputs necessitate adoption of protected horticulture in India on large scale for which National Horticulture Mission and other national and state horticulture development programs are making good and visible contribution.

Success stories on transforming cold desert of India into producer of large number of horticulture crops particularly vegetable crops with the help of protected cultivation technology harnessing solar and soil heat even during frozen atmosphere has been discussed. Use of innovative solar green houses such as underground poly trench, seed production of certain vegetables considered impossible has been explained in detail. Dissemination of this technology in Ladakh cold desert has been documented. Use of different low cost poyhouses/structures for large scale production of mainly vegetable crops for different climates has been covered with successful demonstration and production on farmer's field.

Problems faced under protected cultivation both biotic (nematodes,*Fusarium* wilt etc) and abiotic stress (low temperature, salinity, high temperature etc) have been covered and use of grafted seedlings having resistant rootstock has been suggested by citing their commercial use in India and abroad. Necessity of popularising this technology even for organic horticulture has been stressed upon.Importance of soilless disease free seedling productionin plug trays and cultivation of vegetable and flowers has been highlighted. Hydroponics, aeroponics, vertical cultivation, robotics, nanotechnology under protected conditions have been suggested as potential horticulture production technologies for India. In every stateof India establishment of school of protected cultivation for developing human resource, conduct research on the area and deal with every aspect related to protected horticulture has been suggested. Some novelties associated with protected horticulture such as biosphere, giving desired shape to produce while attached to plants etc have been mentioned. Adoption of plastic mulch coupled with drip irrigation preferably fertigation in horticulture crops production in India has been advocated to increase production, productivity, quality of produce with reduced input cost.

Technical Session 4 : Post-Harvest Handling, Food Technology and Value Addition in Horticultural Crops

L-4.1

Post harvest handling, food technology and value addition in horticultural crops with special reference to NEH region

Lallan Ram[1] and Md Manzar Hossain[2]

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North east region is blessed with diverse agro climatic conditions which are suitable for cultivation of various horticultural crops. The main horticultural crops grown in this region are aonla, banana, guava, jackfruit, khasi mandarin, mango, pineapple, peach, pear, plum, passion fruit, kiwi, beans, brinjal, cabbage, cauliflower, chow chow, cucumber, tomato, turmeric, ginger, king chilli, large cardamom and black pepper. The NEH region produces 11,637,980.00 MT horticultural crops excluding the floriculture. Due to difficult terrain, poor transportation facilities and unavailability of refrigerated vehicle leads to the severe post harvest loss of the horticultural crops. In spite of lack of various post harvest handling facilities fewer innovative techniques have been developed for extending the shelf life of fruits and commercialized such as waxing, packaging in perforated poly bags and corrugated fiber boxes, modified atmosphere storage and control atmosphere storage supplemented with cold temperature. Surprisingly the NEH region has 53 numbers of cold storage with value capacity of 130,376 MT.

Although it is the largest producer of pineapple, khasi mandarin, kiwi and passion fruit in the country, the fruit processing industry itself is extremely underdeveloped in this region. The food processing industries present in this region is underutilized due to non- availability of sufficient amount of raw material throughout the year resultantly few of them are only functional. According to latest estimation which was carried out by the ministry of food processing industries, the number of registered and unregistered under food processing industry in NEH region is 1,333 and 2,241,195 respectively.

Most of the processed product of fruits, vegetables and spices are viz., juice and pulp, jams and jellies, beverages, purees, ketchups, squashes, concentrates, dried product, pickle and powder are prepared in cottage or small scale sector depending upon the availability for wide variety of fruits, vegetables and spices as well as large scale domestic level processing done by women. The growth potential of this sector is enormous in this region and it is expected that the food production will be doubled in next decade. Though there are many promising dynamics which support the potential for growth of this industry, there are still some significant constraints which, if not addressed sooner, can impede the growth prospects of the Food Processing Industry in NEH region. To enhance the output of processing of different horticultural crops, the government agencies should address these issues such as survey of post harvest practices, refinement and adoption of post harvest technology, simple and efficient equipment for processing, development of novel value added product from different horticultural crops, waste utilization, introduction of food park, food quality testing facilities and market promotion. There is dare need to have a close attention to develop the infrastructure facilities with the financial support by the government of India and there is also need to generate the awareness among the farming communities in this region to promote this sector on national and global level.

L-4.2

Recent advances in post-harvest management of fruits

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India is bestowed with diverse agro-climatic conditions and occupies second position in fruit production after China. The fruit occupies an area of 6.98 million hectares with production of 81.3 millions mt. The fruits contributes approximately 12.6 per cent of global fruit production. Despite of being a second largest producer of fruits, India waste around 6-18 per cent of valuable produce during post-harvest practices and supply chain. The major causes of losses are lack of awareness about post-harvest handling, gaps in cold chain and poor marketing infrastructure. Fruits are highly perishable in nature and requires tender care after harvesting, because the biological activities are still going on even after harvesting of produce and during maturation, ripening and senescence. The good agricultural practices are pre-requisite for maintaining the quality and safety of produce.

In the recent past, tremendous advances in post-harvest management of fruits have taken place in India , which has made a positive impact in reducing the post-harvest losses of fruits and assure the availability of fruits to masses at affordable prices. Some of the advances such as use of harvesting devices like clippers or secateurs and use of plastic crates at farm level have proved beneficial in minimizing the losses. The use of pre-cooling especially forced air-cooling, hydro-cooling and vacuum-cooling are recent introduction in the post-harvest chain of fruits. The storage technology such as controlled atmospheric storage has revolutionized the horticultural industry. The use of different eco-friendly packaging materials i.e CFB cartons, polymeric films and heat shrinkable films have played a great role in improving the quality of fruits to a greater extent. Some technologies like vapour heat treatment, hot water treatment in mango, wax coating in citrus and apple are well known post-harvest treatments across the world. The introduction of automatic grading lines and colour sorting lines have made a great impact on systematic marketing of fruits. With the use of recent post-harvest machinery and technologies, India has made a stride in exporting its major fruits like mango, grapes, pomegranate, apple etc. to middle east and few European countries.

L-4.3

Integration of bio-technologies for sustainable future

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While the increase in urbanization is endowed with a package of many tantalizing living styles for humans, it is also inflicted with massive environmental degradation, where increasing demand for fertile land and fresh water for the cultivation of food / commercial crops and continuous addition of emission gases have together continuously lopsided the environmental balance. This has made scientists to come up with an alternative solution of integrating many new technologies, the urban farming, which not only addresses the above issues, but also create several new avenues for job opportunities and energy conservation. Integration of many new Biotechnologies and other innovative energy/resource management technologies have culminated in the emergence of advanced farming where many issues such as method for safe (pest/pesticide-free) and designer food production, efficient by-product recycling, water and energy conservation, fish/prawn farming, algal cultivation and advanced food processing occur simultaneously under a fully-controlled environment located within urban limits. The advancement made in this direction, the different models available, their merits and associated problems would be discussed.

Technical Session 5 : Underexploited and exotic horticultural crops

L-5.1

Underexploited exotic fruit crops of India

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Introduction

Underexploited and neglected fruits fall within the broad basket of 'minor fruits'. But what does 'minor' mean? Does it mean minor in terms of production? Does it mean minor in terms of the area of cultivation? The use of the two terms, neglected and underexploited, has the advantage of pinpointing two crucial aspects of these species. They highlight the degree of attention paid by users and the level of research and conservation efforts spent on them. Neglected crops are those grown primarily in their centres of origin/diversity by traditional farmers and are still important for the subsistence of local communities. Words such as underexploited, underutilized, neglected, orphan, minor, promising, niche and traditional are often used to describe the sorts of plant species that are grown, eaten or used very little, or very locally, but have great promise. A widely accepted definition of these crops is "species with underexploited potential for contributing to food security, nutrition, health, income generation, and environmental services". The crops, which are neither grown commercially on large scale nor are traded widely may be termed as underexploited crops. These are cultivated, traded and consumed locally. The popularity of these crops varies from crop to crop and locality to locality which however can be enhanced to a greater extent through publicity.

Underexploited or underutilized horticultural crops have immense potential to contribute location specific food production, as they are well adapted to existing and adverse environmental conditions and generally resistant to pests and diseases. Furthermore, these crops have long been a traditional part of cropping systems, especially in home gardens. Therefore, increased in production of these crops will not only reduce the dependency of livelihood improvement on few crop species but also help in diversification of agriculture besides catering multifarious human needs. Most of the crops are very rich sources of vitamins, minerals, and other nutrients such as carbohydrates, proteins and fats.

Why think about Underexploited Horticultural crops?

Placing too much reliance on just a handful of crops is risky. Climate change threatens to destabilize production and, as the global population shoots up, the green revolution is reaching its limits in generating the ever-increasing amounts of food needed to feed it. Bringing underexploited crops out of the shadows into the mainstream reduces the risks. These crops usually thrive in infertile or difficult terrains that are not well suited to large scale commercial agriculture. The poor are often the main inhabitants of such areas and underexploited crops give them alternative sources of income - paths out of poverty.

Scope of underexploited fruit crops

Country has substantial area under marginal and wastelands of different kinds viz. ravine, hilly tracts, alkaline, acidic, marshy, sandy soils which are not suitable for cultivation of high input demanding horticultural crops, either due to poor quality of soil or lack of water resources. Such lands may be utilize for growing of low input demanding potential underexploited fruits and vegetables to diversify the pressure on present day agriculture, which is so inevitable in views of increasing population pressure and fast depletion of natural resources as well as changing human needs. Food grain farming is proving unremunerative due to high input cost and dependency on rainfed farming. Production of these underexploited horticultural crops especially fruits through adoption of scientific technologies could be one of the appropriate options to enhance the fruit production in the country. Some of the potential underexploited fruit diversity available in India is given in Table 1.

Table 1: Potential underexploited fruit crops of India

Common name	Scientific name	Family	Flowering	Fruiting	Uses
Kiwifruit	*Actinidia deliciosa*	Actinidaceae	Feb-March	Oct-Nov	Fresh, beverages, culinary
Carambola	*Averrhoea carambola L.*	Oxalidaceae	June-July	Dec-Jan	Eaten fresh, RTS
Lutqua	*Baccaurea sapida*	Euphorbiaceae	April-May	May-July	Eaten fresh, Squash
Tree tomato	*Cyphomandra betacea*	Solanaceae	Round the year	Round the year	Fresh, chutney
Elephant apple	*Dillenia indica*	Dilleniaceae	June-July	Oct.-Dec.	Chutney, pickle
Longan	*Dimocarpus longan*	Sapindaceae	March-April	July-Aug	Fresh, resins
Persimon	*Diospyros kaki*	Ebenaceae	Feb-March	Oct-Nov	Fresh, dried product
Durian	*Durio zibethinus*	Bombacaceae	July-Aug	Oct-Nov	Fresh, processed
Silver berry	*Elaeagnus latifolia*	Elaeagnaceae	Aug.-Nov.	March-April	Fruit eaten Fresh, Chutney, Jam
Loquat	*Eriobotrya japonica*	Rosaceae	Oct-Nov	March-April	Fresh fruit, jam, jelly, squash
Bhawa	*Garcinia cowa*	Clusiaceae	February-March	April-June	Fruit eaten fresh, juice, squash
Mangosteen	*Garcinia mangostana*	Clusiaceae	April-June	Oct-Nov	Fresh, processed
Bay berry	*Myrica esculenta*	Myricaceae	Oct-Nov.	March-April	Pickle, eaten fresh, refresh drink
Rambutan	*Nephelium lappaceum*	Sapindaceae	March-April June-July	June-Oct	Fresh, RTS
Pulasan	*Nephelium mutabile*	Sapindaceae	March-May	Aug-Oct	Fresh, RTS
Passion fruit	*Passiflora edulis*	Passifloraceae	April-May	June-Aug	RTS, beverages
Avocado	*Persea americana*	Lauraceae	Feb-March	July-Aug	Fresh, shakes
Star gooseberry	*Phyllanthus acidus*	Euphorbiaceae	March-April	Sept-Oct	Fresh, culinary
Dragon fruit	*Pitaya hylocereus*	Cactaceae	May-June	Sept-Oct	Juice, wine
Water apple	*Syzgium aqueum*	Myrtaceae	March-April	July-Aug	Fresh

Potential underexploited fruits

Rambutan (*Nephelium lappaceum*)

Rambutan is a juicy tropical fruit belonging to the family Sapindaceae and the aril resembling to litchi fruit. Its aril is sweeter and crisped than litchi or longan aril. The fruit is native to Indonesia and Malaysia from where it spread westwards to Thailand, Burma, Sri Lanka and India, Vietnam, and Philippines. In India it is commercially cultivated in Kerala, Karnataka, T.N., NE states and has possibility of growing of cold tolerant variety in Bihar. Seeds are light brown, high in certain fats and oils (primarily oleic acid and arachidic acid) and valuable to industry, used in cooking and the manufacture of soap. Rambutan roots, bark and leaves have various uses in medicine and in the production of dyes. Fruits have high demand in Europe, the Middle East and North America market as fresh fruits. The Rambutan fruit is rich in nutritive value and has very rich source of energy contain 82 kcal, carbohydrate 20.87g, dietary fiber 0.9 g, less fat 0.21g and protein 0.65g in100g of fresh fruits. It is rich in mineral matter containing potassium 42mg, calcium 21mg, sodium 11mg, magnesium 7mg, phosphorus 9mg and small quantities of iron and zinc. The fruits are rich in several vitamins and acids viz. folate (vit. B_9) 9µ g, riboflavin (vit. B_2) 0.022mg, thiamine (vit. B_1) 0.013mg, niacin (vit. B_3) 1.352 mg, coblamin (vit. B_6) 0.02mg and ascorbic acid (vit. C) 4.9mg in 100g of fresh fruit aril. Rambutan is evergreen tree growing to a height of 12–20 m. The fruit is a round to oval drupe 3–6 cm (rarely to 8 cm) tall and 3–4 cm broad, borne in a loose pendant cluster of 10–20 together. The leathery skin is reddish (rarely orange or yellow), and covered with fleshy pliable spines. Flowering periods differ for other localities. In south India, rambutan flowers from March to July and again between June and November. Rambutan require warm tropical climates, temperature around 22–30°C, and is sensitive lower than 10 °C, The fruit matures 15–18 weeks after fruit set. The important cultivars grown in India are Arka Coorg Arun, Arka Coorg Patib, N-18 and E-35. It is commercially propagated by grafting, air-layering and budding. Budded trees may fruit after 2–3 years with optimum production occurring after 8–10

years. Trees grown from seed bear after 5–6 years. Planting distance should be kept 5-6 m apart and planted during monsoon season with provision of pollenizer. Fertilizer at the rate of 80: 60: 60 g NPK per plant per year is recommended along with 10 kg vermi-compost. Training and pruning should be done to give a strong frame work and for managing the plant canopy after harvesting of the fruit. Rambutan is infested by leaf-eating insects, mealybug, (*Pseudococcus lilacinus)* and giant bug (*Tessaratoma longicorne)*. Powdery mildew, (*Oidium* sp.) and stem canker (*Fomes lignosus) are* major disease *of concern.* An average 60–70 kg fruit per tree fruit yield may be obtained regularly. The ripened fruits continue to be staying on the trees up to 30 days.

Longan (*Dimocarpus longan* Lour.)

The longan is native to southern China (Kwangtung, Kwangsi, Schezwan, Fukien) and hills of Assam and the Garo hills. It can be grown between elevations of 150-450 m asl. It is a sub-tropical fruit belongs to family Sapindaceae and a prolific bearer and also known as dragon eye fruit. The tree is erect 9-12m in height and 14m in width, spreading, slightly drooping, heavily foliaged branches. The fruits, in drooping clusters, are globose 1.25-2.5 cm in diameter, with thin, brittle, yellow-brown to light reddish-brown rind, more or less rough, the protuberances much less prominent than litchi. Longans are also renowned in Indian and Chinese cultures for their blood-boosting benefits: the fruits stave off anemia and boost iron absorption. Furthermore, the high antioxidants improve skin health and keep signs of aging at bay. It requires a cool climate for its growth, particularly for flowering. The longan prefers soil pH 6.0 to 6.5 and can not tolerate acidic soil condition. In India, West Bengal is a prominent longan growing state. Longan season in Southeast Asia is mid to late summer, from July through September. There is an off-season period in Thailand from November to early February as well. Perfectly ripe longans are sweet, refreshing and clean with hints of floral nectar. It has 60 kcal energy, 15 g carbohydrate, 84 mg vitamin C, 10 mg magnesium, 21 mg phosphorous, and 266 mg potassium in 100g of edible longans. Most longan trees have been grown from seed. It is planted at 5-6 m apart during monsoon season. Longan is normally propagated by air layering. The longan is relatively free of pests and diseases. At times, there may be signs of mineral deficiency which can be readily corrected by supplying minor elements in the fertilization program.

Pulasan (*Nephelium mutabile*)

Pulasan is a fruit from South East Asia and is native of Myanmar, Indonesia, Malaysia, Thailand and the Philippines. It is mostly grown in lowland primary forests, often on river banks but rarely in swamps, and usually on sand or clay soils. In India it is grown Kerala, Tamil Nadu and some parts of Karnataka. The fruit contains per 100 g edible portion: water 85 g, protein 0.8 g, fat 0.6 g, carbohydrates 13 g, fibre 0.1 g and ash 0.4 g, vitamin C 10.8 mg. The dried seed kernels yield mildly perfumed oil. This oil solidifies into a white fat when the temperature falls below 105 F. This oil can be used for soap making. The wood is light red, harder and heavier than that of the rambutan and of excellent quality but rarely available. An evergreen dioecious tree reaching 9-14 m, with a short trunk and a wide, rounded crown. The leaves and roots are employed in poultices. Root decoction is administered as a febrifuge and vermifuge. It is commonly propagated by air-layering and grafting. The pulasan is ultra-tropical and thrives well only in very humid regions between 110-350 m of altitude. In Malaya, it is said that the tree bears best after a long, dry season. The trees require less space than rambutan trees and

can be planted at 8 to 10 m apart each way. 'Asmerah Tjoplok, Kapoelasan mera tjoplok, P-15 and Seebabat are important cultivars. As a rule, they receive little or no fertilizer or other cultural attention. Pulasan fruits are harvested twice in a year. The season of trees flowering is from March-May and August-October. After flowering, the fruits start to mature in 15-18 weeks time. It takes 100-130 days to mature, in warm tropical areas. The first season of fruiting is from July-November and the next one is from March-July. Fruit is harvested in bunches when most of them turn yellow or red color. The grafted trees produce fruits in 4-5 years.

Avocado (*Persea americana*)

Avocado (Butter fruit) is a native of tropical America belongs to family Lauraceae. It originated in Mexico and Central America, possibly from more than one wild species. The early Spanish explorers recorded its cultivation from Mexico to Peru but it was not in the West Indies at that time. It was introduced into Jamaica in 1650 and to Southern Spain in 1601. It was reported in Zanzibar in 1892. It was first recorded in Florida in 1833 and in California in 1856. In India, avocado is not a commercial fruit crop. It was introduced from Sri Lanka in the early part of the twentieth century. In a very limited scale and in a scattered way it is grown in Tamil Nadu, Kerala, Maharashtra, Karnataka in the south-central India and in the eastern Himalayan state of Sikkim. Avocado is the most nutritive among fruits and is regarded as the most important contribution of the New World to human diet. The fruit is relished by some people, but not by others. The pulp is rich in proteins (up to 4%) and fat (up to 30%), but low in carbohydrates. The fat is similar to olive oil in composition and is widely used in the preparation of cosmetics. Avocados have the highest energy value (245 cal/100 g) of any fruit besides being a reservoir of several vitamins and minerals. Avocado is mainly used fresh, in sandwich filling or in salads. It can also be used in ice creams and milk shakes and the pulp may be preserved by freezing. Climatically, it is grown in tropical or semitropical areas experiencing some rainfall in summer, and in humid, subtropical summer rainfall areas. It can not tolerate the hot dry winds and frosts of northern India. It can successfully grown under water logged condition. All three horticultural races adapted to tropical and sub-tropical conditions i.e. West Indian, Guatemalan and Mexican have been tried in India. The cultivars of West Indian race are grown in localized pockets in Maharashtra, Tamil Nadu and Karnataka. In tropical and near-tropical areas, only West Indian race is well-adapted but its hybrids with Guatemalan (e.g. Booth selection) perform well and are considered valuable for extending the harvest season. In the eastern Himalayan state of Sikkim, avocado has been introduced successfully in hill ranges with an altitude of 800 to 1,600m asl. Both the Mexican and Gautemalan races are grown successfully in Sikkim. The varieties that are cultivated in India go by several names, such as Purple, Green, Fuerte, Pollock, Peradeniya Purple Hybrid, Trapp, Round and Long. Among the several existing varieties, perhaps Fuerte is the most widely grown, but it is regarded as unsuitable for the tropics. Avocado is commonly propagated through seeds. The viability of seeds of avocado is quite short (2 to 3 weeks) but this can be improved by storing the seed in dry peat or sand at 5^0C. At the Fruit Research Station, Kallar, in the Nilgiri Hills of Tamil Nadu, layering as well as inarching gave up to 75 per cent success, while in West Bengal chip-budding is reported to be successful. Avocado is planted out to a distance of 6 to 12m depending on the vigour of variety and its growth habit. Among insect pests, scales, mealy bugs and mites are the important ones, and may be controlled by suitable insecticides. The most serious disease of avocado is the root rot caused by *Phytophthora cinnamoni*, leading to death of plant. The disease situation is aggravated by ill drained and waterlogged conditions. Metalaxyl (Ridomil) mixed with soil before planting or applied as a soil drench controls root rot at least for four months after treatment. The yield ranges from about 100 to 500 fruits per tree. In Sikkim, specifically, on average 300-400 fruits can be harvested from 10-15 years old trees. In Sikkim, fruits of Purple variety are harvested during July, and for Green variety September-October is the usual harvesting time. In Tamil Nadu, July-August is the peak harvest time. The yield performance of avocado, both in tropical southern India and humid sub-tropical northeastern India is highly satisfactory.

Kiwifruit (*Actinidia deliciosa*)

Kiwifruit or Chinese gooseberry is known as 'China's miracle fruit, and 'the horticultural wonder of New Zealand'. It belongs to family Actinidiaceae. From China it is spread to New Zealand where it was recognized as a potential fruit and became a popular backyard vine. In India, the area under this fruit is negligible being a new exotic introduction. In India, it is grown in mid hills of Himachal Pradesh, Jammu and Kashmir, Arunachal Pradesh and Kerala with an altitude of 800 to 1500 m asl. Kiwi can be grown in areas experiencing 700-800 chilling hours (no. of hours during which temperature remains at or below 7^0 C during the winter season). Kiwifruit among fruit crops has been a recent introduction in India. Fruits are rich in minerals, sugars, vitamins and carbohydrates. Besides, it has a refreshing delicate flavour with pleasing aroma. Fruits can be eaten fresh or processed in to squash, juice and wine. At present seven cultivars of kiwi namely Allison, Monty, Hayward, Abbott, Bruno (Female) and Tomuri and Matua (Male) have been introduced in India. Planting distance varies according to system of training. In T-bar a spacing of 4m from row to row and 5-6 m from plant to plant, whereas, in pergola, a spacing of 6m from row to row and 4-6 m from plant to plant should be maintained. January is ideal time for planting of kiwifruit. Kiwi is dioecious plant (means male and female flower are born on different plant) thus needing plants of both sexes to produce fruit. A staminate plant is provided for the pollination of every six-pistilate plants. Every third plant in alternate row should be a pollinizer (staminate). In India only two male clones Tomuri and Allision are generally inter planted. Kiwi plants are pollinated mainly by honeybees besides hand pollination in early morning hours are very effective for heavy fruit setting and quality yield. It is commercially propagated by cutting and tongue grafting during dormant season (Dec.-Jan.). Training is required to establish and maintain a well-formed framework of main branches and fruiting arms. Vines are trained in two arm kniffin system. Bearing starts at the age of 4-5 years. Yields vary from 25-100 kg /vine. It ripens from October to December depending upon variety and climate. So far, no serious pest and diseases attack has been reported in this fruit from India. Therefore, it has got a better scope to become commercial eco-friendly fruit crop in foot and mid hills of the region.

Silver berry *(Elaeagnus latifolia)*

It belongs to Elaeagnaceae family grown in NE and Himalayan region. It is quite common in Sibsagar (Assam), Nagaland, Khasi and Jaintia hills of Meghalaya, part of Uttarakhand and South India. It is grown in sub tropical to temperate region ranging from 400-1500 m asl. It is a large evergreen woody shrub with rusty-shiny scales that are often thorny. Flowers are hermaphrodite (have both male and female organs) and are pollinated by Bees. Fruits of *E. latifolia* are oblong in shape with dark pink colour at ripening. It flowers during September-December and light pink coloured fruits are harvested during March-April. Fruits are eaten raw with salt and also used for making pickle. Plant can be propagated by both seed and cutting.

Elephant apple (*Dillenia indica* L.)

It is originated in Indonesia and this evergreen tropical tree belongs to family Dilleniaceae and also called as Chalta. It is grown in Meghalaya, Assam and other parts of the country. This is a spreading tree and has beautiful white fragrant flowers, toothed leaves and globose fruits with small brown seeds. Greenish-yellow fruit, which has a thick protective covering, is edible; unripe fruits are cooked to make pickle and chutney. Juicy pulp is aromatic but very acidic.

Tree tomato (*Cyphomandra betacea*)

It is native of South America belongs to Solanaceae family, a perennial shrub producing red tomato like fruit used for making chutney. It is grown as backyard venture crop in India especially in Meghalaya, Mizoram Manipur, Nagaland and some parts of South India. It is a small, tender 2-3 m tall tree which bears prolifically egg shaped berries with pointed ends in cluster near the young shoots. The long-stalked, pendent fruit, borne singly, or in clusters of 3 to 12, is smooth, egg-shaped but pointed at both ends and capped with the persistent conical calyx. In size it ranges from 5-10 cm long and 4-5 cm in width. Skin color may be solid deep-purple, blood-red, orange or yellow, or red-and-yellow, and may have faint dark, longitudinal strips. The inside pulp of fruits is light orange and seed is black. Tree tomato is consumed as chutney when raw or after roasting and peeling off the skin. It is liked by the people due to unique falvour. It is propagated by both seed and cutting.

Lutqua *(Baccaurea sapida)*

A lesser-known species distributed in sub-Himalayan tract mainly on eastern side from Nepal to Sikkim, Darjeeling hills and Arunachal Pradesh to Assam, Tripura and Meghalaya. The tree grows wild from southern China, Thailand and Cambodia to Malacca and it is occasionally cultivated in northern Malaya and Thailand. It belongs to family Euphorbiaceae. It looks attractive, particularly when stem is laden with flowers and fruits. It is a semi-evergreen tree, small to medium size, which grows up to 10 m in height. Yellowish ripe fruits are edible and turn into ivory to yellowish or pinkish-buff or sometimes bright red. Pulp is whitish and occasionally deep pink near seeds; varies from acid to sweet in taste. Fruits are available in market during May- July @ Rs15-20/kg in local market. In fact, people used to eat flesh or aril around seed coat. Rind of fruit is occasionally used for making chutney. Physico-chemical analysis of fruit revealed that fruit weight ranges from 11.02-12.60 g, fruit length 2.63-2.76 cm, fruit diameter 2.64-3.16 cm, pulp weight 6.01 g, Juice recovery 27.37-36.30%, Juice density 0.99g/ml, seed weight 1.90 g/seed, TSS 8.2-14.1% and acidity 1.93%.

Water Apple (*Syzygium aqueum* Alst.)

Native range extends from India through Malaysia. The water apple occurs naturally from southern India to eastern Malaysia. It is commonly cultivated in India, southeastern Asia, and Indonesia. In the Philippines, it grows as though wild in the Provinces of Mindanao, Basilan, Dinagat and Samar. It has never been widely distributed but is occasionally grown in Trinidad and Hawaii. It belongs to family Myrtaceae. The flesh has a very mild, watery flavor. Tree height ranged from 3-10 m, has a short, crooked trunk branching close to the ground and a nonsymmetrical, open crown. The fruit varies from white to light-red or red, pear-shaped with a narrow neck and broad apex.

The flesh is white or pink, mildly fragrant, dry or juicy, crisp or spongy, and usually of sweetish but faint flavor. There may be 3 to 6 small seeds, frequently only 1 or 2, but generally the fruits are seedless. The water apple is suited only to low altitudes in the tropics and areas where there is rainfall fairly well spaced throughout the year. It prefers warm, humid climates, with rainfall distributed throughout the year. It is usually propagated by seeds. Fruits ripened in the month of July-August.

Bay berry *(Myrica esculenta*)

It belongs to family Myricaceae, is a sub-temperate evergreen tree found throughout mid-Himalayas, starting from about 1300 m and going up to about 2,100 m. It is quite common in Sibsagar (Dikho valley of Assam), Khasi and Jaintia hills of Meghalaya, parts of Uttarakhand. A medium to large woody, evergreen, dioecious tree, 12 to 15 metre high; male and female trees have almost similar appearance. Leaves almost crowded towards end of branches. The bark is used externally as stimulant against rheumatism and in preparation of yellow dye. Colour of fruit initially green and later becomes reddish during ripening stage. Juice has a very attractive sparkling red colour. Flowering season starts from first fortnight of October and continues till second fortnight of December. Similarly fruiting season starts from last week of March and continues till last week of June depending upon climatic condition and species. Small, seedy fruits are sweet, with pleasant blend of acid. They are very attractive and overall fruit quality is excellent. People eat fruit with salt and used for making pickles, while, juice is used for making 'Sharbat'. Small, medium and big sizes of green, partial green and pinkish colour fruits Myrica were analyzed and result revealed that significant variation was seen among the different physic- chemical parameters. Fruit weight ranged from 15.21 to 23.4 g in big size, 8.37 to 8.70 g in medium size, while small size fruits showed the average 3.86 g fruit weight. Maximum pulp (86.7%) and juice recovery (80.44%) was obtained under big size of yellowish green colour fruit and medium size fully pink coloured fruits, respectively. The maximum TSS (9.0%), reducing sugar (2.44%), total sugar (6.67%), 'b' carotene (3.86 mg/100 ml)) and anthocyanin (13.84 (mg/100 ml)) was analyzed in small size fully pink coloured fruits. Whereas, maximum ascorbic acid (30.36 mg/100 ml) and minimum acidity (3.58%) was recorded in big size yellowish green and small size fully pink coloured fruits, respectively.

Passion fruit (*Passiflora* spp.)

Passion fruit is a high value export-oriented crop owing to its excellent flavoured juice. This is a native of Brazil and widely cultivated in South Africa, Kenya, East Africa, Australia, New Zealand and Indonesia. In India, it grows wildly in Niligiri Hills, Kodaikanal, Coorg, Malabar, Kerala, and Himachal Pradesh. It is commonly cultivated in warm and tropical regions. Recently its cultivation has been extended to some areas of north eastern hill region. The juice is a good source of vitamin 'A' and 'C', and used to flavour ice cream, making jam and refreshing drinks. Some home-scale products like squash and nectar can be prepared from its juice. Further, the excellent flavour of juice can be utilized to enhance the overall quality of the blended products. Its cultivation is extended to South India and NE region. Passion fruit is commercially propagated by cuttings and seed. The passion fruit (*Passiflora* spp.) belongs to the genus Passiflora, which includes about 500 species. There are at least ten species of the genus *Passiflora* that are cultivated for their fruits. Among these species, only purple passion fruits (*Passiflora edulis* Sims) and yellow passion fruits (*Passiflora edulis f. flavicarpa* Degener) are commonly cultivated. Commercially Purple, Yellow type and Hybrid (Kaveri) cultivars are being cultivated in India.

Yellow passion fruit *(P. edulis f. flavicarpa)*: The vine is much like that of the purple variety. It is distinguished by the suffusion of reddish, pinkish or purplish colour in stems, leaves and tendrils. The leaves resemble those of the purple form but usually are somewhat larger. In the flower, the bases of the corona filaments are much deeper, brighter purple. The flower opens about noon and closes about 9 or 10 p.m. The average fruit is slightly larger than the purple form and has a bright canary-yellow rind. The pulp is somewhat more acid and the seeds are dark brown rather than black. This species is prone to frost.

Therefore, initially it takes more time at least two years to become hardy and give the satisfactory yield.

Purple passion fruit (*P. edulis*): The stems are green, angular when young, becoming round with maturity and their centers are hollow. There are many green tendrils on the stem. Leaves are alternate, simple, divided into three large, deep lobes, except in very young plants where they may be undivided. They have five sepals and five petals, which are alternate, giving the flower the appearance of having 10 petals. Long, thin, curly whiskers or threads, called the corona, radiating in a circle from a central hollow. At its base are five spreading stamens with oblong, loosely attached yellow anthers and ovary is three tripartite styles. On the flower stalk just above the flower are three large, green, leafy bracts called the involucre. The fruit is round or oval, 3 to 5 cm in diameter, green at first and deep purple when ripe and finally becomes crinkled when fully mature.

Kaveri: It is a hybrid of purple and yellow passion fruit. It is high yielding, tolerant to collar rot, wilt, brown leaf spot and nematodes. It is very vigorous; its fruits are a blend of purple and yellow varieties but having the size of the yellow variety. The pulp is less acid than that of the yellow variety.

Mangosteen (*Garcina mangostana*)

Mangosteen is native to South-East Asia belongs to family Clusiaceae and it requires a warm, very humid and equatorial climate to grow. It is found in tropical countries in Asia such as Thailand, India, Malaysia, Vietnam and the Philippines. Mangosteen grows in four areas of India, as all of them are tropical, have high humidity and decent rainfall: Nilgiri hills, the southern districts of Tinnevelly and Kanya-Kumani in Tamil Nadu, and Kerala. In Tamil Nadu, the trees grow from 250ft to 5,000ft elevation. Mangosteen season occurs twice a year: April to June and during the monsoon season from July to October. The tree grows from 6 to 25 m (19.7 t o 82.0 ft) tall. The mangosteen is an evergreen tree. Fruits are sweet and tangy, juicy, somewhat fibrous, with fluid-filled vesicles (like the flesh of citrus fruits), with an inedible, deep reddish-purple colored rind (exocarp) when ripe. In each fruit, the fragrant edible flesh that surrounds each seed is botanically endocarp, i.e., the inner layer of the ovary. Seeds are almond-shaped and sized. Mangosteen fruit contains antioxidant, antibacterial and antifungal properties. Scientific research has proved its effectiveness against breast cancer, liver cancer and leukemia. The nutritive value in 100g fruit are 73kcal calories, 17.91g carbohydrates, 1.8g fiber, 0.58g fat, 0.41g protein, 0.054mg thiamin, 0.054mg riboflavin, 0.286mg niacin, 0.032mg pantothenic acid, 0.018mg B6, 31ug folate, 2.9mg vitamin 'C', 12mg calcium, 0.3mg iron, 13mg magnesium, 0.102mg manganese, 8mg phosphorous, 48mg potassium, 7mg sodium and 0.21mg zinc. Plants are commercially propagated by seed and vegetative methods of propagation.

Bhawa *(Garcinia cowa)*

It belongs to family Clusiaceae and is a lesser-known edible fruit of Mizoram. Ripened fruit is externally similar to tomato and internally to citrus because of the presence of juice sacs. Fruits are rich in vitamin C, sour in taste, nutritious and are used in stomach disorder. It is a medium sized (3-5 m), evergreen plant having drooping branches and lanceolated leaves. Plants start flowering during February-March. Ripened fruits are pinkish red in color and look similar to tomato. Fleshy, smooth hard rind contains no oil glands and tightly covers juice sacs. Number of juice sacs varies from 4-9 and each juice sac contains one seed inside. Rind and juice sacs with seeds are very tasty and sweet and are eaten by local people. Fruits take about 3 months to ripe and fruits are harvested in April-June. Average yield varies 150-250 fruits/plant. Plants start

bearing after 3-4 years of planting. The most common method of propagation is by suckers. One year old suckers are used as planting materials. Fruit yield ranges from 5-10 kg/plant, fruit weight 40-75 g, fruit length 3.5-6 cm, fruit diameter 5-5.73 cm, rind 52-55%, Juice 38-42%, Juice sac 7-8/fruit, rind thickness 0.48 cm and seed weight 0.70-0.75 g/seed. Chemical analysis of juice sac revealed TSS 6.8%, pH 3, acidity 2.34%, ascorbic acid 42.3 mg/100 ml juice, reducing sugar 1.01% and total sugar 3.40%. Rind data revealed that Juice content 64.9%, TSS 5.6%, pH 2.8, acidity 2.37%, and ascorbic acid 21.15 mg/100 ml rind juice.

Star gooseberry *(Phyllanthus acidus)*

Star gooseberry belongs to family Euphorbiaceae. It is widely distributed in India and found in Southern parts and in North eastern parts particularly in Mizoram. Fruit is oblate with 6 to 8 ribs in 1-2.5 cm wide; pale-yellow to nearly white when fully ripe; waxy, fleshy, crisp, juicy and highly acid. Tightly embedded in center is a hard, ribbed stone containing 4 to 6 seeds. Star gooseberry is subtropical to tropical, being sufficiently hardy to survive. It thrives up to an elevation of 900 m asl. Tree grows on a wide range of soils but prefers rather moist sites. Tree is generally grown from seed but may also be multiplied by budding, greenwood cuttings or air layering. Seedlings produce a substantial crop in 4 years. Average fruit weight is 3.39g, fruit length 1.57 cm, fruit diameter 1.94 cm, pulp recovery 95.28 %, seed weight 0.16 g/seed, seed length 0.58 cm, seed diameter 0.62 cm, TSS 4.68%, acidity 2.27% and ascorbic acid 21.15 mg/100 ml juice .

Dragon fruit (*Pitaya hylocereus*)

Dragon fruit is a cactus fruit that can be found throughout Asia, Australasia, North America and South America, even though they are believed to be native to Mexico originally. This fruit belongs to Cactaceae family also known as strawberry pear or pitaya. There are two main types of dragon, the sour types, typically eaten in the Americas, and sweet types found across Asia. The fruit comes in 3 different color varieties, labelled as red, yellow and Costa Rican dragon. The “red” fruits are generally a bright magenta color on the outside, with yellow flesh. The Yellow dragon fruit is yellow inside and out, and the Costa Rican dragon are magenta on the outside and the inside. They smell deliciously fragrant and most have a sweet flavor similar to a kiwi fruit. Juice or wine can be obtained from the fruit, while the flowers can be eaten or used for tea.

Carambola (*Averrhoea carambola* L.)

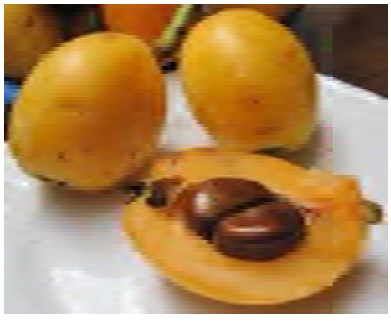
Star fruit or carambola belongs to family Oxalidaceae is a fruit tree native to the Philippines, but can be found throughout Southeast Asia, East Asia, South America, Florida and Hawaii. This fruit has five ridges running down its length, which when cut sideways, makes the star pattern after which it is named. The fruit is rich in vitamin ‘C’ and antioxidants. Tartness in fruit is due to calcium oxalate crystals in flesh, which dissolve in saliva forming oxalic acid. It is a slow-growing, short-trunked evergreen tree with a much-branched, bushy canopy. Mature trees seldom exceed 7.5 to 10 m in height

and 6 to 8 m in spread. Skin is thin, light to dark yellow and smooth with a waxy cuticle. Flesh is light yellow-to-yellow, translucent, crisp and very juicy, without fiber. Seeds lose viability in a few days after removal from fruit. Ripe fruits are eaten fresh as raw as well as processed product like squash and as refreshing drink. The fruit turns a bright yellow when ripe, has a waxy skin and the entire fruit is edible, juicy and crunchy. It is propagated by seed.

Durian (*Durio zibethinus*)

Durian is a native to Borneo belongs to family Bombacaceae, produce fruits with a unique appearance, taste, flavour and aroma. The durian is grown intensively and commercially for its fruit only in Indonesia, Malaysia and Thailand. In India, there are no large orchards or commercial plantings of durian, but for some trees in and around Nilgiris (Tamil Nadu) and West Coast. This fruit tree grows tall and straight to a height of 30 m in the forests. However, grafted orchard trees seldom grow over 12 m. The durian fruits are ovoid to ellipsoid, large, weighing up to 5 kg with thorny surface like jack and normally olive green in color. People have strong like or dislike for this fruit. Many like it, because of its sweet, delicious and filling taste, while others dislike it for its highly objectionable odour. The penetrating odour is comparable to that of rotten onion and is unacceptable to many people. However, once the odour barrier is overcome by a strong determination, the experience of eating a good durian is never forgotten. The pulp is rich in sugars (12%), protein (2.8%) and carbohydrates (34%) in addition to iron, B vitamins especially the uncommon but valuable vitamin E. When durian fruit is consumed, it gives a feeling of internal warmth, followed by a glowing sensation, and this has led to a strong belief that the fruit has aphrodisiacal qualities. The fruits are highly prized both as fresh fruit and in processed form. Durian also has some pharmacological properties, e.g. decoction of roots is used to treat fever and that of leaves and roots is used to check inflammation, infections and to treat jaundice. Durian thrives in humid, equatorial climate with short or no dry season. An annual rainfall of 200 cm is a minimum requirement, but heavy rains prior to flower initiation affect normal flowering, and the production decreases. If minimum temperature falls below 8°C, the tree suffers from cold injury. Usually the growers propagate durian by seeds and their off springs vary from generation to generation due to genetic heterozygosity. However, the recommendation would be to go for vegetative propagation of proven elite trees. Grafted durian trees are precocious and produce crop in 4-5 years, while seedlings require as long as 10 years. The fruiting is clearly seasonal, available 2 times in a year. Immature fruits are picked only for use as 'vegetables'. Fruits take about three and a half months to reach maturity. When mature, the fruits drop but it should be harvested since the fallen fruits do not keep long. Harvesting is done manually or with the help of bamboo poles when the fruits are smooth, flat with far apart spines. The yield varies with the age, variety, and agro-climate of the region. However, 100-120 fruits/tree are considered as good.

Loquat (*Eriobotrya japonica* Lindl.)



The loquat (Japanese plum) fruit is native to China belongs to family Rosaceae. Many good loquat cultivars also originated in China and Japan. It has become a commercial fruit of Australia, U.S.A. Hawai, France and India. U.P. occupies the first position as for as area under loquat is concerned. Loquat is highly preferred fruit for kitchen gardens in Punjab. It is also being grown on a small scale in the orchards at Amritsar, Gurdaspur, Hoshiarpur and Patiala districts. It is also found promising in Delhi, Himachal Pradesh, Assam, Maharashtra, and a few of the hill stations in the south. The trees are evergreen, spreading and erect growing. A full grown tree may attain a height of 7-8 meters. Selected varieties produce clusters of excellent yellow fruit that mature in the month of March-April. It contains 60 to 70 percent pulp depending upon the cultivar and 15-20 percent seed. The pulp is composed of 88% water, 0.6% proteins, 9.6% carbohydrates, 0.5% minerals, 1.0% fibre and 55% IU vitamin 'A'. Some preparations like Jam, Jelly and squash are made from the pulp. It is consumed as a fresh fruit. The colour of epicarp usually ranges between yellow-red. The fruit tastes sweet and sour with good flavour. Loquat has adapted well to the harsh climate of North India. It is performing well in tropical climate and lower hills, where temperature rarely falls below 0°C and can be grown up to 1600 m asl in India. Where the climate is too cool or

excessively warm and moist, the tree is grown as an ornamental but will not bear fruit. As subtropical fruit, loquats are grown most successfully in citrus-producing areas. Loquats are quite resistant to most diseases and insect damage. Loquat fruits should be allowed to ripen fully before harvesting. They reach maturity in about 90 days from full flower opening. The commercial cultivars of India are Golden Yellow, Improved Golden Yellow, Pale Yellow, Tanaka, California Advance and Improved Pale Yellow. It is propagated by grafting. Planting distance should be kept about 6-7 m apart.

Persimmon (*Diospyros kaki)*

Persimmon is a deciduous fruit tree which is predominantly cultivated in sub-tropical and warm temperate regions belong to family Ebenaceae which is the most widely cultivated species is the Asian persimmon. Ripe fruits of the cultivated strains are in light yellow-orange to dark red-orange depending on the species and variety. Persimmons are eaten fresh, dried, raw, or cooked. When eaten fresh they are usually eaten whole like an apple or cut into quarters. Compared to apples, persimmons have higher levels of dietary fiber, sodium, potassium, magnesium, calcium, iron and manganese, but lower levels of copper and zinc. The persimmon market in India is limited for a number of reasons, mostly because of low demand and paucity of supply. However, several of India's cooler regions grow persimmons viz., Jammu and Kashmir, Himachal Pradesh and the hills of Uttar Pradesh. The temperate regions of Kullu, Mandi, Solan, Chamba, and Shimla of HP are best for persimmon cultivation. A few trees also grow in the chilly Coonoor hills of Tamil Nadu. It has a relatively low winter chilling requirement in comparison with other deciduous fruit crops. The tree tends to have a higher tolerance to heat, water stress and water logging than other deciduous fruit crops. Persimmon cultivation has potential, though, as a single tree may bear 200 kilograms of the fruit per year. Fruiting season begins in mid September and lasts until November, sometimes December. Commercially and in general, there are two types of persimmon fruit: astringent and non-astringent.

Constraints for improvement of underexploited fruit crops

- Lack of awareness among the beneficiaries about nutritional and economic benefits.
- Lack of standard varieties and propagation techniques.
- Unavailability of quality and healthy planting materials.
- Technology for crop husbandry and canopy management is lacking.
- Lack of technological support for value addition through processing.
- Non-priority of research on these crops.
- Poor recognition of these crops in horticultural promotion programmes.
- Casual approach of growers for cultivation of such crops.

Strategies for improvement

- Establish a database of existing information on climatic adoptability, stress tolerance, nutritive values and uses of underutilized species.
- Domestication through homestead cultivation of these potential wild fruit species needs to be encouraged.
- Create awareness of the importance of diets with nutritional value of underutilized species.
- Develop a local/regional based priority list of top ten underexploited fruit species.
- Selection of superior genotypes for diverse uses like fruit juice, wine and extraction of natural colour etc.
- Standardization of propagation techniques for true-to-type and faster multiplication.
- Production of quality plants and promotional schemes for area expansion.
- Development of crop husbandry and canopy management technique.

- Documentation of indigenous knowledge to tap medicinal uses and value addition for multipurpose uses.
- Development of standard protocol for post harvest management and value addition.
- Involve communities in the conservation, information gathering, knowledge sharing and dissemination.
- Develop guidelines and good practices for sustainable use of underutilized species.

Conclusion

Indo-Malayan and sub Himalayan regions of diversity have one of the richest reservoir of genetic variability and diversity of horticultural crops that exists in plant types, morphological and physiological variations, adaptability and distribution. The geo-climatic condition of India offers an excellent scope for growing of different types of horticultural crops including fruits, vegetables, spices and plantation crops, medicinal and aromatic plants of high economic value. A wide range of underutilized tropical, sub- tropical and semi-temperate fruits such as avocado, bay berry, *Baccaurea sapida,* carambola, dragon fruit, durian, elephant apple, Elaeagnus, kiwifruit, loquat, longan, mangosteen, passion fruit, persimmon, pulasan, rambutan, tree tomato, etc are grown in different regions of the country. Underexploited crops have immense potential to contribute location specific food production, as they are well adapted to existing and adverse environmental conditions and generally resistant to pests and diseases. Therefore, increased production of these crops will not only reduce the dependency of livelihood improvement and nutritional security on few crops species but also helps in diversification of agriculture besides catering multifarious human needs. These crops may also be provide many fold employment opportunities and agro based industries, packaging, storage, preservation, canning and product diversification. The promotion of such species is need of the hour and systematic approach needs to be developed in this direction.

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Genetic improvement of under utilized fruits and their conservation in semi arid ecosystem of Western India

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India is emerging as a major stake holder in the global horticulture scenario. This has been made possible due to concerted efforts of scientists and progressive farming community. In recent years, there is considerable awareness about the nutritional security and food safety. More emphasis is given to underutilized fruits due to their high nutritive and medicinal value in addition to being resistant/tolerant to many biotic / abiotic stresses. The demand of these fruits is gradually increasing owing to tremendous potential for commercial exploitation aimed at improving the economic status of the poor and marginal farmers. An area, which needs immediate attention, is the collection, documentation, conservation and utilization for their sustained production and popularization. Jamun (*Syzygium cuminii* Skeels), fruits are used as an effective medicine against diabetes, heart and liver trouble. The powder of seeds has high value being useful in the treatment of diabetes. Therefore, the j*amun* fruits are having high value in terms of therapeutic and nutrition. Fruits and seeds of tamarind have tremendous potential for industrial use. The medicinal properties of the bael (*Aegle marmelos* Correa) fruit are due to high marmelosin content. The pulp of mature bael fruit is very effective to cure dysentery and diarrhoea. Mahua (*Bassia latifolia*) is a boon for tribal farmers of Gujarat. The corolla commonly called as *mahua* flowers is a rich source of sugar containing appreciable amount of vitamins and minerals. Flowers (fresh and dried) and spent flowers (after fermentation) are also used as feed for livestock. Fruits are eaten as raw or cooked. Seeds are good source of oil. The oil obtained from Mahua kernel is used for edible purpose and permitted for preparation of vegetable oil. Mahua oil is used in manufacture of soap, lubricating grease, fatty alcohols and candles. Chironji (*Buchanania lanzan* Spreng) is excellent tree of agro forestry and social forestry. The flesh of ripe fruit is very palatable and the oily kernels are good source of protein (28.00-30.00 %) and are used in preparation of sweets. Kernel oil can be used to substitute olive and almond oil. Karonda(*Carissa carandas* L), is also very hardy plant, it is planted as protective hedge on the fringes of the orchard. Khirni (*Manilkara hexandra*) thrives well on rocky, gravelly, saline and sodic soils and is good source of sugars and antioxidants. It is being used commercially as rootstock for sapota. Capegooseberry (*Physalis peruviana* L.) is a short duration minor fruit of the family Solanaceae. It is quite promising fruit crop for western India. The fruit is rich sources of Vitamin C, carotene, phosphorus and iron. These crops are being evaluated at this research station since 2001 and the varieties on jamun (Goma Priyanka), tamarind (Goma Prateek) and bael (Goma Yashi) have been developed. These varieties are precocious bearer with good yield and quality attributes and suitable for high density planting. Promising genotypes of mahua, chironji, khirni and karonda are being evaluated under field conditions. These minor fruits have potential in secondary agriculture through value addition. Many products like vinegar, squash, seed powder may be prepared from jamun. Very good jelly, juice and candy may be prepared from mature karonda fruits. Tamarind pulp is being exported abroad, it may be promoted through value addition. Minor fruits have been conserved at the station and it has great potential under semi-arid regions of western India.

Genetic resources of minor fruits

Jamun: The Jamun (*Syzygium cuminii* Skeels), a member of family Myrtaceae is one of the important minor fruits.

Singh and Singh, 2005 made a survey in Gujarat to identify the elite genotypes of jamun. The study revealed that there was a wide variation among the genotypes. Earliest flowering (Mid February) took place in GJ-24, and latest (Last March) in GJ-23, GJ-30, GJ-31, GJ-32 and GJ-33. Maximum panicle length (15.24 cm) and number of fruits per panicle (26.00) were found in GJ-19. Collection numbers GJ-19, GJ-21, GJ-22 and GJ-25 have been found earliest (First Week May) in ripening period, while GJ-17, GJ-28 and GJ-32 ripened at the last (Last June).

Individual fruit weight ranged from 10.10 to 22.50 g, length from 1.99 to 3.24 cm and pulp percentage from 73.66 to 85.68. There was a wide variation in chemical characters also. Total soluble solids varied from 10.30 to 12.34 %, total sugar 8.58 to 9.13% and vitamin C 32.12 to 46.37 mg/100g. On the basis of overall performance GJ-18, GJ-19, GJ-23, GJ-24 and GJ-25 were found to be promising among the genotypes studied based on its yield and physico-chemical characters. Singh *et al*, 2006 studied developmental pattern of jamun and observed that the fruit growth was faster initially and slowed down while reaching towards maturity stage and followed sigmoid growth pattern. Total soluble solids, total sugar and vitamin C increased as the fruits reached towards the maturity. Titratable acidity showed declining trend while reaching towards ripening stage. Deep purple colour on fruit surface was observed in all the genotypes during ripening. Percentage of total soluble solids was found to be 14.00, 15.00, 13.50, 13.40, 14.10 and 14.50 in GJ 1, GJ 2, GJ 3, GJ 4, GJ 5 and GJ 6 respectively during ripening, however titratable acidity was registered 0.39, 0.38, 0.34, 0.36, 0.38, 0.30 per cent in GJ 1, GJ 2, GJ 3, GJ 4, GJ 5 and GJ 6 respectively at the same stage. On the basis of physico-chemical attributes, it was concluded that fruits of GJ 1 and GJ 2 may be harvested by the 1st week of May, GJ 3 by 3rd week of May and that of GJ 4, GJ 5 and GJ 6 by 1ST week of June under semi- arid ecosystem of western India.

At CHES, Godhra, jamun genotypes were evaluated (2001-2009) for their growth, flowering and fruiting attributes and Goma Priyanka was released as variety. Salient characters of Goma Priyanka are as under:

Goma Priyanka

Goma Priyanka was released at CHES, Godhra in the year 2009. The selection out performed in respect of flowering pattern, fruiting and fruit quality attributes. The tree height and girth was recorded 5.25 m and 64.66 cm respectively. North- South and East- West spread was found to be 5.00m and 4.76 m respectively. It is semi-dwarf, spreading growth habit, dense foliage and drooping branches, early, precocious bearer (starts flowering in 4th year) and suitable for high density planting. It starts flowering in the month of March, ripens in the fourth week of May and recorded 19.86 g average fruit weight, 85.06 per cent pulp, 16.80°Brix TSS, 0.38 % titratable acidity, 12.10 % total sugar, 6.11 % reducing sugar, 45.44 mg/100 g vitamin C, 14.38 mg/100g. It recorded 43.80 kg fruit yield during 8th year of orchard life under rainfed conditions of hot semi-arid ecosystem of western India.

Other promising genotypes of jamun (CHES, Godhra)

GJ-8

It was collected from Ode village of Anand district of Gujarat. Peak period of flowering is in the month of March. It ripens in the second week of June and recorded 17.00 g average fruit weight, 81.82 per cent, pulp, 14.20 per cent, TSS, 0.39 per cent, acidity, per cent, 11.35 per cent, total sugar and 45.10 mg/100 g vitamin C.

GJ-40

It was also collected from Ode village of Anand district of Gujarat. Peak period of flowering is in the month of March. It ripens in the fourth week of June and recorded average fruit weight 16.00 g, 82.00 % pulp, 14.00 % TSS, 0.39 % acidity, 11.00 % total sugar and 46.10 mg/100g vitamin C.

Tamarind: Tamarind (*Tamarindus indica* L.) a member of sub family caesalpiniaceae of family leguminoceae, is a minor fruit and widely distributed throughout tropic and sub-tropics as stray plantation or avenue. Owing to its varied use in household and export market, it has emerged as a potential fruit crop.

In tamarind, Singh and Singh (2005) reported maximum panicle length (15.12 cm) and number of fruits per panicle (15.00) in T13. Early ripening (4th week March) was recorded in T1, T2, T6, T7 and T12, while T4 and T15 ripened at the last (2nd week May). The highest pulp percent (53.87) was recorded in T10. Total soluble solids and total sugars were found to be maximum in T13. Singh *et al*, 2008 also reported variability in respect of flowering and fruiting pattern of tamarind under semi arid ecosystem of western India.

At CHES, Godhra, total 24 genotypes were evaluated (2001-2009) for their growth, flowering and fruiting attributes and Tamarind-13 (Goma Prateek) was released as variety. Salient characters of Goma Prateek are as under:

Goma Prateek

Goma Prateek was released at CHES, Godhra in the year 2009. It is early, spreading growth habit, regular bearer, semi dwarf and starts flowering in 4th year. Peak period of flowering is first week of June and ripens in the first week of March and recorded 26.70 g average pod weight, 16.70 cm pod length, 50.50 per cent pulp, 14.06 % acidity, 71.00°Brix TSS, 55.81 % total sugar, 27.27 % reducing sugar, 17.53 mg/100g vitamin C, 3.29g/100g protein, 177.70 mg/100g calcium, 44.17 mg/100g magnesium, 70.83 mg/100g phosphorus. Fruit shape is slightly curved with reddish pulp, suitable for processing. Fruit yield per plant is 58.50kg during 9th year of orchard life under rainfed conditions of hot semi-arid ecosystem. These fruits have great potential under semi arid conditions of western India.

Varietal wealth: Some promising tamarind selections as a result of evaluation at different institutions are listed below.

PKM 1: It is a selection made at Horticulture College and Research Institute, Periyakulam. Grafts come to flowering three years after planting. The pods have 35% pulp, 17.1 % acidity and 3.90 mg/100 g ascorbic acid.

Urigam: It is progeny of more than 200-year–old tree identified near Urigam by Department of Horticulture, Tamil Nadu. The average length of fruits is 30 cm.

Pratisthan : It was released from Fruit Research Station, Aurangabad. It has 61 % pulp, 12% seed, 27 % shell and 7-9 % acidity. It is sour –sweet tamarind. Its pulp can be stored for long period.

Tamarind - 263: It was also released from Fruit Research Station, Aurangabad. The fruits have pinkish and light yellow pulp and 18-19 % acidity.

Yogeshwari: The variety has been released from Taluk Seed farm, Ambajogai (Beed) in Maharashtra .The fruits are large and have red and sour – sweet pulp with 6-7 % acidity.

DTS-1: It is a selection identified at University of agricultural Sciences, Dharwad. The pods are straight having semi-curved shape, 23.6 cm length, 3cm width, 19.5 gm weight, 51.00 % pulp and 13.60 % acidity. It is a late variety and takes 310 days from fruit set to maturity.

DTS-2: This is a selection made at University of Agricultural Sciences, Dharwad. The pods are straight having semi- curved shape, 17.60 cm length, 2.60 cm width, 18.00 gm weight, 53.00 % pulp and 12.20 % acidity. It is an early variety and the pods mature in 280 days after fruit set.

Chiraunji

Chiraunji (*Buchanania lanzan* Spreng.) is excellent tree of agro forestry and social forestry. In the wasteland development and dry land horticulture, it assumes great significance due to its multifarious uses and capacity to withstand adverse climatic conditions. It gives monitory reward to the tribal community of the country and seems to be boon for them. The flesh of ripe fruit is very palatable and is largely eaten raw or roasted and the oily kernels are the most important part and are used in preparation of puddings. Very good juice may be prepared from the pulp of chironji fruits. The kernel is highly nutritious and rich in protein (25.0-30.0%) and yields sweet oil, which can be used to substitute olive and almond oil. Kernel contains 33.50 % oil, 1.90 % of which is unsaponifiable. The saponifiable part contained 20.00 % of linoleic acid. An ointment made out of the kernels is used to cure itch of the skin and to remove blemishes from the face. Chironji provides quality timber wood for various uses.

Peak period of anthesis was recorded between 6-11 AM while peak period of dehiscence was recorded between 8 AM -12 noon. Fruit set / panicle was found to be positively and significantly associated with panicle length and it may be observed while selecting elite genotypes.

Singh and Singh, 2006 observed earliest flowering (first week of February) in ‘CPT 1’, ‘CPT 5’, ‘CPT 10’, ‘CPT 15’, ‘CPT 17’, ‘CPT 19’ and ‘CPT 22’, while the latest (4th week of February) occurred in ‘CPT 13’. Maximum panicle length (35.11 cm) was found in ‘CPT 1’, while ‘CPT 18’ recorded least panicle length (14.20 cm). Highest percentage of perfect flowers (13.10) and fruit per panicle (37.50) was recorded in ‘CPT 12’ while, it was found least in ‘CPT 18’. Ripening time varied from third week of April to second week of May indifferent genotypes. The highest fruit yield per plant was found in ‘CPT 7’ (28.00 kg/ plant).

At CHES, Godhra, horticultural traits were studied and the genotype, CHESC-7 was found promising. Salient characters of CHESC-7 is as under:

Chiraunji "CHESC-7"

It was collected from Kada Dam of Panchmahal district, Gujarat. Peak period of flowering and fruit set was in the first week of February and 3rd week of February respectively. It recorded 26.00 cm panicle length. Peak period of ripening time was third week of April and recorded 1.20 g fruit weight, 22.00 % TSS, 13.00 % total sugar and 50.00 mg/100g vitamin C, 0.12g kernel weight and 30.50 % kernel protein.

Mahua

Survey of Mahua was made in Gujarat. It is one of the important crops for tribal farmers of Gujarat. Singh and Singh, 2005 recorded early flowering ie 1st week of March in MH-1, MH-4, MH-5, while it was recorded late (2nd week of April) in MH-6. The number of flowers (45.00) and fruits (8.00) per fascicle were noted highest in MH-2. MH-8 recorded maximum leaf area (128.00 cm^2). Range of ripening span in different genotypes was observed from 2nd week of May to first week of June. Dry flower yield varied from 30.00 to 46.00 kg / plant being highest in MH-2. Variation in fruit yield among the genotypes ranged from 35.00 kg to 82.00kg / plant and it was maximum in MH-2

Detailed description of 4 promising genotypes, selected at CHES, Godhra are as under**:**

Mahua-10

It was collected from Vejalpur village of Panchmahal district, Gujarat. Peak period of flowering is in the second week of March. Flowers recorded 2.29 g weight, 65.00 % juice and 26.37 % TSS. It ripens in second week of May and recorded 30.50 fruit weight, 13.50g seed weight and 11.00g kernel.

Mahua-14

It was collected from Otala village (Baria Road) of Panchmahal district, Gujarat.. Peak period of flowering is in the second week of March. Flowers recorded 2.24 g weight, 66.00 % juice and 25.00 % TSS. It ripens in the second week of May and recorded 29.00 g fruit weight, 12.70g seed weight and 9.53g kernel.

Mahua-35

It was collected from Reechawani village (Baria Road) of Dahod district. Peak period of flowering is in the second week of March. Flowers recorded 2.13 g weight, 64.12 % juice and 24.90 % TSS. It ripens in third week of June and recorded 28.50 g fruit weight, 12.23g seed weight and 10.08g kernel weight.

Mahua-63

It was collected from Reechawani village (Baria Road) of Panchmahal district, Gujarat. Peak period of flowering is taken place in the 4th week of March. Flowers recorded 2.50 g weight, 68.00 % juice and 24.37 % TSS. It ripens in 4th week of May and recorded 23.50g fruit weight.

Khirni

Khirni or Rayan botanically known as (*Manilkara hexandra*) is an economically multipurpose tree of the family sapotaceae. Thirty genotypes were selected & evaluated their fruiting and fruit quality attributes. Detailed descriptions of promising genotypes are as under:

GK-1: It was collected from Kharsalia village of Panchamahal district, Gujarat. The peak period of flowering was recorded in the month of November. It ripens in the first week of March and recorded 5.66g fruit weight, 4.93g pulp weight, 21.00 % TSS, 16.20mg/100 vitamin C and 4.30g/100g carotene.

GK-10: It was collected from Parwadi village of Panchamahal district, Gujarat. The peak period of flowering was recorded in the month of December. It ripens in third week of May and recorded 6.64g fruit weight, 5.71g pulp weight, 26.40 % TSS, 24.25mg/100 vitamin C and6.6.06g/100g carotene.

Karonda

The karonda (*Carissa carandas*), belongs to the family Apocynaceae. It thrives well as a rainfed crop, the plant hardly needs any care and gives yield with minimum management. It is a sprawling semi vine shrub native to India. It is used as live fencing around the orchards besides providing fruits. The fruit is a berry, ellipsoid and pointed or globose or oval or round, 1.8-2.5cm long, green in colour when unripe and turn to red and finally black or dark purple on ripening. It is highly heterozygous, cross-pollinated fruit crop and as such seedlings exhibit a wide range of variations, which aids in the selection of the superior desirable genotypes. Forty genotypes were selected and evaluated at CHES, Godhra. The average fruit weight ranged from 1.87-6.15 g, fruit diameter from 1.41 cm – 2.06 cm, fruit length from 1.71-2.39 cm, pomace weight from 0.36-0.92 g, seed weight from 0.04-0.47 g, pulp weight from 1.29-4.79 g, total soluble solids from 9.15-10.95 per cent, acidity 0.45-1.22 per cent and vitamin C 22.65-38.32 mg/ 100g in different genotypes. With respect to all horticultural traits studied the genotypes, Karonda-1 and Karonda -2 were found to be promising. Konkan Bold recorded maximum fruit weight (14.90g) and TSS (10.10 ^{0} Brix) but fruit yield was 2.5 kg per plant only.

Brief characters of CHESK-2

CHESK-2: It was collected from Chirai Gaon, Varanasi, UP. Peak period of flowering was recorded in the month of March. Peak period of anthesis was recorded from 3-6 pm. Anthers dehisced between 4-7 pm on the same day. It recorded 10.00 kg fruit yield/plant, fruit weight (5.10 g) and TSS (6.10 ^{0} Brix) at the time of maturity.

Cape gooseberry (Makoi)

Capegooseberry (*Physalis peruviana* L.) is a short duration underutilized fruit crop of the family Solanaceae. The fruit is rich sources of Vitamin C, carotene, phosphorus and iron. It is excellent for making jam and sweet pickles. The plant is partially erect attaining a height of 60 cm to 1 m. Flowers are large open bell shaped, long or broader, spreading and light yellow. The berry is dusty yellow. The fruit is tasty, quick growing and can be grown as either pure crop or as inter crop. It is famous for its flavour and having good blending of acid-sugar. The fruits are attractive in colour at maturity and if properly packed can easily be sent to distant markets. Ten promising genotypes were grown under field conditions. Highest plant height was observed in CHESC-1, followed by CHESC-3, CHESC-4. Peak period of flowering and fruit set was recorded in November- December. Peak period of anthesis was noted during morning hours in all the genotypes. Maximum number of fruit per plant was noted in CHESC-1, closely followed by CHESC-4 and CHESC-6. Peak period of ripening was observed in the month of February in different genotypes. TSS was found to maximum in CHESC-1 (18.00%), it was closely followed by CHESC-2 (16.00%). Based on the horticultural traits studied, the genotypes, CHESC-1, CHESC-2, and CHESC-4 were found to be promising. Detailed description of two promising genotypes are as under:

CHESC-1: It was collected from Bihar. It ripens in the month of January- February and recorded 11.50 g fruit weight, 12.00 % TSS, 1.64 % acidity, 7.50 % total sugar and 220.10 mg/100g vitamin C.

CHESC-2: It was also collected from Bihar. It ripens in the month of Januar- February and recorded 10.75 g fruit weight, 11.20 % TSS, 1.70 % acidity, 7.25 % total sugar and 190.22 mg/100g vitamin C.

Propagation techniques standardized for multiplication of elite genotypes of minor fruits

In jamun, highest success through patch budding was noted in March (70-80 %), where as soft wood grafting recorded maximum success in the month of July and August (75-80%). Chovatia and Singh, 2000 recorded 41.67 percent success through soft wood grafting during the month of June under Gujarat conditions.

In tamarind, the highest percentage of budding success was noted in the month of July-August (75-80.00 %). While, soft wood grafting recorded maximum success in the month of May, June,July and August (60-75%). It was concluded that patch budding in the month of July-August and soft wood grafting in the month of April-May may be adopted in the region for multiplication of elite tamarind genotypes(Singh and Singh, 2007).

Soft wood grafting in Khirni(*Manilkara hexandra*), chironji (*Buchanania lanzan* Spreng) and Mahua (*Bassia latifolia*) was standardized under Gujarat conditions. In Khirni, highest percentage of graft success was noted in March (76.66 %) followed by June, July and August, where as it was recorded least in the month of February

(10.00 %). In chironji, highest percentage of graft success was noted in July (66.66 %) followed by August and June. The highest percentage of graft success in Mahua was recorded in the month of March (70.00) closely followed by April, July and August. Naturally defoliated scion sticks of Mahua were found suitable to achieve good success through softwood grafting during the month of March-April. Soft wood grafting during the month of June, July and August may be practiced with 65.00-80.00 per cent success for multiplication wood apple and custard apple genotypes. Lasoda (*Cordia myxa*) may be propagated through Patch budding with 70-80 % success under different agro-climatic conditions. Hardening of grafted plants should also be followed to reduce mortality of the grafts in the field. It may be concluded that most of the under utilized fruits may be multiplied through soft wood grafting and patch budding during the month of July, August, March and April. Hi-Tech glass house may also be used to multiply quality planting materials through out the year.

Conclusion

Minor fruits are the future for horticulture of the 21st century because it offers a variety of potential benefits in profitability, productivity, sustainability, crop quality, food safety, environmental protection and rural economic development. It may be concluded that these fruits have tremendous potential under arid and semi-arid ecosystem of western India and need attention for its exploitation.

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Technical Session 6 : Horticulture for Environment and Society

L-6.1

Green cold chain solution

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Refrigerated transport is necessary for maintaining the quality and prolonging the shell life of fresh, frozen and perishable products during transportation. In the present paper, development and performance evaluation of a refrigeration truck with phase change material is conducted. It will replace the predominant technology used in refrigerated road transport i.e. mechanical compression refrigeration driven by a diesel engine. Phase change material will be charged for the storage of coolness using off-vehicle refrigeration unit powered by electricity and stored coolness has been used to maintain the truck temperature.

Introduction

India is an agricultural-based economy. More than 52 percent of India's land is cultivable, compared to the global average of 11 percent. Each year, India produces 63.5 million tons of fruits and 125.89 million tons of vegetables. India is also the largest producer of milk of quantity 105 million metric tons per year. India produces 6.5 million tons of meat and poultry, as well as 6.1 million tons of fish a year. The perishable products transaction volume is estimated to be around 230 million metric tons. Although India has the potential to become one of the world's major food suppliers, the lack of infrastructure in the cold chain network results in spoilage of almost 40 percent of its total agricultural production. Unlike the agricultural sector which is offered highly subsidized power tariffs by the Government of India, the cold chain industry does not enjoy this status and is instead subjected to industrial power tariffs. This significantly increases the operational cost for cold chain operators and act as a major deterrent for growth. The total value of the cold chain industry is estimated to be as high as USD 3 billion and growing at 20-25 per cent a year.

Today, Indian agricultural sector is witnessing a major shift from traditional farming to horticulture, meat and poultry and dairy products. The demand for fresh, quality and processed fruits and vegetables is increasing as urban populations rise and consumption habits change. Due to this increase in demand, diversification and value addition are the key words in the Indian agriculture today. As a result of the government of India is focusing on food preservation, the cold storage sector is going to make a big role in it.

Cooling and freezing are the most popular forms of food preservation used today. In refrigeration, the idea is to slow bacterial action to a crawl so that it takes food much longer to spoil. In freezing, the idea is to stop bacterial action altogether. Frozen bacteria are completely inactive with the exception of a few which can survive freezing temperatures. Since foods are of plant and animal origin, it is worthwhile to consider the intrinsic and extrinsic parameters of foods that affect microbial growth. The parameters of plant and animal tissues that are an inherent part of the tissues referred to as some key intrinsic parameters are (a) pH (b) moisture content (c) oxidation-reduction potential (d) nutrient content (e) antimicrobial constituents and (f) biological structures.

The extrinsic parameters of foods are the properties of the storage environment that affect both the foods and their microorganisms. They are of greatest importance and are (a) storage temperature (ii) relative humidity of environment (iii) presence of gases in the environment and (iv) concentration of gases in the environment.

Due to the perishable nature of fruits and vegetables, harvesting and handling speed is of utmost importance as soon as harvest maturity has occurred. After harvesting, we aim to extend postharvest shelf life of the perishable products by: Reducing respiration by lowering temperature, slowing respiration by maintaining optimal gaseous environment and slowing water loss by maintaining optimal relative humidity.

Conventional Technology for Refrigerated Transport

Refrigerated transport is necessary for maintaining the quality and prolonging the shell life of fresh, frozen and perishable products during transportation. The product temperature needs to be kept at the point where metabolic and microbial deterioration in minimized. A rigid semi-trailer box normally consists of expanded foam insulation sandwiched between two external skins. Each skin consists of a few millimeters of plywood covered with a glass reinforced polyester, steel or aluminum skin. The most popular insulation is expanded polyurethane (PU) foam. This construction achieves a thermal conductivity in the region of 0.022 W/(m K). Roofs and floors often have 100 mm or more insulation.

At present, the predominant technology in refrigerated road transport is mechanical compression refrigeration driven by a diesel engine. This type of engine is relative expensive, noisy and its efficiency is only 35-40 %. Another drawback of the diesel engine driven refrigeration is its association with greenhouse gas and particulate matter. On the average, a typical refrigerated vehicle will produce approximately 50 tons of CO_2 annually with a fuel consumption of 2 liter/hour per ton of refrigeration cooling capacity. The refrigeration system of refrigerated van is operated by diesel set running on diesel oil to maintain the temperature. In India, power generation is very expensive @ Rs 10-12 per unit of electricity, however, electricity is available during off hours is Rs 2-5 per unit of electricity.

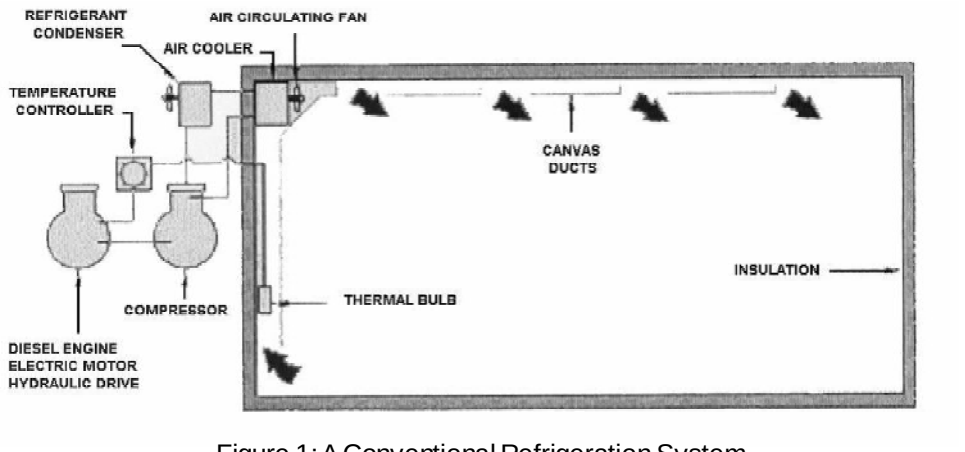

Figure 1: A Conventional Refrigeration System

Green Technology for Refrigerated Truck System

In the present paper, development of a refrigeration truck with phase change material has been developed, it will replace the predominant technology used in refrigerated road transport i.e. mechanical compression refrigeration driven by a diesel engine. A phase change material (PCM) is a substance with high heat of fusion which melts and solidifies at a certain temperature is capable of storing or releasing large amounts of energy per unit mass over a small range of temperature. This property can be used to minimize temperature fluctuations. Phase change material will be charged for the storage of coolness using off-vehicle refrigeration unit powered by off-peak electricity and stored energy will be used to maintain the temperature. The temperature range of interest is -20 °C to +5 °C. The Developed system would help to provide a nearly constant temperature during transportation of cold chain products/temperature sensitive products for 10 – 12 hours without running a chiller on DG sets. Hence, the system would reduce the running cost of a Refrigerated Vehicle.

Selection of Phase Change Material

There can be several criteria for selecting a suitable phase change storage material. Some of the desired properties of PCM are as given below:

- Melting/freezing in the desirable operating range.

- High latent heat of fusion per unit volume so that the required volume of the container to store a given amount of energy is less.
- High specific heat to provide for additional significant sensible heat storage.
- High thermal conductivity of both solid and liquid phases to assist the charging and discharging of energy of the storage system.
- Small volume changes on phase transformation and small vapor pressures at operating temperatures to reduce the containment problem.
- Congruent melting of the phase change material for constant storage capacity of the material with each freezing/melting cycle.
- High nucleation rate to avoid super cooling of the liquid phase.
- High rate of crystal growth, so that the system can meet power demands of heat recovery from the storage system.
- Chemical stability.
- Complete freeze/melt cycle.
- No degradation after a large number of freeze/melt cycle.
- Non-corrosiveness to the container materials.
- Non toxicity, non-flammable and non-explosive materials for safety.

Performance Studies of Refrigerated Van having PCM

To conduct the experiments, a refrigerated van has been retrofitted with phase change material of 0. The size of the refrigerated van was 2m (L) x 1.8m (H) x 1.2m (W). The PUFF insulating material of 100mm thickness was used. Ten closed trays of 1.2m (H) x 0.3m (W) x 0.025 m (D) was used to fill the identified phase change material. The storage capacity of each tray was 3400 kJ. A photo snap of the prototype system is shown in figure 2. The material was charged using a conventional refrigerating system operating at -10. After complete charging of the phase change material, it was allowed to discharge to maintain the temperature. During discharging time, air temperature variation with time of the container was recorded and plotted in figure 3. The temperature was maintained about 6 hours.

Figure 2: Prototype Green Refrigerated System

Figure 3: Container air temperature (y-axis) with time in minutes (x-axis) during the discharging of phase change material

Conclusion

The prototype experimental proved the feasibility of using phase change material to store the coolness and also to maintain the temperature. This technology can find place not only in refrigerated trucks but also in cold storage and milk collection centers in the rural area. If the technology combined with solar energy, it can further provide greener solutions.

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L-6.2

Good agricultural practices for sustainable agriculture

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Agriculture is the mainstay of Indian economy. It feeds the nation and provides raw material for food industry. Growing population is placing increased pressure on resources, which is multiplied as the population grows richer. The global challenge is to cope with depleting natural resources.

Demand for agricultural crops, food, water, energy etc. is expected to double as the world's population reaches 9.1 billion by 2050. Increasing the quantity and quality of food in response to growing demand will require increased agricultural productivity and higher use of resources. It is now at the threshold of taking initiative towards commercialization agriculture. But the big challenge today is balancing economic growth and negative impact on environment. This leads to the emphasis on sustainable agriculture.

Although the green revolution greatly benefited, the country had to pay a heavy price for uncontrolled used of chemical fertilizers, irrigation water and pest control products leading to adverse environment impact, degradation and increased salinity in soil, deforestation and depletion of water resources. There is therefore a need to develop a well thought-out strategy to modify the current agricultural practices to attain a more sustainable agriculture. This is being shaped up through implementation of Good Agricultural Practices (GAP), which provides a structured methodology to harness the new technology without its adverse impact on environment and health and safety of people.

Good Agricultural Practices (GAP) are a collection of principles to apply for on-farm production and post-production processes, resulting in safe and healthy food and non-food agricultural products, while taking into account economical, social and environmental sustainability. They are applied through sustainable agricultural methods, such as integrated pest management, integrated fertilizer management and conservation agriculture. They rely on four principles:

- Economically and efficiently produce sufficient, safe and nutritious food leading to food security, food quality and food safety,
- Sustain and enhance natural resources,
- Maintain viable farming enterprises and contribute to sustainable livelihoods, and
- Meet cultural and social demands of society.

The concept of GAPs has changed in recent years because of a rapidly changing agriculture, globalization of world trade, emerging food borne illness, pollution of water, appearance of pesticide resistance pest and diseases, erosion. This provides the opportunity to assess and decide on which farming practices to follow at each step in the production process. For each agricultural production system, it aims at allowing a comprehensive management strategy, providing for the capability for tactical adjustments in response to changes. The implementation of such a management strategy requires knowing, understanding, planning, measuring, monitoring, and record-keeping at each step of the production process.

Modern management and control methods by introducing standardization, quality control and certification systems help to reap the benefit of Good Agricultural Practices in sustainable agriculture.

This helps in conservation of resources, judicious utilization of resources and maximization of yield, thus making agriculture produce more competitive by exploiting vast fertile land with diverge agro-climatic conditions and availability of labour to boost the returns/export by improving productivity, sustainability, quality and safe produce

Technical Session 7 : Horticultural Crops as Nutraceuticals and Pharmaceuticals

L-7.1

Seed spices: Rich nutraceutical crops

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India is well known as "Land of Spices" across the Globe since time immemorial. We have been cultivating these precious spices for fulfilling our various needs since ages. Our ancestors have been using the spices for adding taste and flavor in edibles and beverages. These have been used in treatment of various ailments, which is evident from our old literature. Seed spices (Coriander, cumin, fennel, fenugreek, ajwain, dill, nigella, anise, celery, caraway) possess many neutrachutical and medicinal properties. They are carminative, appetizer, digestive, stimulant, tonic, spasmolytic, antipyretic, anthelmintic. Cultivation and production seed spices, their trade, marketing and export is remunerative to the stake holders owing to their gradual increasing demand in domestic as well as international markets. By virtue of the important nutraceutical properties and fetching high price in market, seed spices called high value low volume crops. Nowadays people are moving towards naturopathy because they don't want to bear silently the aftermath of allopathic medicines. It is high time for Ayurveda and Unani medicine system to regain its lost glory in the changing scenario of awareness of the people towards natural and herbal products for remedy of different ailments, since these products don't have any side effect. Seed spices can be better alternative as nutraceuticals and pharmaceuticals for common man due to their availability more or less everywhere on the Planet.

Introduction

Nutraceutical, a portmanteau the words "nutrition" and "pharmaceutical", is a food or food product that provides health and medical benefits, including the prevention and treatment of disease. Health Canada defines the term as, "*A nutraceutical is a product isolated or purified from foods that is generally sold in medicinal forms not usually associated with food. A nutraceutical is demonstrated to have a physiological benefit or provide protection against chronic disease*." Such products may range from isolated nutrients, dietary supplements and specific diets to genetically engineered foods, herbal products, and processed foods such as cereals, soups, and beverages. With recent developments in cellular-level nutraceutical agents, researchers, and medical practitioners are developing templates for integrating and assessing information from clinical studies on complementary and alternative therapies into responsible medical practice. The term nutraceutical was originally defined by Dr. Stephen L. DeFelice, founder and chairman of the Foundation of Innovation Medicine (FIM), Crawford, New Jersey. Since the term was coined by Dr. DeFelice, its meaning has been modified by Health Canada which defines nutraceutical as: a product isolated or purified from foods, and generally sold in medicinal forms not usually associated with food and demonstrated to have a physiological benefit or provide protection against chronic disease. Nutraceutical foods are not subject to the same testing and regulations as pharmaceutical drugs.

Seed spices are annual herbs and their leaves and fruits (seed) used as such or in different forms for flavoring, seasoning and making food tasty and tempting. About 20 spices are grown in India and out of them ten seed spices are commonly used. India is the leading nation in . production, consumption and export of seed spices in the world (Lal *et al*., 2012). About 12 Lakh metric tones (2012-13) seed spices are produced from 13.65 Lakh hectare land every year in our country (Anonymous 2013). Rajasthan and Gujarat produce 80% of the total seed spices and other producing states are Madhya Pradesh, Uttar Pradesh, Panjab, Maharastra, West Bengal, Arunachal Pradesh, Karnataka, Tamil Nadu, Bihar etc. Seed spices as mentioned in the Aurveda and Unani literature are important commodities with respect to nutritional, pharmaceutical and medicinal properties are concerned. Besides this, as per the definition given by Health Canada, seed spices are very well fit into the category of nutraceuticals.

Pharmaceutical properties of seed spices

Seed spices are valuable crops due to different type of aroma, taste and flavour. They change flavour and taste of drink or edible food, whenever added to these products. The aroma of seed spices is due to presence of volatile oil and its quantity determines quality and value. Alkaloids present in spices are responsible for pungency, which are different in various seed spices. Now, spices are used in different forms like volatile oil, oleoresins, total oils, beverages, herbal tea, chutney, germinated seeds, mixtures etc. due to development of post-harvest technology. Seed spices have been used in various Unani as well as Ayurvedic medicinal preparations against different diseases since ancient time. The pharmaceutical properties of various seed spices are given in Table 1.

Table 1. Pharmaceutical properties of different seed spices.

Name of spice	Pharmaceutical properties
Ajwain	Digestive, Pungent, Mild stimulant, Stomachic, Carminative, Aphrodisiac & Antiflatulence
Aniseed	Carminative, digestive, mild expectorant, antispasmodic soporific & antiseptic
Caraway	Mild stomachic, carminative, anthelmintic, lactagogue and anti-dermatitis
Celery	Tonic, stimulant, antispasmodic, anti colic, diuretic, carminative & anti-inflammatory
Coriander	Carminative, anti-flatulence, diuretic, stimulant, stomachic, appetiser, refrigerant & tonic antibilious
Cumin	Carminative, diuretic, stimulant, digestive, tonic, appetiser, stomachic & astringent
Dill	Carminative, pain killer, antipyretic & stomachic antiflatulence
Fennel	Digestive, stomachic, carminative, anthelmintic, stimulant & appetiser
Fenugreek	Diuretic, tonic, carminative, aphrodisiac, galactagague, digestive & astringent
Nigella	Carminative, stimulant, diuretic & germicidal

(Meena *et al.*, 2013)

Flavour, taste and colour contributing compound in seed spices

The seed of these spices contain volatile oil, which makes them important and valuable. Seed spices add flavor and taste in the foods. However, the predominant and the most important faction is flavoring and this quality is dependent on the essential oil components in the spices, while the pungency depends on non-volatile components such as alkaloids (Table 2).

Table 2. Flavour, taste and colour contributing compound found in seed spices

Name of spice	Compounds present
Ajwain	Thymol, Carvacrol
Aniseed	Anethole, Methyl Chaviciol, Anisaldehyde, limonene.
Caraway	D-Carvone, Limonene.
Celery	Limonene, Selenene, Sesquterpene Alcohol.
Coriander	Linalool, Alpha and Beta pinene, Para Cymene, Alpha terpenene.
Cumin	Cuminaldehyde, Beta pinene, Alpha terpenene, Paracymene, P- Mentha-1, 3-dien-7-al.
Dill	Carvone, Alpha pinene, Limonene, Phellandrene.
Fennel	Anethole, Limonene, Fenchone, Alphapinne, Camphene.
Fenugreek	Trigonellin
Nigella	Nigellone

(Singh *et al.*, 2007)

Nutritional value of seed spices

Besides adding test and flavor in the foods, seed spices also add some nutritive value. Various nutrients viz., carbohydrates, proteins, fats, mineral matter, vitamins are present in seed spices in different proportions (Table 3).

Table 3. Nutritional value of different seed spices (g/100g).

Spices	Carbohydrate	Protein	Fat	Mineral matter	Moisture
Ajwain	24.6	17.1	-	7.9	7.4
Aniseed	50.0	17.6	15.9	7.0	9.5
Caraway	49.0	19.8	14.6	5.9	9.9
Celery	40.9	18.1	22.0	10.2	5.1
Coriander	24.0	1.3	19.6	5.3	6.3
Cumin	35.7	17.7	23.8	7.7	6.2
Dill	35.7	13.1	17.9	6.0	6.3
Fennel	42.3	9.5	10.0	13.4	6.3
Fenugreek	44.1	26.2	5.8	3.0	13.7
Nigella	17.0	22.0	41.0	4.5	4.0

(Singh *et al.*, 2007)

Uses of different seed spices as home remedies in various ailments

Ajwain

Ajwain or bishop's weed, a valuable Ayurvedic ingredient cultivated mainly in Rajasthan and Andra Pradesh but at small scale in all the states of India and also in Iran, Egypt and Afghanistan. It is a small, erect, annual shrub with soft fine hairs. It has many branches of leafy stems, small feather like leaves, and 4 to 12 rays of flower heads, each bearing 6 to 16 flowers. The fruits are minute, egg shaped and grayish. Its seeds are pungent and bitter, spasmodic, germicidal, antiseptic, digestive, antipyretic, expectorant and an extra ordinary tonic (Lal *et al.*, 2012). Ajowain seeds consist of moisture, protein, fat, minerals, fiber, carbohydrates, calcium, phosphorus, iron, carotene, thiamin, riboflavin and niacin. Ajwain essential oil valued considerably in medicine on account of the presence of thymol. For a long time this oil was the main source of thymol. Some very valuable Ayurvedic medicines are prepared from Ajowain seeds. Ajowain relieving flatulence, dyspepsia and spasmodic disorders, the seeds may be eaten with betel leaves. A teaspoon of ajwain with a little rock salt is a household remedy for indigestion. Ajwain oil given in doses of 1 to 3 drops is useful in cholera, flatulent, colic, diarrhea, dyspepsia and indigestion (Singh *et al.*, 2007). Ajwain water is given in doses of 30 to 60 grams to check vomiting in early stages of cholera.

Ajwain seeds have long been used in traditional Ayurvedic and Unani medicines for various ailments. According to Ayurveda, it is digestive, tasty, pungent, light and bitter. It is useful in flatulence, colic, diarrhea, indigestion, cholera, hysteria and dyspepsia. It is a remedy for different diseases and more popular prescriptions are *Jeevan Rakshak Sudha* and *Agnivardhak Churna*. *Agnivardhak Churna* is used in constipation, indigestion, bilious and chronic diarrhoea diseases where as *Jeevan Rakshak Sudha* is used for massage in headache, chest and waist pain. Ajwain seed oil has the highest percentage of thymol. Thymol's germicide and antiseptic properties can be employed in the preparation of cough remedies and the seeds' decoction often used to ease asthma.

Some therapeutic uses are

1. Ajwain seeds soaked in water for a night and its water is taken next morning. This helps in stomach diseases as it cures digestion and acute dyspepsia.
2. Dry roast one teaspoon of ajwain seeds and cumin seeds. Add to it one cup of water and bring it to boil and strain it. Add some sugar and take one teaspoon as a remedy for indigestion and acidity.
3. *Sat ajwain, sat piperment* and camphor is used in cholera.
4. Teaspoonful of seeds with a little salt is a common domestic remedy for indigestion, flatulence and low appetite.
5. For stomachache, cough and indigestion, seeds are masticated and swallowed, followed by a glass of water.
6. Taking ajwain powder with jaggery after delivery for a few days relives back-ache, cleans the uterus, stimulates digestion, increases appetite and gives strength.
7. To instantly stop hiccups, ajwain seeds are taken with one or two sips water. Prepare ajwain water by boiling one teaspoon ajwain powder with little salt in water. Gargling with lukewarm of this water gives relief from throat pain.
8. Ajwain fumes are also inhaled to cure toothache, which is caused by decaying tooth. Decoction of ajwain is useful against hook worm and teeth pain.
9. Ajwain seeds are taken regularly with vinegar or honey for a week. This remedy removes kidney stone with the urinal flow.
10. In some regions, ajwain seeds are taken during pregnancy. The seeds are taken with jaggery as it is believed that it purifies the blood and reduces lumbago.
11. In traditional Vedic medicine, paste of ajwain seeds is mentioned as a remedy for venomous insect bite such as scorpion bite, as it has pain killing properties.

Anise

Anise, also known as aniseed (*Pimpinella anisum*), has been used for centuries to treat a wide range of

diseases. It is used to treat coughs, pectoral affections (Saxena *et al.*, 2014) bronchitis, gastric gas, ulcers of the digestive tract, nausea and even the hiccups. Anise is also known to promote lactation and can be used as a breath freshener. The active ingredients of aniseed include volatile oils, coumarins, falconoid glycosides and phenylpropanoids. These have a strong peppery-thyme flavor. It is very popular in North Indian cooking. It is used in preparing many Indian vegetables and pulses. Modern research has found scientific proof supporting the anti-microbial, anti-oxidant, anti-fungal (Acta Pharm. 55 (2005) 377–385) and gastro protective potential of *Pimpinella anisum*. Anise is considered to be a very safe herb to use, even for very small children. It may be advisable to avoid consuming anise in large dosages if pregnant. Its ability to decrease bloating and settle the digestive tract still is used today, especially in pediatrics. In high doses, it is used as an antispasmodic and an antiseptic and for the treatment of cough, asthma, and bronchitis. It is carminative and helps in digestion along with correcting foul breath of mouth. It works as mild expectorant and always used in cough mixtures and lozenges.

Some therapeutic uses are

1. Anise is an ideal medicine for expelling wind from the stomach.
2. It possesses antibacterial, antispasmodic and soporific properties.
3. Gripe water for infants also contains anise extract.
4. It can also be used as herbal tea. One teaspoon of anise seeds can be added to two cups of boiling water. Let it simmer for two or three minutes, add a bit of honey or sugar and enjoy.

Caraway

Caraway (*Carum carvi* L.) is native to Europe, western Asia and northern Africa where people have been using it as a spice for thousands of years. Europe continues to be the largest producer and exporter of caraway seed. Caraway seed has a spicy flavour. Licorice-flavoured caraway seeds give rye bread its characteristic taste. The seeds are also used in soups, cheeses and cheese spreads, sauerkraut and salad dressings. Liqueurs, such as Kummel and some Schnapps, use caraway seed for their unique flavour. Caraway seeds are also high in protein and fat. The seeds and their oils also have a long history of use as herbal and household remedies for treating disorders such as rheumatism, eye infections, toothaches and digestive complaints. The seed and teas made from the seed have an anti-spasmodic action, which soothes the digestive tract and its carminative (gas relieving) action relieves bloating caused by wind and improves the appetite. Caraway is often added to laxative medicines to prevent gastric and intestinal pain. Caraway is one of the most effective of all carminative herbs and the seeds have excellent carminative as well as stomachic properties, while the oil has spasmolytic and antimicrobial activity.

Some therapeutic uses are

1. Caraway is used to aid the digestion and is recommended for indigestion, gas and infant colic since time immemorial.
2. Antispasmodics, which are present in caraway are thought to relax the uterus and may provide relief from menstrual cramps.
3. Breastfeeding mothers take it to produce more milk and it is also used for hiatus hernia, stomach ulcers, diarrhea and bronchitis and is added to laxative medication to prevent griping.
4. The chewing of caraway seeds is a popular way of aiding digestion after a meal.
5. It is mild stomachic and carminative and gives relief from flatulence. It is useful in stomachache, indigestion, diarrhoea, chronic fever etc.
6. Mix one spoon caraway seed powder and a cup curd and take it twice a day for curing stomach problems.
7. It is also used as a gargle for laryngitis.
8. Its oil contains carvone which is used to kill worms of intestine particularly hookworm.

Celery

Celery (*Apium graveolens* var. dulce) is a plant variety in the family Apiaceae, commonly used as a vegetable salad. Celery is considered as tonic, stimulant, diuretic, carminative etc. Its use helps in digestion and also cures flatulence and other stomach troubles. The use of celery seed in pills for relieving pain was described by Aulus Cornelius Celsius around AD 30. Celery seeds contain a compound, 3-n-butylphthalide, that has been demonstrated to lower blood pressure in rats. Bergapten in the seeds can increase photosensitivity, so the use of essential oil externally in bright sunshine should be avoided. The oil and large doses of seeds should be avoided during pregnancy, as they can act as a uterine stimulant. Celery is a healthy medicinal food, often used to reduce the need for salt in cooking. The seeds contain aliening and isoquerticin compounds that help blood vessels to expand, lowering blood pressure. A natural diuretic, celery can reduce excess water buildup and decrease the uric acid that causes pain and inflammation in gout and arthritis. Celery is used in weight-loss diets, where it provides low-calorie dietary fiber bulk. Celery is often incorrectly thought to be a “negative-calorie food,” the digestion of which burns more calories than the body can obtain. In fact, eating celery provides positive net calories, with digestion only consuming a small proportion of the calories taken in. **Some therapeutic uses are:**

1. Celery seeds and rock salt should be taken with warm water in stomachache and other stomach related troubles.
2. Its use in morning and evening with water is useful in chronic fever, cold etc.
3. Celery has antispasmodic properties and is useful in treatment of asthma, bronchitis, pleurisy and tuberculosis.
4. It is useful in diseases related to urine bladder, stomach and respiration pain.

Coriander

Coriander (*Coriandrum sativum* L.) belongs to family Umbelliferae is used as common flavoring substance. Mainly used for its fresh, soothing and cooling taste, coriander seeds are very light weight and have a mild flavor. Coriander is a pleasantly sweet spice with a lemony top note. It is commonly used in chili and curry dishes. Coriander seed is used as a whole spice and in a powdered form. The aromatic fragrance of the roasted coriander powder enhances the taste of any dish. Coriander herb is widely available fresh in local market. It is also available as ground, frozen or preserved fresh in jars in super markets. Its oleoresin is used for flavouring beverages, pickels, sweets and sausages (Lal *et al.*, 2010). Coriander seed decoction is used in sore throat, common cold and bilious complaints. Decoction may also be used in eye wash and in chronic conjunctivitis (Lal *et al*., 2012). Seeds are chewed to remove foul breath and used as a purgative and roasted seeds are useful in dyspepsia. The juice of fresh plant is applied to erythematic. The leaves are carminative, antibilious, diuretics, tonic, stomachic and aphrodisiac. The paste of seeds is applied to relieve pain in cephalgia. Its seeds are used in different medicines to cure diseases related to indigestion, cold, dysentery, vomiting and urine. It is mainly anti colic, carminative, diuretic and stimulant. Coriander essential oil is carminative, antiseptic, bactericidal, fungicidal and muscle relaxant. Its volatile oil is used to mask the bad smell of different allopathic medicines. Coriander has been used for medicine for thousands of years (Mathias, 1994) and its seeds have health supporting reputation (Saxena *et al.*, 2014).

Some therapeutic uses are

1. To get relief from sunstroke, wet and squeeze coriander herb in water and add sugar candy and give it to the affected person.
2. Coriander has an eroticizing effect due to its estrogen content and is also useful in rheumatism, neurologic conditions.
3. Prepare decoction of coriander, dry ginger, sugar candy, *nagarmotha* in water and administered to pregnant woman or other patients to stop vomiting immediately.
4. Cold decoction of coriander with sugar candy and honey is administered to provide relief from burning sensation of fever and thirst.
5. Coriander leaves mixed with juice of apple, milk and *multani mitti* tones skin during summer.

Cumin

Cumin (*Cuminum cyminum*) is a widely used spice in Indian cuisines and known for its warm earthy aroma. Cumin is also associated with Mexican and Spanish foods and widely used in Middle Eastern cooking. It has a very distinct flavor and in the US is most often used in packaged taco seasonings. Cumin's flavor makes it a favorite for many, but it's health supporting properties are impressive too. It is used in the raw form or roasted in hot oil or ghee to release its aroma. Sometimes the raw seeds are ground and sometimes the seeds are briefly roasted in the skillet and ground into a powder. The roasted and fried cumin seeds impart a very unique, smoky flavor to food. It is known for its actions like enhancing appetite, taste perception, digestion, vision, strength, and lactation. It is used to treat diseases like fever, loss of appetite, diarrhea, vomiting, abdominal distension, edema and puerperal disorders. Cumin possesses many medicinal properties due to which it is used in domestic as well as Ayurvedic medicines. It is mainly carminative, stomachic and diuretic. A decoction of cumin mixed with milk and honey, taken once daily during entire period of pregnancy helps the healthy development of the foetus, eases child birth and increases the secretion of breast milk (Lal *et al.*, 2012).

Some therapeutic uses are

1. Cumin powder with old jaggary is used to improve appetite. It cleans urine and also gives relief from burning inside the stomach.
2. Cumin with curd is given in diarrhea.
3. Cumin mixed with sugar candy and decant of rice is useful in leucorrhoea.
4. Taking cumin powder with juice of bitter gourd gives relief in malaria disease.
5. *Jaljeera,* prepared of cumin, is a very popular drink in the summer used for quenching thirst.
6. Use of one teaspoon cumin powder and black pepper powder each, with honey eliminates pain and cures piles. Gargling with cumin water eliminates hoarseness of throat.
7. Prepare paste by grinding equal parts of cumin, aonla and cotton leaves are apply this paste on the head for 21 days for getting relief from night blindness.
8. Cumin is essentially consumed by that woman who is having less milk secretion just after delivery as it promotes milk secretion.

Dill

Dill (*Anethum graveolens*) is an annual herb belongs to family Apiaceae. Dill seed's most common use in the United States, is to flavor cucumber pickles. Use 2-3 teaspoons per quart for dill pickles. These seeds are also used in Scandinavian cooking to flavor bread, potatoes, vegetables, sauerkraut. For German pork roast, use 1 teaspoon per pound of meat. Dill is one of the earliest cultivated herbs, showing up in Neolithic burial sites, Greek and Roman ruins, and even the tomb of Amenhotep II. It has a reputation for relieving digestive troubles - in the 8th century Charlemagne offered vials of dill seeds at banquets to relieve hiccups. Dill fresh herb is generally sold in the market and frozen or freeze- dried in the supermarket. Dill weed is a unique perennial herbal plant in the sense that both its leaves as well as seeds are used as a seasoning. Oil extracted from seed is used in various medicines.

Some therapeutic uses are

1. Dill is used to soothe the digestive tract and treats heartburn.
2. Patient suffering from jaundice should take to get desirable progeny. Even sterile woman can conceive by using this preparation.
3. Powder of fresh dill seed with ghee is taken to get desirable progeny. Even sterile woman may conceive by using this preparation.
4. Decoction of dill is used in indigestion, vomiting and promoting milk in delivered woman.

5. Its oil is uses in preparation of dill (gripe) water, which is administered to children suffering from bloat, stomachache and hiccups.

Fennel

Fennel (*Foeniculum vulgare* L.) belongs to family Apiaceae and its plants were found growing wild in the central Mediterranean region. It is mainly used in North Indian cuisine and posses digestive qualities. Anyone can have the fennel grains coated with colored sugar and offered after meals as a mouth freshener especially in Indian restaurants. Fennel green herb is generally used as flavorings, either incorporated in dishes or sprinkled on food prior to serving. The dried herb is of inferior quality but freeze-dried or frozen leaves are superior. Fennel seeds are also often used to spice up teas and drinks including alcoholic beverages. It is also used as gripe water given to colicky infants. It is used to relieve bronchial spasms because of its antispasmodic properties. It targets the smooth muscles of the respiratory system, stomach muscles and intestines. Herbalists have used it for centuries to induce milk production in nursing mothers. Fennel is used in diseases like cholera, biliousness, dysentery, diarrhoea, cough, cold, constipation and also for those diseases, which affect chest, lungs and kidneys. Fennel volatile oil relieves abdominal air, stomach pain and bloating, stimulates appetite. It is diuretic and anti-inflammatory (Mehta *et al.*, 2009). Chinese, Indians and Egyptians use fennel seed as a remedy for snake bites and scorpion stings. Its essential oil is having estrogen stimulation properties (Lal *et al.*, 2012).

Some therapeutic uses are

1. Fennel and its oil both are stimulant, aromatic and stop flatulence.
2. It possesses both digestive and carminative properties.
3. It is a good anthelmintic and vermicide against hookworm.
4. In cough, it is used with sugar candy to get relief.
5. Fennel decoction is given to woman for blood purification and uterus cleaning.

Fenugreek

Fenugreek (*Trigonella foenum graecum* L.) belonging to family Fabaceae, commonly known as *Methi* in Hindi. It is one of the plants used both as herb (the leaves) and as a spice (the seed). A native to India and southern Europe, this plant is cultivated worldwide as a semi-arid temperate crop. The dried leaves of Kasuri Methi (*Trigonella corniculata*) have a bitter taste and a strong characteristic smell and are used as a flavorings agent in preparing many dishes, especially curry. For centuries, it has grown wild in India, the Mediterranean and North Africa. It is also used in preparing different traditional and Ayurvedic medicines. It has many medicinal properties like diuretic, tonic, carminative and aphrodisiac. Different products made by fenugreek leaves and seeds are used at large by diabetic patients as it is having anti-diabetic properties. Raghuram *et al*. (1994) reported that fenugreek improves peripheral glucose utilization. It is also known to have galactagogue properties and thus Indian women consume the seeds for its power to promote lactation (Lal *et al.*, 2012).

Some therapeutic uses are

1. Fenugreek is traditionally used to stimulate the metabolism and to help control blood sugar level in cases of diabetes.
2. Germinated seeds are useful in diabetes and also in fever.
3. Fenugreek seeds ground into paste and one teaspoon of the same in lukewarm water taken internally at early morning is helpful in *vata* diseases, especially in joint pain, back pain etc.
4. Some special dishes prepared from fenugreek are very beneficial in increasing appetite, regulating digestive system and giving relief from joint pain particularly common in old people.
5. In leucorrhoea, 3-6g of fenugreek powder and 6-12 g of sugar candy with 50-100 ml of fresh cow milk should be taken twice daily.

6. Boil the seeds and prepare a paste, mix honey and take it twice a day for one month to treat asthma.
7. Its seeds are also used as substitute to cod liver oil.

Nigella

Nigella (*Nigella sativa* L.) has been used for healthcare since civilization. It is also known as black seeds, fennel flower, Roman coriander and locally as Kalonji. It is the member of the Ranunculaceae or buttercup family. It is an annual herbaceous plant, believed to be indigenous to the Mediterranean region but has been cultivated into other parts of the world including Asia and Africa. It helps in the regulation of immune system and is excellent for treating chronic allergies, improve digestion and lowers blood sugar levels. It is carminative, stimulant and diuretic. Its use is also beneficial during mild delivery fever, skin blisters and Scorpion sting.

Some therapeutic uses are

1. Its paste is used to apply on swelling in hand and legs. This reduces the swelling and gives relief.
2. Its use increases appetite and corrects digestion.
3. It has antibacterial properties. Its oil contains nigellone which is used in cough and asthma.
4. Decoction of nigella with rock salt is given for relief in dyspepsia and stomachache.

Conclusion

The seed spices are helpful in curing various diseases/ailments apart from spreading aroma, flavour and taste. There is a need to focus research on these aspects so that these spices could be widely utilized as a good source for different neutrachutical preparations. Though, India is a leading country in the area and production of these important high value crops, the productivity is still very less (<880 kg/ha). These are very less input loving crops, hence some area of waste and marginal lands can be brought under their cultivation. It can be said that, there is tremendous scope for increased production of seed spices by introducing them in new areas. The higher productivity can be achieved through development of high yielding varieties, area specific production management techniques, biotic and a-biotic stress management. More production will lead the increased availability of these nutritionally, pharmaceutically and medicinally valuable crops for common man in his proximity.

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Technical Session 8 : Entrepreneurship for Farmers, Self Employment and IPR

L-8.1

Horticulture technologies for commercialization and entrepreneurship

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Entrepreneurship for farmers, self employed and IPR

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In last five decades, food and agribusiness value chain across the countries is becoming very complex. On global stage, we are moving away from a linear producer driven value chain to multi stakeholders driven complex value chain. In this emerging value chain, stakeholders and value chain functionaries are interwoven in a cobweb of network. Peculiarity of this value chain is that here primary producer slowly but continuouslylost primacy in agribusiness value chain. As a natural consequence of this, primary producer is no longer a critical player in value creation and value capture in food and agribusiness value chain. Operations and execution of business strategies by these numerous stakeholders also create complex business decision making environment and situations. These complex situations then need creative and innovative solutions at different levels of value chain. These solutions also necessitate need for entrepreneurship at different levels of agribusiness chain. Such business environment also create strong need for a different skill set across stakeholders through which intellectual property rights of their creative ideas and solutions can be protected.

Present paper try to explore these issues.

Technical Session 9 : Innovative Technologies in Horticulture and Farmers Interaction Session

L-9.1

Indigenous technologies: A ray of hope for sustainable horticulture

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Indiscriminate use of agro-chemicals and water over 5-6 decades, have adversely affected soil fertility, crop productivity, produce quality and particularly the environment in many parts of the world. With this, we have contaminated all the five sources of energy i.e. *Pancha Mahabhta's* (land, water, air, fire and cosmos) due to our greed. Now these, are not capable of giving their free energy thereby humanity is facing crises in every sphere of life. Now country is at cross road, and trying for few new techniques such promotion of genetically engineered seeds and organisms, development of complex fertilizers and new molecules for pest, disease management of weeds. On deep insight, it is apparent that plants grow under the influence of light and warmth and theseenergies are transformed intobiologically active energies by the way of photosynthesis through green parts of plant. It is obvious that polluted air loaded with breakdown of products of industrial and city combustion, gasoline, oil fumes, sulfuric acid and many others are detrimental to plant growth, soil, water and environment. On close observations, it appears that the new concepts in the pipeline are going to deteriorate the situations of agriculture.

In recent decades major emphasis is given for commercial exploitation of horticultural commodities. The main reasons for this sifts of mind are i) high productivity per unit area, ii nutritional security, iii) employment security iv) better possibility of export of few select commodities. But on close observation, now it is well proven that human health is at threat owing to consumption of chemically loaded vegetables and fruits. It is matter of common experience that most of the fruits, few vegetables are eaten in fresh condition, and there consumption is causing lot of health hazards. It is paradox to record that sometimes pesticides are sprayed in the evening and vegetables are brought to market in early morning.For this one should look what's on in your platter. Cypermethrin, heptachlor, quinolphos, aldrin, chlorodane, dichlorovas –these are banned pesticides could well be part of our diet. Vegetables such as okra, leafy green vegetables such as cabbage and other vegetables and fruits like bananas, oranges and apple that we so relish may be overloaded with some of these harmful pesticides. Brinjal tops with the level of banned pesticides 860 % above legal limits followed by cauliflower and cabbage.

Lead talk delivered in International Symposium on "Innovations in Horticulture for Nutritional Security, Conserving Bio diversity & Poverty Elevation" organized at BBA, University, Lucknow October, 2014.

Lesson learnt from Conventional Agriculture

- Great burden to government to manage agro chemicals;
- Farming community to use it as per need of crop;
- Consumers has to pay more and ill effects on human health;
- Society is to face climatic disasters and deterioration in human values;
- This calls for rampant change in farming system approach and our mind set;
- As viable alternative we propose Homa Jaivik Krishi. Pathak

With our close observation of one and half decade on organic farming, we are firm view that indigenous technologies, still provides an opportunity to assure sustainable production without use ofany agrochemicals and

can resolve many crises being faced by humanity as on today. The technology being promoted by us is known as "Homa Jaivik Krishi". It is principally based on enhancing rhizosphere and biosphere simultaneously. Field experiences on wide range of the crops will be presented while delivering the talk.

Sustainable Agriculture

"Sustainable Agriculture' pertains with management of resources for agriculture to satisfy human needs along with its conservation, without any deterioration and enhancing environmental quality".

"Natural resources are free gift of nature to humanity, we are simply custodian, hence it is imperative on our part to handover these to coming generation in improved conditions". Pathak

In fact, the Indian Farming Systemhad been a sustainable way of life for thousands of years. It was based on" *Jiwa Jivasya Jivinam"*, meaning thereby life sustains life. In fact creation of biodiversity of flora and fauna was the key component jointly promoted and preserved by the village communities hence they cherished quality of life for centuries. We are of the view that with little support and human involvement we can assure sustainable production and can ensures "Ever Green Revolution" even at this juncture. On this background, we tried to reorient the established techniques of "Organic Farming" which have potential in meeting the present day challenges and ray of hope for sustainable agriculture.

In country like India, where solar energy is available in plenty for almost, 300 days in a year, harnessing solar energy could be sustainable and viable options for meeting the energy need at planet earth. During our involvement for more a decade we conceived acheap and effective technique of harnessing the solar energy. The technology is capable of enhancing all five sources of energy and thus quality of life at planet earth.With some literature and skill up gradation every farmer can be active partner for this noble job.

Steps for harnessing solar energy: Through Homa Jaivik Krishi

- Promoting Farming System Approach;
- Encouraging massive plantation for greening of organic village;
- Integration of legumes in the cropping system;
- Integration of indigenous cows with hump and use of her products in farming;
- Adopting use of agriculture calendar for various farm activities;
- Enhancing biological quality of soil by enhancing humus to harness & retain the energy;
- Integration of Homa Organic Farming known to heal the ailing environment.

Homa Jaivik Krishi, pertains with use of agriculture calendar for different crop activities, encouraging massive plantation including green manures, cover crops, auro green crops, thereby greening of area, mulching, creation of water bodies for harvesting rain water, treatment of seeds/seedlings, integration with cows and use of her products thereby enhancing biological quality of soil to enhance humus content thus the rhizosphere and its further integration with Homa Organic Farming an effective tool to enhance biosphere.

Cow is as pecial creature on planet earth**.** She lives on left over material byhuman consumption (straw, bran, oil cakes) and converts these to valuable products for agriculture and human health. All the five products of cow i.e. dung, urine, milk, curd, butter milk and ghee are of immense use in agriculture and human health. It is pertinent to record that in all the Organic Farming Systems, prevalent in the country, cow is integral component. One cow can manage up to 4-5 ha of organic area. Scientists at NBRI have isolated three promising strains from cow milk while cow dung has been found to be rich in *Actinomycetes* effective for management of gummosis and other diseases in fruits like mango, while urine and butter milk are used for preparation of composts, bio- enhancers and bio-pesticides.

Bio enhancer is almost new concept in agriculture which needs to be researched out and promoted by the organic farmer. Basically these are prepared with cow dung and cow urine, but for enhancing their efficacy, materials such as milk, ghee, curd, virgin soil, vermi compost, Agnihotra ash etc are mixed and these are incubated over specific duration. The common bio enhancers in use are BD-500, BD-501, Cow Pat Pit, Amrit Pani, Bijamrita,

Jiwamrita, Panchagavya, Agnihotra ash, Biosol etc;. It is interesting to record that all the organic farming system use one or other bio enhancer. It is interesting to record that these are potent source of all macro, micro nutrients, PGPR activities, immunity enhancer and used in many ways to enhance soil fertility and crop productivity. Since, bio enhancers are used in limited quantity; hence there is need of *in situ* management of organic matter which can be recycled with use of any bio enhancer as per convenience of the organic farmer. Recycling of crop residues, growing of auro green crops, green manures all are helpful in enhancing fauna and flora in a given area, thus improvement in soil fertility and environmental quality.

Homa Organic Farming

Agnihotra is a gift to humanity from ancient- most Vedic Sciences of bio energy, medicine, agriculture and climate engineering. It is based on principle that "you heal the atmosphere and healed atmosphere will heal every one". Agnihotra is science of Pyramid logy, biorhythm of nature, burning of organic substances and sonic power of chanting specific mantras.When Agnihotra is performed, the Agnihotra smoke gathers practices of harmful radiation from the atmosphere and on very subtle level neutralizes their radioactive effect. Nothing is destroyed, merely changed from one form to another.When Agnihotra fire is burnt there is not just energy from the fire, but subtle energies are generated or thrust into the atmosphere by fire and as result the environment is full of subtle energies. These energies are captured by Agnihotrasmoke from the atmosphere and gets stored in the ash. In fact much healing energy emanates from the Agnihotra pyramid which acts as turbine.

In fact there are two basic energy systems in the physical world: heat and sound. In performing Agnihotra, both i.e. heat from Agnihotra fire and sounds from chanting of Vedic Mantras are blended to achieve the desired physical, psychological and spiritual benefits. The purpose of Agnihotra is not to burn the substances that are added in the form of oblations, rather it is to vaporize them. Thus they diffuse into the surrounding air and transform the air quality.

Narang, 2005.

Effect of Agnihotra

Agnihotra has the ability to neutralize pathogenic bacteria in the atmosphere, pollution in the soil and water. With regular performance of Agnihotra acidic soil with pH of 4.4 was brought normal soil of 7.2 in Poland and highly brackish water with 9.5 in Australia recovered to normal ground water suitable for human use and agriculture. In fact plants receive nutrition from Agnihotra atmosphere, become happy and grow well.The sun brings and takes the energy, which makes all conditions conductive to an anti pollution change. Agnihotra ash is powerful tool to farmers. It is used for seed storage, treatment of seed/plants, better establishment of the plant, encouraging plant vigour and management of pests and diseases. A special bio formulation known as Biosol is prepared from Agnihotra ash and few other ingredients in Agnihotra atmosphere. It is one of the most potent bio enhancer, so for we have noticed. Impact of Agnihotra can be summarized as:

Benefits:

- Rejuvenation of all kind of soils (acidic, saline, barren)
- Prevention, control eradication of plagues and diseases in all crops with short and long vegetative cycles.
  - Cereals like rice, corn, wheat, millets etc;
  - Vegetables like tomato, onion, cabbage, cucumber, cauliflower, beans, potato
  - Fruits like banana , papaya, mango, orange, lemon, pineapple, apple, pomegranate, guava etc;
  - Nuts like peanut, walnut, cashew nut, coconut;
  - Coffee, cocoa, cotton, etc.
  - Forest trees and pastures;
  - Water bodies.

- PasturesCrops become superior in quantity, taste, texture, colour and dieses resistance.
- Homa Therapy controls and eradicates weeds.
- Homa Technology is cheap and no agrochemicals are required.
- Homa improves the health of cattle and no vaccinations are required. Homa Therapy improves quality and quantity of milk.
- Earthworms and honeybees are beneficially affected by Homa and they produce more.
- Now it is necessary to establish Homa seed banks and Homa farms to survive.

It is pertinent to record that Homa Organic techniques can be integrated with any organic farming systems to accelerate its implication. It is equally effective for all crops, all conditions including animals and human being. With establishment of Resonance point, it can manage up to 60 hectares area with almost same human efforts. If adopted with organic mind set, it can ensure high productivity, excellent produce quality, continuous improvement in soil fertility, water quality its availability and environment in the given area. As on today, Homa Organic Farming is practiced in around 71 countries in all the continents. However, systematic research and extension efforts are required to generate scientific information, so that it provides confidence to policy makers and farmers that indigenous technologies are still relevant to address many issues associated with sustainability in agriculture.

We the members of Five Fold Mission would like to share our international experiences to any individuals, organizations and request scientific community let us see strength of “Indigenous technologies in mitigating the current crises being faced by humanity as on today.

Field experiences with respect to soil fertility, crop productivity with few select horticultural crops will be discussed while delivering the talk.

L-9.2

Impact of homa organic farming in mitigating soil, water and environmental crises

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Plant Kingdom is part of Nature.

Therefore Agriculture is totally depending on Nature.

Now Nature is more and more getting out of order. Pollution of the atmosphere, the soil, and water resources as well as erratic weather patterns create an imbalance in Nature and farmers suffer because of that.

Homa Therapy brings Nature back to balance.

Homa Therapy with Agnihotra as its basic tool has wide-reaching beneficial effects on our whole environment, means on our atmosphere, on the soil, and on our water resources, and also biodiversity is increased.

1) Atmosphere

In this process of Agnihotra medicinal substances (like cowdung, ghee) are burnt in a copper vessel of precisely prescribed size and shape along with certain mantras (vibrations) at certain times (tuned to the basic biorhythm of sunrise/sunset). Cowdung is known for disinfectant properties.

When we burn the cowdung, this disinfectant effect goes to the atmosphere and the atmosphere is disinfected, purified.

a) Experiments done with Agnihotra showed that indoor microbial pollution is greatly reduced. Regular practise of Agnihotra controls pathogenic bacteria in an area.

b) The concentration of negative ions is an important indicator of atmospheric pollution: The more negative ions in the air, the less pollution.

Normally smoke particles are charged positive. This can be easily tested if we blow cigarette smoke towards an instrument measuring the electric charge of the air. It will show that the concentration of negative ions is getting less.

But if you perform Agnihotra and place the same device above the pyramid, the smoke of the Agnihotra fire shows a higher content of negative ions.

Agnihotra is thus purifying the air in an area around the pyramid.

2) Soil

Reports show that

a) Acidic soil was brought back to normal on a Homa Farm in Poland. Soil with a pH of 4.4 was brought back to normal by organic farming methods like composting and mulching and Homa Therapy including the use of Agnihotra ash.

b) High salinity in soil could be brought back to normal by Homa atmosphere and by adding some Agnihotra ash.

As there are large areas in India of previously fertile land which now are lying barren because of high salinity Homa Therapy could give a solution to a big problem.

c) Water solubility of phosphorus will be increased by adding Agnihotra ash to the soil. This has been shown in institutes both in U.S. as well as recently in Germany.

d) Aeration of the soil is increased by Agnihotra.

e) Moisture holding capacity of soil is increased in Homa atmosphere.

3) Water resources

a) Several reports show that by performing Agnihotra and putting Agnihotra ash in a the well, the water quality improves considerably. Non-potable water became good drinking water – in one case the pH came down from 9.5 to 7.2, and the salinity from 1150 ppm to 720 ppm (report from Australia).

On one farm in Austria officials closed one well as the water was not even good enough for the aninmals to drink. With Homa and putting Agnihotra ash to the well after only two months another inspection was done and they found out now it was good quality drinking water.

b) A simple experiment shows that if you put Agnihotra ash in a container with putrid water within a few days the water becomes clear again.

c) One experiment done in a Polish institute for Environmental Biology showed that by adding Agnihotra ash to water with some decomposing plant matter the beneficial microorganisms grew much better than in control environment.

d) Even without putting Agnihotra ash you can purify water by just keeping it in a closed glass bottle nearby the Agnihotra fire. This experiment has been well documented.

4) Radioactivity

The ancient Vedic Knowledge states that radioactivity can be neutralized by Agnihotra and Agnihotra ash.

This statement sounds quite extraordinary or even incredible as there is no technique known to modern science to reduce radioactivity. You cannot change the half life of radioactive elements.

But experience shows that with Homa methods this is possible:

We have the report of one Homa Farm in Austria on which there was no increased radioactivity neither in the milk nor in vegetables after Chernobyl - although on all surrounding farms they had this problem.

And recently an experiment was done at the Academy of Sciences in Kiev where highly radioactive rice was tested. After soaking this rice in Agnihotra ash water, the radioactivity was totally neutralized.

5) Protection from Natural Disasters

a) In December, 2009 there was an unseasonal storm in the Dhule / Jalgaon region of north Maharashtra. 35,000 hectares of farms were damaged, and crores of rupees of crop losses were reported by farmers in the area.

In Parola tehsil 49 villages were affected; in some places 2 feet of ice was reported in the fields from the hail storm.. This ice remained in some fields for 3 days after the storm.

There is one Homa Farm in the centre of the affected area called Tapovan. On this Homa Farm there was only minimal damage to the crops which is very unusual as all farms around were heavily affected.

So it seems that Homa Therapy creates some type of beneficial microclimate which acts as a protective shield around these places.

Similar reports of protection from natural disasters we also got from South America:

b) Stone and mud avalanches stopped right in front of Homa Farms both in Chile and in Venezuela.

6) Homa Therapy saves life in an industrial catastrophe

During the tragic Union Carbide chemical gas leakage in Bhopal in 1984, when so many tens of thousands of people died, the few residents of the area that were performing regular Agnihotra and who immediately fortified their Agnihotra biosphere with special supplementary healing fires at the time of the leakage, where spared. They did not have gas masks or any other form of protection. They simply stayed in their homes and performed the Homa fires.

This protective shield created by Homa Therapy was powerful enough to save peoples' lives.

7) Next Steps - Homa Farming Project to improve acidic soil

Recently more studies are being carried out or being planned in several universities and scientific institutes to understand better how these beneficial effects of Agnihotra and Homa Therapy on all environment come about.

It seems that in Jharkhand there are large areas with acidic soil.

We suggest to start a Homa Farming project in one of the areas to see how Homa Therapy can help to bring the soil back to normal with regular scientific observations and documentation.

This Homa Farming project could then be a model for other farms all over the countries where farmers could go and learn about this method.

L-9.3

Innovative production system for betelvine (*Piper betle* L.)

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Betelvine or Paan *(Piper betle L.)* of Piperaceae family is a perennial creeper, grown for its leaves as an important cash crop. The crop generally survives in southern India in open orchards whereas it is cultivated in Northern India in closed structures, known as *Bareja* or *Bheet'.* These structures are meant to provide ideal conditions, diffused light and humid conditions; required for its cultivation. These conditions are conducive to pathogens *viz.* fungi and bacteria also. Betelvine is capital and labour intensive crop and high susceptibility to diseases further makes it a risky cash crop in northern states. The major cost is incurred on construction of *bareja*, planting material and disease management. Due to high growth and regular harvesting of leaves, its nutrient management is also very important. To address these issues, two varieties of betelvine; namely Mahoba and Kalkatiya Bangla were grown at CSIR-NBRI, Lucknow. Various experiments included bed composition, i.e. growing in traditional pond soil (farmers practices) and scientifically prepared soil mixtures [combination of soil, farm yard manure, press mud, neem cake, cocopeat and rice husk]. The traditional bamboo based *bareja* was replaced by poly-net house, erected with GI pipes to provide diffused light, mild temperature and high humidity through micro-irrigation system using foggers. To advance the planting time to ensure early harvests, the two nodes cuttings were planted in poly-house in the end of January so that rooted cuttings were available by end of February. This method resulted in early start of harvestings for economic returns. The beds were raised up to 6 inches to avoid water logging. Once the vines reach sufficient height, they are provided support by split bamboo stacks. Under high humidity conditions, these stacks get rotten and invite termites. The bamboo stacking was replaced by coconut rope. It was observed that the modified production system resulted in early yield of large, healthy, disease free leaves at lower cost of cultivation.

Oral Lectures
&
Poster Presentations

Technical Session 1:

Conventional & Non-conventional Approach for Crop Improvement and Biodiversity Conservation

O-1.1

Tailoring fruit crops through recombinant DNA technology

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India has emerged as a major player in the horticulture sector. Today, India is the second largest producer of fruits and vegetables in the world. However, in order to produce 360 million tones of horticultural produce from current level of 150 million tones by 2020 requires careful planning and application of newer tools such as Biotechnology. There is a need to utilize r-DNA technology in few commercial fruit crops for very specific traits such as resistance against biotic (fungus, bacteria, viruses) and abiotic (salt, moisture), stresses, nutritional qualities etc. Fortunately, advances made in recent years in the area of r-DNA technology has provided altogether a new dimension to horticultural research. Development of transgenic fruit crops has created interest globally. However, except transgenic papaya resistant to viruses which has been commercialized in USA, none of the fruit crops has reached to end user.

We have developed genetic transformation protocol for papaya and guava. Somatic embryo of papaya has been transformed with hair pin loop of truncated coat protein gene of PRSV. These transformed embryos were successfully regenerated and established in containment facilities. The molecular analysis confirmed the presence of gene of interest. These plants are being evaluated for resistance to PRSV. *In vitro* grown microshoots of guava were transformed with *endochitinase* gene derived from *Trichoderma harzianum*. These microshoots were regenerated into complete plantlets which are being analyzed for introgression of gene of interest (*endochitinase*). The T_0 plants are being evaluated for resistance against *Fusarium*.

O-1.2

Recent advances in temperate fruit crop improvement

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India is the second largest producer of fruits with an production of 81.29 million tonnes fruits from an area of 6.99 million hectares. Unlike other regions, the horticulture in NHW including NEH states is a backbone of the economy, supports about 12-15 lakh families and provides directly or indirectly employment to the tune of about 50-60 lakh people annually. Therefore, it is an important activity and should be given priority and developed systematically to harness the vast potential of natural resources. To boost production, like other states several schemes in temperate horticulture were implemented and made some significant progress. Apple and walnut represent major crops of temperate fruits covering about 52% and 23% of the total area and accounting for 79% and 5.44% of temperate fruit production respectively; while rest came from other fruits like pear, peach, plum, almond, apricot, etc. have significance and can contribute to region's economy. Keeping in view the strength and the weaknesses of the horticulture sector in the temperate region and to overcome the bottlenecks of low productivity, the following crop improvement programs played a significant role in the transformation of horticulture leading to livelihood security.

O-1.3

Evaluation of garlic germplasm in Kumaun region of Uttarakhand

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Garlic has become an important crop of the world because of its spice, medicinal and vegetable properties and increasing demand for fresh consumption as well as processing industry. India is the second largest producer of garlic in the world and states like Madhya Pradesh, Gujarat, Odisha, Rajasthan, Karnataka, Tamilnadu, Maharashtra and Bihar are the major contributors. The Uttarakhand state also has vast potential for its production and productivity especially for long day varieties. Many strains/varieties in garlic are available in the country, but there is need to find out better varieties for growing under climatic conditions of Uttarakhand. For this, evaluation of genotypes to select better type from the existing 52 lines was carried out at Central Institute of Temperate Horticulture - Regional Station, Mukteshwar, Nainital (UK) during Rabi 2013-14. Sufficient variations among the genotypes for various traits *viz*., number of leaves/plant, number of cloves/plant, average bulb weight, bulb size and bulb yield were observed. The plant height varied from 19.41 cm in BGLD-1217 to 75.30 cm in BGLD-1335. In case of average number of leaves/plant was found minimum (3.38) in GRL-1340 and maximum (8.04) in GRL-1335, whereas number of cloves/ bulb was minimum (4.05) in AGLD-1201 and maximum (25.06) in BGLD-1234 genotype. The highest bulb weight of 67.33 g was exhibited by the genotype GRL-1349 with 05.63 cloves/bulb followed by AGLD-1204 (66.00 g), GRL- 1335 (64.43 g), BGLD-1335 (63.30 g), BGLD-1235 (63.00 g), while genotype BGLD-1217 produced lighter weight bulb weighing 5.20 g with 12.17 cloves/bulb. From this study, it can be inferred that the present garlic genetic material has sufficient variability for various traits and could be exploited for further improvement through selection for enhancing the productivity levels of garlic in the state. Further, the genotype BGLD-1219, GRL-1349, AGLD-1204, GRL-1335, BGLD-1335 and BGLD-1235 could be taken into consideration while selecting and developing superior genotype/ variety for the state of Uttarakhand.

O-1.4

Assessment of genetic diversity in cashew varieties

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Forty cashew varieties released from various centers of India were characterized using a combination of RAPD, ISSR and SSR. Markers were analyzed alone and in combination. RAPD analysis carried out with 10 selected random primers generated 75 amplicons, of which 52 bands were polymorphic (86.9%). ISSR analysis carried out with 10 primers generated 88 bands, of which 77 bands were polymorphic (87.5%). Similarly, 15 SSR primer pairs of cashew generated 33 bands of which 31 were polymorphic (93.3%). High polymorphism (86.9-93.3%) observed with different markers indicated the efficiency of markers. Genetic relatedness among the varieties was assessed on the basis of Jaccard's genetic similarity coefficient which varied from 0.58 to 0.97 in SSR. For better genetic differentiation, markers data from all the markers (RAPD+ISSR+SSR) were combined which resulted in a total of 196 bands, of which 160 bands (81.6%) were polymorphic with an average of 4.6 polymorphic bands per primer. The genetic similarity values with combined makers varied from 0.70 to 0.84 with high average similarity indicating the existence of low genetic diversity among the varieties. The highest genetic similarity was observed between Goa 11/6 and VRI-3 and Ullal-4 and H 32/4 and lowest similarity (high diversity) was observed between Kanaka, and Jhargram-1. Cluster analysis with UPGMA method could group varieties in to 10 clusters and correspondence between molecular clusters with region of origin or morphological groupings was not observed.

O-1.5

Application of biotechnological tools for enhancement of crop improvement

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Food has always been the foremost need of human beings. As the world population expands, the food problem will become increasingly severe reaching a point where populations growth would outstrip food supply. This is likely to happen sooner than later because the per capita availability of fertile land is decreasing not only due to population growth but also due to erosion. Restoring erosion losses is even more difficult than population control because it is very slow process: it take about 500 years to form 25 mm of soil under agricultural conditions. The situation becomes worse when the quality (i.e. the nutritional value of the food) dimension is also taken into account. Thus, the sustainability of worlds food supply is a multidimensional problem that can only be addressed by adopting multifaceted approaches. If adopted carefully, biotechnological tools/ strategies do have the potential to address these issues in totality.

Biotechnology will have a major impact on agriculture in coming decades. It is an excellent tool which can be used to modify plants, animals and microorganisms to enhance their value. A whole spectrum of gene technology is now routinely and successfully applied to a wide range of problems in agriculture and horticulture. Biotechnology bases research has resulted into the increased production of crops having resistance to pests and diseases, tolerance to herbicides, higher nutrition content, better flavor, longer shelf life and potential to survive in drought, cold temperatures, high salt concentrations and other environmentally stressed conditions.

Although the food production can also be enhanced by increasing the area of the land we farm, this may not be feasible because we have only limited terrestrial land that can be made available/ cultivatable for crop production. However, since ninety percent of the world's food is derived from just 15 plant and 8 animal species, biotechnological tools may be exploited for exploring new crop species that could make a large contribution to the human food pool. Furthermore, the potential of marine biotechnology can be utilized to its fullest to augment the food supply wherever it is possible. Although oceans cover about 70% of the Earth's surface, most food is produced on land areas through agricultural and animal husbandry. Ocean farming, more particularly the deep sea farming (being more nutrition rich, near shore areas are more productive and are already being used to some extent) holds immense potential for food production through biotechnologically designed crop plants.

O-1.6

Improvement of mango through introduction, selection, hybridization and mutation

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The Mango (*Mangifera indica* L.), one of the 73 genera of the family Anacardiaceae in order Sapindales, is amongst the most important tropical fruits of the world. It is also called as king of the fruits (Purseglove, 1972). It originated in the South East Asian or Indo-Burma Region having 41 recognized species of mango originating as forest trees with fibrous and resinous fruits ((Mukherjee, 1951, 1967). Mango has been cultivated for thousands of years in India (Mukherjee, 1953; Kostermans & Bompard, 1993) and its cultivation is as old as Indian civilization (De Candolle, 1884). Its development and culture in the subcontinent is mainly contributed by the Mughal Emperors, especially Akbar who planted one lakh mango saplings is known as 'Lakha Bagh', at Darbhanga in Bihar during 15th Century, amateur gardeners, nurserymen and farmers by means of selection and subsequent cloning. Now, it is an integral part of history and culture of Indo-Pak subcontinents.

P-1.1

Breeding of pomegranate for evolving improved hybrids

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Pomegranate (*Punica granatum* L.), an important fruit crop of arid and semiarid regions of the world, is a perennial shrub with heterozygous nature. It belongs to the family 'lythraceae' (sub-family 'punicoideae') with somatic chromosome number 2n=2x=16. '*Punica'* encompasses two species viz., *P. granatum* (cultivated pomegranate) and *P. protopunica* (wild type). The inflorescence (dichasial cyme) consists of hermaphrodite, intermediate and staminate flowers. Fertilization in pomegranate takes place through both self pollination and cross pollination. The presence of hermaphrodite flowers favors self pollination whereas dichogamy (protogyny), heterostyly and heteromorphism facilitate cross pollination. The mode of pollination is through entomophily. The fruit is a modified berry (balusta) which usually develops from the inferior ovary of hermaphrodite flowers. Bhagwa, Ganesh, Ruby, Arakta, Mridula, etc., are some of the soft-seeded (mellowness) cultivars of pomegranate which are commercially cultivated in India. In order to evolve soft-seeded varieties with yield and quality comparable / superior to Bhagwa and acquiescent to table purpose, hybridization was attempted during 2007-08. Crossing was done through emasculation and hand pollination technique. Fertilization paved the way for fruitset and fruit development. The 20 progenies surviving out of numerous offsprings segregated into 3 types viz., sweet, sour and subacidic type. NRCP- H6 had 95.0 fruits/tree, 17.5°B TSS and 38.5 g of 100 aril weight. NRCP- H14 had 86 fruits/ tree, 17.7°B TSS and 44.5g of 100 aril weight. Consecutive evaluation revealed that the NRCP hybrids viz., H-6 and H-14 were superior in yield and quality compared to the standard check 'Bhagwa' with suitability for table purpose.

P-1.2

Evaluation of tomato parents and their hybrids against bacterial wilt (*Ralstonia solanecearum*)

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The success of hybridization in any crop including tomato depends upon the selection of suitable parental genotypes and performance of their cross combinations. Based upon varietal evaluation trials, the better performing genotypes can be picked up, but these may not necessarily transmit their superior characters in hybrid combinations. Besides, yield attributes, bacterial wilt resistance is very important which directly influenced the marketable yield in tomato. Low yield and bacterial wilt both are the major limiting factors for successful cultivation of tomato in india. There is a substantial scope in tomato for enhancing yield and bacterial wilt resistance. This is possible through adoption of suitable breeding procedure which in turn, would depend to a large extent on the knowledge of the genetic architecture governing various traits influencing yield potential of tomato varieties which has increased three to five folds during the last 40 years. However, very few works has been done towards genetic improvement of tomato especially for yield characters with bacterial wilt resistance.

Genetically diverse thirteen genotypes of tomato (H-24, Sikkim Local, FEB-2, Sel-2, KT-10, BT-207, BT-116-8-1, FEB-4, 97/6400, BT-102-2-1, DVRT-2, Type-1 and Futesiro) as lines and three genotypes (Flora-Dade, KT-15

and BT-117-5-3-1) as tester were used and crosses were made in line x tester mating design as given by Kempthorne (1957). Twenty five days old seedlings of 39 F_1's and 16 parents were transplanted in well prepared field on *rabi* season in randomized block design. All the recommended cultivation practices were followed to raise a good crop. Statistical analysis was done by taking the mean value of twenty plants of each genotype in each replication.

On the basis of study, result showed that the parents Sel-2 (line), BT-117-5-3-1(tester) and hybrid FEB-4 x BT-117-5-3-1, and FEB-2 x BT-117-5-3-1 were found best combiners for higher yield and exhibited resistant disease reaction against bacterial wilt. These parents and hybrids could be utilized in bacterial wilt disease resistant breeding programme in tomato.

P-1.3

Flowering and fruiting characteristics of guava (*Psidium guajava* L.) cultivars under himalayan terai region of West Bengal

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Guava (*Psidium guajava* L.) is an important sub-tropical fruit crop of India and successfully grown in Madhya Pradesh, Maharashtra Uttar Pradesh, Bihar, Andhra Pradesh, West Bengal, Punjab. To study the performance of guava cultivars in the Himalayan Terai region of West Bengal, the present experiment was carried out in the Instructional Farm of Dept. of Pomology & Post Harvest Technology, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal during 2013-2014 in randomized block design. Seven cultivars of guava plants having 3 year age were selected as individual treatments; i.e., L-49 (T_1), Baruipur (T_2), Khaja (T_3), Dudh Khaja (T_4), Pant Probhat (T_5), Allahabad Safeda (T_6) and Bhagalpur (T_7). The maximum numbers of flowers (27.33) and fruit set percentage (64.06%) was observed in cv. Dudh Khaja (T_4) in summer season. The fruit drop percentage was lowest (32.83%) in cv. Khaja which was statiscially at par with all other cultivars except Allahabad Safeda during summer season. Fruit drop percentage was higher and statiscally at par in all the cultivars in winter season for all the cultivars compare to summer season. Maximum number of fruits and yield per plant were recorded in Dudh Khaja for both summer season (17.50 numbers and 2.538 kg/plant) and winter season (8.5 numbers and 1.245 kg/plant). The maximum fruit weight (192.40g), fruit length (6.73cm), fruit diameter (6.73 cm) was observed in winter season in cvs. Khaja, Pant Probhat, and Dudh Khaja, respectively. Maximum TSS (12.37 ^{O}brix) was recorded in Dudh Khaja (T_4) and it was statistically at par with all other cultivars, whereas, ascorbic acid content was recorded highest in cv. Khaja (263.03mg/100g of pulp). Highest total sugar percentage (7.93%) and reducing sugar percentage (4.75%) was recorded in cv. Allahabad Safeda (T_6) during winter season.

P-1.4

Study on gene action and combining ability in bitter gourd (*Momordica charantia* L.)

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Bitter gourd (*Momordica charantia* L.) is most important vegetable crop extensively grown throughout the country for its nutritive value and therapeutic properties. It is rich source of minerals (iron, calcium and phosphorous) and vitamins (A and C). Consumption of its fruit juice is very useful for diabetic patients due to its potent oxygen

free radical scavenging activity. Combining ability analysis is one of the powerful tools available which estimates combining ability effects and aids in selecting desirable parents and crosses for further exploitation. Further, the diallel mating provides information on combining ability and thus helps in the selection of desirable parents for utilization in the hybridization programme, as well as in the choice of appropriate breeding procedure for the genetic improvement of various quantitative traits in the crop species. The present investigation was therefore, undertaken at College of Horticulture, Rajendranagar, Hyderabad using 8 parents and 28 F_1 hybrids to obtain information on gene action and estimates of general and specific combining ability. The results revealed that non-additive gene action played major role than additive gene action in inheritance of yield and yield attributing traits. Among parents, IC-044438, IC-470560, IC-470558 and IC-085622 were found good general combiners for yield attributing characters and earliness hence, these parents can be exploited for hybridization for producing desirable recombinants in the segregating generations. High specific combining ability effects for yield and related characters were exhibited by IC-044438 × IC- 045339 followed by IC-044417 × IC-470558 and IC-045339 × IC-085622. For earliness the crosses *viz*., IC-044438 × IC-045339, IC-045339 × IC-470550 and IC-045339 × IC-470558 were identified as promising ones. Most superior specific cross combinations involved High × Low and Low × Low general combiners. Five crosses were identified for developing high yielding genotypes in bitter gourd.

P-1.5

Genetic variability, correlation and path analysis in *Valan Kakri* (*Cucumis sativus* var*. utilismus* L.)

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Valan Kakri (*Cucumis sativus* var*. utilismus* L.) belongs to similar genus and species of cucumber but in respect to size of fruit, length of fruit and keeping quality are different from cucumber which is little bit higher than cucumber. It is also known as the name “Balam Khira”. The use of *Valan Kakri* just similar to cucumber likewise used as salad and cooking vegetable which is easily digestible and increase appetite when consumed. It is widely grown as a summer and rainy season vegetable in India especially in northern states. Evaluation of genotypes to assess the existing variability is considered as preliminary step in any crop improvement programme. In order to pursue an effective breeding programme, the present investigation was carried out to gather information on genetic variability, heritability, genetic gain, correlation and path analysis for different characteristics in *Valan Kakri*.

Analysis of variance exhibited significantly difference for all the characters suggesting the presence of good deal of variability in the material study. The estimation of GCV, heritability and genetic gain were of higher order for total yield per vine (kg), weight of fruit (g), number of fruits per vine and acidity of fruit (%). These characters were governed by the additive gene action. Hence, selection would be effective for their improvement. Total yield per vine exhibited significant and positive correlation both at genotypic and phenotypic levels with number of fruit per vine, pulp thickness, average weight of fruit, diameter of fruit, length of fruit, acidity of fruit and total soluble solids, while negative association were observed for days to anthesis of first male flower and days to anthesis of first female flower both at genotypic and phenotypic levels. Path coefficient analysis revealed that characters *viz*., acidity of fruit, number of fruit per vine, weight of fruit, number of male flowers per vine, days to anthesis of first male and female flower had positive direct effect on yield per vine. Hence it can be concluded that total yield per vine was mainly a product of direct as well as indirect effect of number of primary branches and number of fruits per vine. On the basis of present study the genotypes PVK-15, PVK-8, PVK-4 and PVK-3 were found superior for total yield per vine, which could be gainfully utilized in further breeding/improvement programme.

P-1.6

Genetic variability of quantitative trails in fenugreek (*Trigonellafoenum-graecum* L.)

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Thirty entries of fenugreek (*Trigonellafoenum-graecum* L.)were evaluated for genetic variability of quantitative trails of ten characters during the year of 2011-2012. Significant differences were recorded for all the characters and considerable amount of variation was observed for all the traits are under study. The phenotypic coefficient of variance (PCV) was higher their respective genotypic coefficient of variance (GCV) for all the characters. The PCV and GCV estimate were high for plant height, number of branch plant^{-1}, seed yield qha^{-1}, seed yield plant^{-1}, 1000-seed weight (g) and number of pod plant^{-1}. High heritability estimates were recorded for days to 50% flowering, plant height (cm), seed yield qha^{-1}, length of pod (cm), seed yield plant^{-1} and number of pods plant^{-1}, while moderate heritability was recorded in days to maturity. High heritability estimates coupled with high genetic advance was recorded for total plant height (cm) followed by seed yield qha^{-1}, days to 50% flowering, number of pods plant$^{-1,}$ numberof seed pod^{-1},and length of pod (cm), from the estimates of high heritability coupled with high genetic advance, it was concluded that improvement of seed yield in fenugreek is possible through selection for plant height, number of branch plant^{-1} and seed weight through number of pods plant^{-1} and length of pods.

P-1.7

Leaf gas exchange parameters of selected clones and induced mutants of Kinnow mandarin

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Citrus is the third most important fruit crop in India after banana and mango. Among mandarins, Kinnow a hybrid of *Citrus nobilis* x *Citrus deliciosa* has become the most favoured cultivar choice among citrus growers in India because it has adapted very well under arid and semi-arid climatic conditions where other citrus varieties are not performing well. However presence of large number of seeds in Kinnow mandarin is not preferred from the consumers and processing point of view.

To obtain seedlessness, Kinnow buds were radiated with physical (5, 10, 15 and 20 Gy of ã-ray) and chemical mutagens (0.05%, 0.1%, 0.2% and 0.5% EMS). Some of the clonal selections made form Sri Ganganagar for seedlessness (1/4, 2/4, 4/8 and 2/20 EEA) is also under long term evaluation. Leaf gas exchange variation were recorded in pre bearing population of clonal selections and mutatnts. The highest (P = 0.05) photosynthetic rate (A) and stomatal conductance (gs) were detected in the parent Kinnow [(control) (7.68 ±0.13, 0.105 ±0.001 respectively)] and the same was recorded minimum in the plants treated with 20 Gray treatment (3.02 ±0.10; 0.061 ±0.00 respectively). Similarly, at 0.5% EMS treatment, a reduction of 39.25 and 28.57% was observed, whereas a non-significant variation existed amongst the clonal selections. Conversely, enhanced internal carbon dioxide concentration (Ci) of 8.72, 7.10 and 4.4% were recorded at 20 Gray, 15 Gray and 0.5%. EMS treatments respectively with minimum recorded in the clonal selections. Further, lower transpiration rate (E) was recorded in the clonal selections 12EEA 2/20 and 12 EEA 2/4 and at 20 Gy (3.75, 4.20 and 4.33 mmol $m^{-2}S^{-1}$ respectively), while maximum was observed at 10 Gray (4.90 mmol $m^{-2}S^{-1}$). Non-significant variation in E ranging from 4.70 to 4.75 mmol $m^{-2}S^{-1}$ was found amongst the chemical mutants. This study provides an insight into the potential use of mutation treatments in manipulating leaf gas exchange parameters of Kinnow plants and deals with some of these issues.

P-1.8

Studies on genetic variability and character association in Taro [Colocasia esculenta (L.) var. antiquaram]

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To assess the genetic variability & genetic advance for quantitative characters estimate correlation coefficient among the coefficient analysis and genetic advance. Experimental material for the study consisted of 30 genotypes including 2 check NDC??? 1 and NDC-2. The experiment was conducted in RBD with 3 Replication.

The analysis of variance for the design of experiment should that the genotype were highly significant for the all the characters under study. The high magnitude of phenotypic coefficient of variation was observed for number of cormel per plant followed by days to sprouting, weight of corm, width of leaf, height of plant and total yield t/ha. and genotypic coefficient of variation was observer for days to sprouting followed by no. of cormel per plant, height of plant, width of leaf, length of leaf, followed by days to sprouting length of leaf, width of leaf, girth of corm, exhibited high value of heritability with high genetic advance was found days to sprouting followed by height of plant, width of leaf, and number of cormels per plant for with high magnitude of PCV & GCV total yield t/ha. had positive and highly significant and phenotypic correlation with weight of cormels per plant followed by number of cormels per plant, weight of corm, girth of plant, length of leaf, width of leaf, height of plant, while total yield t/ha have negative and significant correlation with days to sprouting at phenotypic level highest positive direct effect was found on weight of cormel, and indirect at genotypic level it highest positive direct effect was also recorded on length of leaf. The genotypic NDC-2 (check) produce of highest yield followed by NDC-7, NDC-5, NDC-8, NDC-9, NDC-17, is superior to NDC-1 (check) for all the characters expect weight of corm, width of leaf and height of plant.

P-1.9

Studies on correlation and path analysis in turmeric (*Curcuma longa* L.)

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An experiment consisting 80 turmeric genotypes for 12 characters was laid out during June 2011 to May 2012 in Augmented design at Main Experimental Station department of vegetable science, NDUA&T Kumarganj, Faizabad (U.P.). The character Studied were plant height (cm), number of tillers per clump, number of leaves per plant, weight of fresh rhizome per plant (g), weight of mother rhizome, number of primary rhizome per plant, weight of primary rhizome per plant, number of secondary rhizome per plant, number of tertiary rhizome per plant, rhizome yield q/ha, dry matter (%) and TSS (%).

In present study weight of fresh rhizome per plant showed highly significant and positive association with plant height, weight of mother rhizome, number of primary rhizome per plant, number of secondary rhizome per plant and number of tertiary rhizome per plant. Path coefficient analysis carried out at genotypic as well as phenotypic level revealed that weight of mother rhizome followed by number of tertiary rhizome per plant, number of tillers per clump, dry matter percent, rhizome yield q/ha, number of primary rhizome per plant and number of secondary rhizome per plant exerted high order positive direct effect on weight of fresh rhizome/plant.

P-1.10

Screening for yield and its attributing traits in sponge gourd (*Luffa cylindrica* (L.) Roem.)

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Analysis of variance in the present investigation indicated that the genotypes evaluated differed significantly among all the treatment for all the eleven traits. The genotypes NDSG-1 (3.352 kg), NDSG-3 (3.405 kg), NDSG-41 (2.920 kg), NDSG-52 (2.917 kg), NDSG-55 (3.048 kg), NDSG-60 (3.117 kg), Pusa chikni (c) produced highest fruit yield per plant. These genotypes also exhibited average mean performance for fruit diameter, vine length and fruit length. Node number to anthesis of first pistillate flower appears on earlier node in NDSG-10 (6.56) followed by NDSG-17 (9.57), NDSG-41 (9.67), NDSG-23 (10.00), NDSG-49 (10.00), and Pusa chikni(c) showed earlier development of pistillate flower. The higher magnitude of coefficient of variation at phenotypic as well as genotypic levels was observed among the genotypes. The presences of high heritability with high genetic advance in per cent of mean were observed for node number to anthesis of first staminate flower, node number to anthesis of first pistillate flower, fruit length, vine length, number of fruits per plant and average fruit weight exhibiting additive gene effect. The significant and positive correlation with yield per plant was observed at phenotypic level with average fruit weight and number of fruits per plant. Path coefficient analysis revealed appreciable amount of direct positive effect of average fruit weight followed by number of fruits per plant and fruit diameter on fruit yield per plant.

P-1.11

Heterosis analysis for quantitative traits in Bitter gourd (*Momordica charantia* L.)

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The present investigation were carried out in two years with aims to determine heterosis, involving 9 parental lines *viz*., NDBT-7, NDBT-9, NDBT-3, NDBT-2, Pusa Do Mausmi, NDBT-12, NDBT-1, K. Sona, NDBT-5 of bitter gourd and their 36 F_1 Hybrids at MES Vegetable Science N.D.U.A.&T. Kumarganj, Faizabad during summer 2011and 2012. The experiments were laid out in RBD with three replications single row plot with 3m x 0.5m spacing. Observations were recorded on parents and F_1's for 13 characters *viz.* node number to first staminate and pistillate flower anthesis, days to first staminate and pistillate flower opening, days to first fruit harvest, number of primary branches per plant, node number of first fruits set, vine length (m), fruit length (cm), fruit diameter (cm), number of fruits per plant, fruits, fruit weight (g), yield per plant (kg). Heterosis for fruit yield per plant ranged from -20.63 % to 28.63 % over better parent and -20.63 % to 12.41 % over standard variety (Pusa Do Mausmi) in 2011 and in case of 2012 it ranged from -6.28 % to 6.77 % and -5.24 % to 5.71 % over better parent and standard variety, respectively. For days to first fruit harvest as most important maturity traits, heterosis ranged from -8.77 % to 14.32 % and -9.25 % to 12.27 % over better parent and standard variety, respectively in 2011 and in case of 2012, it ranged from -9.55 % to 13.54 % and -10.76 % to 2.13 % over better parent and standard variety,(pusa Do Mausmi) respectively. The significant and heterotic crosses common in both the year for fruit yield were Pusa Do Mousami x NDBT-1, NDBT-7 x Pusa Do Mousami and NDBT-3 x Kalyanpur Sona in better parent. It's observed for most of the important economic traits showing ample scope of improvement in Bitter gourd.

P-1.12

Heritability and genetic advance studies in okra (*Abelmoschus esculentus* (L.) moench) under subtropical climatic condition

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The experiment was laid out in randomized block design under 16 treatments at Horticultural Research Farm under the Department of Applied plant science (Horticulture) Babasaheb Bhimrao Ambedkar University, Lucknow Uttar Pradesh (India). during the Rabi season of 2011-2012. In present study the evaluation of Heritability and Genetic advance in 16 genotypes of Okra for 12 characters. The findings revealed that the high Phenotypic coefficient of variance and Genotypic coefficient of variance are observed for Number of leaves per plant, No.of fruits per plant, No.of flowers per plant and plant height where, high heritabilty in broad sense observed for No. of flowers per plant (99.5%), Fruit yield per plant(99.4%) , No. of leaves per plant (99.4%) ,No.of fruits per plant (99.3%) and Fruit weight (98.8%) where as moderate for fruit diameter(93.6%), and No. of branches per plant (92%) and lowest for stem daimeter (86.9%) and days taken to flower (83.8%). genetic advance as percentage of mean varied from 35.30 to 85.19 for plant height and fruit yield per plant respectively. For more effective selection plant height, branches per plant, and fruit weight having comratively high genetic variabiliy.

P-1.13

Genetic variability in pummelo genotypes (*Citrus grandis* L.) under konkan conditions

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The present study was conducted during October, 2011 to March, 2013 on 30 pummelo genotypes. In Konkan region of Maharashtra (India), preponderance of pummelo seedlings are found growing at scattered/ isolated areas and chance for the selection of elite strains are high due to wide genetic diversity in the exiting germplasm. In order to reveal the genetic variability in pummelo (*Citrus grandis* L.), the fruit samples from diverse areas of province were collected and analysed for various physico-chemical attributes. In the current investigation wide range of variability with respect to fruit characters like spine length, fruit weight, rag weight, number of fruits pre tree, yield per tree, seed number, rind thickness and oil gland density have been observed. This variability can be exploited for the selection of elite genotypes for conservation, evaluation, utilization and a source for crop improvement in future breeding programme. Being an emerging high value cash crop this underutilized fruit crop is recently attracting attention of farmers in Konkan province.

P-1.14

Studies on genetic diversty in garden pea (*Pisum sativum* L. *var hartens*)

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The experiment was conducted at Main Experimental Station of Department of Vegetable Science, NDUA&T, Kumarganj, Faizabad (U.P.) during *Rabi,* 2012-13. Experimental material for study was consisted of 38 early and mid-season genotypes including four checks (AP-3, VRP-6, PC-531 and VRP-7). The experiment was conducted in Randomized Complete Block Design with three replications. Each treatment consisted of five rows spaced 30cm with plant to plant spacing of 10 cm and replicated thrice. Each entries were grown in the plot size of 3 m x 1.5 m. Observations were recorded on sixteen character *viz*. days to 50 percent flowering (days), nodes per plant, internodal length (cm), nodes to first flower appearance, primary branches per plant, plant height (cm), pods per plant, pod length (cm), pod width(cm, seeds per pod, shelling (%), 100 seed weight (g), T. S.S (^{o}Brix), pod per cluster, pod weight (g) and pod yield per plant (g). All the thirty eight genotypes were grouped into seven diverse clusters.Cluster II had highest number of genotypes (14) followed by cluster I (10), cluster III (6), cluster V (4) cluster IV (2) and cluster VI and VII (1). The inter-cluster values between cluster II and cluster V (446.15), cluster V to VII (428.47), cluster IV to V (361.14), cluster I to VII (360.20) and cluster II to IV (318.86), were very high. The minimum inter-cluster D^2 values were recorded in case of cluster VI and cluster VII (104.18). Pod yield per plant and pods per plant contributed maximum pod yield per plant (34.57 %) toward total genetic divergence in available germplasm of garden pea. Thus, there exists ample variation and as a result scope of improvement after selection in the available germplasm of garden pea.

P-1.15

Studies on correlation and path coefficient analysis insweet potato (*Ipomoea batatas* (L) Lam.) germplasm

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Experimental Station of Department of Vegetable Science, Narendra Deva University of Agriculture and Technology, Narendra Nagar, Kumarganj, Faizabad. During October 2013 to February 2014. Experiment at material for the study consisted of 33 genotypes including two checks (NDSP-10, NDSP-65). The experiment was conducted in Randomized Block Design with three replications. Observations were recorded on thirteen quantitative characters *viz.,* days to initiation of bud, length of leaves (cm), width of leaves (cm),length of vine (cm), number of branches per plant, number of leaves per vine, internodal length (cm),length of tubers (cm), girth of tubers (cm), number of tubers per vine, average weight of tuber (g),yield per plant (g), tuber yield (Q/ha). Total yield quintal per hectare was exhibited positive and highly significant correlation with girth of tuber, tuber per vine, average weight of tuber, yield per plant, while other characters showed positive correlation with yield Q/ha. At phenotypic and genotypic level highest positive direct effect were exhibited on yield per plant followed by average weight of tuber, girth of tuber, days to bud initiation.

P-1.16

Physico-chemical profiling of guava genotyes grown in semi-arid climatic conditions of vidarbha region

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The present study was planned to categories the guava (*PsidiumGuajava* L.) genotypes grown at germplasm block, Department of Horticulture, Dr. PanjabraoDeshmukh Agricultural University, Akola, situated in semi-arid climatic conditions of Western Vidarbhazone of Maharashtra State (India) in relation to its physical and chemical attributes. Physiologically fully mature fruits of forty-nine genotypes of guava including one check (L-49) were picked and subjected for physical and proximate analysis.Remarkable variability amongst the different genotypes studied was observed. For fruit physical parameters *viz*. fruit length, fruit breadth, fruit weight and fruit volume maximum values were observed in the genotype GG-13-3. Regarding the chemical properties the genotype GG-2-2 recorded extreme values with respect to vitamin C (399.17 mg 100 g $pulp^{-1}$), whereas maximum (1.58 %) pectin content was recorded in the genotype GG-2-2. Maximum TSS was observed in the genotype GG-7-2 (16.05º B) and higher values of total sugars was observed in the genotype GG-8-1 (15.67 %). With reverence to seed characteristics Minimum number seeds 100 g $pulp^{-1}$ were noted in the genotype GG-11-6 (76.67), genotype GG-8-4 recorded minimum size of seed cavity (4.20 cm). So, it can be said that the variability in the present genotypes can be tackled and they can be used for further crop improvement programme which will be leading towards overcoming the present constraints in the current growing varieties.

P-1.17

High frequency plant regeneration form leaf and petiole explants of lettuce (*Lactuca sativa* L.)

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The investigation was carried out to standardize a protocol for high frequency plant regeneration in lettuce. Plant regeneration studies were carried out using two types of explants viz. leaf and petiole and different concentrations and combinations of plant growth regulators such as BAP+IAA (mg/l), BAP+NAA (mg/l), Kn+IAA (mg/l), Kn+NAA (mg/l). The leaf explants showed a high percentage (82.44%) of shoot regeneration on MS medium supplemented with 0.25mg/l BAP and 0.10mg/l NAA ,whereas petiole explants produced 64.18% shoot regeneration frequency on MS medium supplemented with 0.50 mg/l kinetin and 0.25mg/l NAA. After shoot regeneration the shoots were transferred to rooting medium. For root regeneration various concentrations of different auxins i.e. IBA and IAA were used. MS medium supplemented with 0.50mg/l IBA was found to be best for root regeneration (81.43%). A protocol for high frequency plant regeneration in lettuce has been standardized and can be successfully employed for large scale multiplication of lettuce tissues.

P-1.18

Genetic divergence analysis for vegetative, flowering, fruit quality and yield characters in strawberry (*Fragaria* x *ananassa* Duch.)

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Fourteen genotypes were evaluated for different vegetative, floral, fruit quality and yield characters to study genetic divergence by employing D^2 analysis. The genotypes were grouped into 3 diverse clusters. Cluster III consisted of maximum six genotypes followed by cluster I and II, both of which consisted of four genotypes. The maximum inter cluster distance was recorded between cluster II and cluster III, hence genotypes belonging to these clusters can be used as parents for hybridization programme for the development of high yielding strawberry genotypes. Highest intra-cluster distance was observed in cluster II.

P-1.19

Variabilty and correlation analysis in grapefruit cultivars under subtropical conditions of Himachal Pradesh

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Grapefruit (*Citrus paradisi* Macf.) is an underutilized citrus species cultivated only in certain parts India. The present investigations entitled “Variability and correlation analysis in two grapefruit cultivars under subtropical conditions of Himachal Pradesh” was carried out at the Experimental Orchard, Regional Horticulture Research Station (RHRS), Dhaulakuan, District Sirmour (HP) and the Department of Fruit Science, Dr YS Parmar University of Horticulture and Forestry Nauni, Solan (HP) during year 2013. Variability and correlation studies of two cultivars (Ruby Red and Duncan) were carried out for plant growth characters, fruit and yield characters. Cultivar Ruby Red was superior in most of the characters compare to Duncan while in correlation studies there was positive correlation observed for yield per plant with fruit weight (0.947), leaf area (0.926), fruit breadth (0.888), total sugars (0.812) and TSS (0.789) whereas negatively correlated with seed number per fruit, plant height and number of segment per fruit.

P-1.20

Evaluationof coriander (Coriandrumsativum L.) varieties for growth, quality, economics and seed yield

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Ten coriander cultivars/accessions were evaluated for various growth parameters, seed yield during 2012-2013 at the R.A.K. College of Agriculture, (RVSKVV Gwalior), Sehore, M.P., India. Seed yield ha^{-1} was noted a highly significant and positively correlated with seed yield per plant, number of umbel per plant, number of umbellate per plant, test weight, days to first umbel initiation and straw yieldper ha.Seed yield of coriander was recorded.

Variety Pant haritma was recorded significantly superior and gave maximum (19.25 q per ha) seed yield per hectarewhich was followed by Rcr 436 (18.41 q per ha), Acr 1 (18.03 q per ha) and Kumbhraj (17.09 q per ha) as compared to other varieties.Variety Pant haritma was observed significantly superior which recorded maximum number of umbels per plant, number of umbellateper plant, fruit size, test weight and seed yield perplant.

P-1.21

Evaluation of gladiolus (*Gladiolus grandiflorus* Hort.) genotypes under hill zone of Karnataka

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The present investigation was carried out with ten cultivars gladiolus at Department of Floriculture and Landscape Architecture, College of Horticulture, Mudigere to evaluate gladiolus cultivars for growth, flowering and corm production under hill zone of Karnataka. Among the cultivars, cv. Red Majesty, Summer Sunshine and Candy Man were early to sprout (5.67, 7.00, 7.00 days respectively), while late in cv. Jester (11.00 days). Per cent sprouting was maximum in cv. Summer Sunshine (95.00%) and minimum in cv. Her Majesty (51.67%). Cultivars Summer Sunshine, Red Ginger, Red Majesty and Green Bay were fairly good with respect to growth attributes such as plant height, number of leaves per plant, leaf length and leaf width, while poor vegetative growth in cultivars Jester and Her Majesty. First floret opening was recorded in cv.Red Majesty (73.87 days), while it was delayed in cv. Jester (91.80 days). Cv. Red Ginger recorded the longest spike length (114.23 cm) and shortest spike length in Her Majesty (70.3 cm). Number of florets per spike was maximum in cv. White Prosperity (18.27). While, minimum in cv.Her Majesty (10.80).Spike yield was maximum in cv. Summer Sunshine (116666.33 spikes per hectare) and minimum in cv. Jester (59259.00 spikes per hectare).Vase life was maximum in cv. American Beauty (11.67 days).Number of corms per plant was maximum in Summer Sunshine (1.47). Diameter of corm was maximum in cv. Summer Sunshine (7.64 cm) and minimum in cv. Her Majesty (5.39 cm). Maximum yield of corms per hectare in cv. Summer Sunshine (9058.67 kg) and minimum in cv. Her Majesty (921.67g).

P-1.22

Ethno-botanical study of papaya

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Papaya (Carica papaya) belong to family Caricaceae with chromosome no. 2n = 18. Papaya, a tropical plant believed to be originated in southern Mexico and Central America, is now popularly cultivated in tropical and sub tropical regions worldwide. C. papaya is cultivated for its edible ripe fruits. Papaya leaves are also used in indigenous populations for its therauptic applications. The fruits are used as flavoring agent in preparation of candies, jellies, preserves, and ice cream. Shallow cuts on the surface of fully grown but unripe fruits produces a milky sap or latex to ooze that is collected, dried, and termed as "crude papain", used in inelustry as well as milk - clotting (rennet) and have protein-digesting properties. Nearly 80% of American beer is treated with papain, which allows the beer to remain clear upon cooling. Papain is most commonly & commercially used in meat tenderizing and chewing gums. Cosmetically, papain is used in some toothpastes, shampoos, and facial creams. The phytochemical analysis of the leaf extract contains saponins, cardiac glycosides, anthraquinones, reducing sugar, flavonoids,

alkaloids and tannins. It is used as an antidiabetic, anti-inflammatory, anticancer and also to treat dengue, malaria, heart disorders, diabetes & helminthes and other diseases due to its wide biological activity. Papaya leaf steams are used in homemade production of candle. Traditionally papaya is used in birth control, parasite control, healing bed sores, and in treating intestinal worm's in human. Dry papaya leaves mixture with palm kernel oil or other leaves like neem are used by Nigerian peoples for protective from fever, skin problems, anemia, diabetes, bronchitis, and in respiratory disorders like - cough, cold, asthma, tuberanlosis etc. Papaya seeds have toxic element benzyl isothiocyanate, but in small doses the dry seeds are used to treat helminthiasis mixed with honey. Seeds are also used for adulteration with black pepper as they look alike. In fact, all parts of papaya are used by peoples of different countries for various purposes.

P-1.23

Combining ability and heterosis for yield, quality and disease resistance in muskmelon (*Cucumis melos* L.)

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A study was conducted to assess the magnitude of heterosis and combining ability in a diallel mating design involving forty five hybrids developed by crossing ten inbred lines in muskmelon during 2012-13 at Department of Vegetable Science, Punjab Agricultural University, Ludhiana. The analysis of variance indicated significant amount of variability among all the genotypes for traits under study. Among parents, MM110 and MM 108 were adjudged as the best general combiners for total fruit yield per vine and TSS content along with other important characters. The cross combination MM109 × MM103exhibited highest specific combining ability fortotal fruit yield per vine whereas MM110 × MM108 for TSS content. The cross combination MM 109 × MM 101, exhibited high heterosis for total fruit yield per vine and TSS content along with number of fruits per vine, fruit weight, rind thickness, flesh thickness, resistance reaction to *Fusarium* wilt and downy mildew over the check Punjab Hybrid. The cross combination MM 109 × MM 103 have displayed high heterosis for total fruit yield per vine and TSS content along with number of fruits per vine, fruit weight, flesh thickness and resistance to downy mildew. The hybrid MM 110 × MM 104 had high heterosis for total fruit yield per vine and TSS content along with number of fruits per vine, fruit weight, days to first fruit ripening and resistance reaction to *Fusarium* wilt. The hybrid MM 110 × MM 105 have shown high heterosis for total fruit yield per vine and TSS content along with number of fruits per vine, fruit weight, flesh thickness. The hybrid MM 103 × MM 104 had high heterosis for total fruit yield per vine and TSS content along with fruit weight, rind thickness, flesh thickness and fruit cavity area over the check.The components of genetic variation indicated the predominance of non-additive gene action (dominance) for most of the characters.

P-1.24

Study on heterosis, growth and yield traits in hybrid Brinjal (*Solennummelongena* L.) in Madhya Pradesh

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The seeds of nine hybrids along with national check Jawahar Brinjal-64 during*kharif*, 2013 were evaluated in a Randomized Block Design in three replications for M.P. plains. Heterosis analysis was carried out for significant

and positive correlation coefficient of girth of fruit was recorded with weight of fruit, Plant height was recorded with fruit set, Primary branches per plant was recorded with fruit yield per plant, Primary branches per plant was recorded with number of flower per cluster, Days to flower initiation was recorded with days to Numberof flower per cluster days to first fruit set was recorded with days to first picking.High estimates of genotypic variation were recorded for Length of Fruit, Girth of fruit, Number of fruits per plot, Number of fruits per plant, Weight of fruit and Number of flowers per cluster. The high estimates of phenotypic coefficient of variation were recorded for characters viz, Length of fruit, Girth of fruit, Number of fruits per plot, Number of fruits per plant. High heritability for the characters viz., Number of fruits per plot, Number of fruit per plant, days to flower initiation, Length of fruit. High genetic advance as per cent of mean were observed in number of fruit per plot, Number of seed per fruit, weight of fruit.

P-1.25

Role of vegetable breeding in food security

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Vegetable breeding has to address and satisfy the needs of both the consumer and the farmer. The general objectives for farmers are good yield, disease and pest resistance, uniformity and abiotic stress resistance. Objectives for consumers are quality, appearance, shelf life, taste, and nutritional value. Quality in vegetable crops, in contrast to field crops, is often more important than yield. For farmers to survive, cultivars must be accepted by the market. Thus, colour, appearance, taste, shape, are usually more important than productivity. Modern cultivars consist of those developed by crossing and selection alone, those developed by crossing and selection but with specific important improvements often obtained from crosses with wild species or by transgenic methods, and F1 hybrids between desirable inbred lines. Creation of vegetable hybrids is a key means towards the development of cultivars for modern vegetable production. Hybrid seed production is high technology and a cost intensive venture. Private breeding companies are placing more and more emphasis on the development of hybrids for only commercial vegetables to exploit heterosis, and to combine multiple disease and stress resistance, but also for economic purposes to ensure growers must purchase seed for each planting. More public sector vegetable breeders are needed worldwide to select and to produce non-hybrid cultivars of the minor and "forgotten'' vegetables. Breeding of vegetables and other minor crops must continue as a viable endeavour. This will benefit small farmers, and will safeguard biodiversity and food security in developing countries.

P-1.26

Potential application of genetic modifications to ornamental horticulture

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Ornamental horticulture is a very important economic aspect of horticulture and floriculture is in turn a dominant sector of ornamental horticulture. In case of cut and loose flowers, the primary focus on colour modification

is important because flower colour is an important driver of new variety development. Other important traits include vase life and perfume, both of which are potentially amenable to genetic modification. Genetic engineering allows the introduction of genes from outside the gene pool, and is precise, because a gene or genes targeted for a specific trait can be introduced. It also shortens the time frame for new variety development. Strategies for colour modification can be achieved by manipulating genes in the anthocyanin biosynthesis pathway. The plant hormone ethylene is involved in senescence in many flowers and vase life can be extended by blocking ethylene biosynthesis. Based on the transgenic techniques several important varieties of ornamental plants like Anthurium, Antirrhinum, Begonia, Calendula, Carnations, Dendrobium, Gerbera, Gladiolus, Petunia, Rhododendron etc are produced. Novelty is also an important driver of new variety development in the pot plant industries. Colour modification, enhancement of flower life and manipulation of plant and flower form are all attractive traits from the marketing point of view. The potential traits that will add value to the end product includes disease resistance, resistance to drought, insect resistance and reduction in leaf senescence. Herbicide resistance in bedding plants can also be expected to significantly reduce the cost of weeding in a landscape environment. Based on the fact that there is ongoing research using genetic modification in ornamental horticulture, it can be expected that more genetically modified ornamental products will be released in the future.

P-1.27

Transgenic vegetable breeding for nutritional quality and health benefits

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Vegetables are grown worldwide and play an important role in human diet because they provide vitamins, minerals, dietary fibre and phytochemicals. About 3 billion people in the world are malnourished due to imbalanced diets. Vegetables can contribute to the prevention of malnutrition disorders. Genetic engineering enables vegetable breeders to incorporate desired transgenes into elite cultivars, thereby improving their value considerably. It further offers unique opportunities for improving nutritional quality and bringing other health benefits. Many vegetable crops have been genetically modified to improve traits such as higher nutritional status or better flavour and to reduce bitterness or anti-nutritional factors. Transgenic vegetables can be also used for vaccine delivery. Consumers could benefit further from eating more nutritious transgenic vegetables, e.g. an increase of crop carotenoids by metabolic sink manipulation through genetic engineering appears feasible in some vegetables. Genetically engineered carrots containing increased Ca levels may boost Ca uptake, thereby reducing the incidence of Ca deficiencies such as osteoporosis. Fortified transgenic lettuce with zinc will overcome the deficiency of this micronutrient that severely impairs organ function. Folates deficiency, which is regarded as a global health problem, can also be overcome with transgenic tomatoes with folate levels that provide a complete adult daily requirement. Transgenic lettuce with improved tocopherol and resveratrol composition may prevent coronary disease and arteriosclerosis and can contribute to cancer chemopreventative activity. Food safety and health benefits can also be enhanced through transgenic approaches, e.g. rural African resource-poor consumers will benefit eating cyanide-free cultivars of cassava. Biotechnology-derived vegetable crops will succeed if clear advantages and safety are demonstrated to both growers and consumers.

P-1.28

Assessment of genetic variability and correlation in gladiolus germplasm

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Twenty genotypes of gladiolus were evaluated for seventeen characters to ascertain the genetic variability and association among the characters during 2013-14 at G. B. Pant University of Agriculture and Technology, Pantnagar. High GCV and PCV were observed for number of cormels per plant, fresh weight of corm, number of corms per plant, rachis length and fresh weight of spike. High heritability with high genetic advance was observed for number of cormels per plant, fresh weight of corm, rachis length and fresh weight of spike. Whereas, correlation and path coefficient analysis in gladiolus revealed that, total blooming life, rachis length and diameter of second floret had positive and significant correlations with maximum direct effect on number of florets per spike. While leaf width, spike length and fresh weight of spike though had positive significant correlations, they exhibited maximum indirect effects.

P-1.29

Study of genotypic and phenotypic correlation coefficient in tomato

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Tomato is an important vegetable crop grown throughout the world including tropical, subtropical and temperate regions. In India, it is grown in an area of 9.05 lakh ha with annual production of 191.03 lakh tones. An increase in production per unit area per unit time is an ultimate aim of most of the breeding programmes. The expression of a complex character like yield is a sum total of the contribution of many simply inherited characters and therefore, direct selection for it may not be their consider but are interlinked and in this interlinked complex genetic system, selection practiced for an individual character might subsequently bring about a simultaneous change in other, thus an understanding of the association between the component characters and their relative contribution to yield is essential to bring a rational improvement in their desirable traits. An attempt was, therefore, made during *Spring-Summer* season of 2011-12 at Vegetable Research Centre, G.B.P.U.A. & T, Pantnagar.

The field experiment was laid out in Randomized Block Design with 29 genotypes along with two checks in three replications. Correlation coefficients for 17 quantitative characters *viz.,* plant height (cm), number of primary branches per plant, days to 50% flowering, number of fruit clusters per plant, number of fruits per cluster, days to first fruit ripening, days to first fruit picking, days to last fruit picking, average fruit weight (g), number of locules per fruit, number of fruits per plant, weight of fruits per plant (g), fruit diameter (cm), specific gravity(g/cm^3), TSS(^{0}B), 1000 seed weight (mg) and fruit yield (q/ha).

Common features of these results were that the genotypic correlation coefficient (G) was higher than the phenotypic correlation coefficient (P).Yield quintals per hectare exhibited highly significant and positive genotypic correlation for these characters namely plant height, number of primary branches per plant, days to last fruit picking, number of fruits cluster per plant, specific gravity, fruit diameter, number of fruits per plant, weight of fruit per plant and number of locules per fruit whereas highly significant and positive phenotypic correlation with plant height, number of primary branches per plant, number of fruits cluster per plant and weight of fruits per plant.

P-1.30

Molecular approach coupled with biochemical attributes to elucidate the presence of DYMV in leaf samples of Indian bean (*Lablab perpureus* L.) genotypes

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Indian bean (*Lablab purpureus L*), an Indian origin crop, less cared and suited for rain fed vegetable production in India. Besides India, this crop is also liked by other South Asian and African countries and used as vegetable and pulse by human and forage by animals. Indo-China region being a centre of diversity is endowed with great variability in terms of morphological characters especially, growth habit, maturity including shape, size, color of fruit and seed has been prone to various diseases that limit the productivity of the crop. Among diseases in Indian bean, Dolichos yellow mosaic virus (DYMV) caused by geminivirus transmitted through whitefly (*Bemisiatabaci*) is a major constraint for its cultivation in India. Chemical and cultural control measures are by and large ineffective, and high levels of host plant resistance in commercial cultivars are not yet available. Use of biotechnological approaches can play a significant role in developing cultivars resistant to DYMV disease. The established method for accurate and precise phenotyping for disease resistance doesn't give reliable results. The modern molecular tools such as molecular markers and gene transfer can be used for screening of genotypes against DYMV. Considering this, tengermplasm of Indian bean collected from different parts of India were subjected to biochemical and molecular screening to confirm the presence of DYMV. These germplasm were also screened against DYMV in both natural (field) and artificial (sap and insect inoculations under mass & cage conditions) screenings at Indian Institute of Vegetable Research, Varanasi, India during 2012-2013.

On the basis of results obtained it was observed that in comparison to non-infected leaves, DYMV infected leaves showed many symptoms, including severe mosaic, size reduction, stunting and deformation. Result from analysis of biochemical parameters indicated that viral infection affected metabolism. Viral infection decreased pigment, protein and carbohydrate levels. But in all non-infected leaves, the protein and carbohydrate contents were noticeably increased. Moreover, the other biochemical parameters showed variable alterations such as phenolic compounds increased in all genotypes under study except VRSEM-301 and VRSEM-749, VRSEM-894 and VRSEM-855. Also, hydrogen peroxide showed signi?cant increase in response to infection with DYMV in all genotypes. The same trend was observed in DHAR and MDHAR content in all tested genotypes. Activities of polyphenol oxidase, peroxidase, and catalase enzymes were also induced in most of the infected genotypes compared with non-infected genotypes. All the genotypes were also tested at molecular level for elucidating the presence of virus by using 5 sets of specific primer pairs. Two primers *viz*. DAC1 and DAC2 confirm the presence of virus in both non-infected and infected leaves. The differentiation in the appearance and/or disappearance of bands according to non-infected to infect reflects the variation between genotypes in defence against infection.

P-1.31

Multiplication of fruit crops through micro-propagation

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One of the most interesting areas of biotechnology is micro propagation. Micro propagation plant uses a high degree of control over is aspect of regeneration in tissue culture. It is propagation method of choice to propagate plants that are slow to multiply or those that cannot be clonally propagated any other way. It is also used to regenerate plants that have been genetically modified (transformed) through biotechnology.

Among fruits, micro propagation has been most successful in banana, papaya and date palm multiplication. Thousand of banana plants derived through micro propagation have been planted. Worldwide, in-vitro propagation of papaya, carica papaya L. for large scale multiplication and germplasm storage has been reported in mulberry, morus species which is an important multiplication tree for sericulture, wood production and fruits. More than sixty grape species or cultivars have been propagated in vitro from auxiliary branches of in vitro grown plant.

P-1.32

Genetic characterization and performance of diverse cultivars of *Rosa damascena* in sodic soil

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Rosa damascena mill L. of Rosaceae family, known as Damask Rose, is an ornamental plant and besides perfuming effect, several pharmacological properties including anti-HIV, antibacterial, antioxidant, antitussive, hypnotic, antidiabetic and relaxant effect on tracheal chains have been reported of this plant. An investigation was done on sodic soil to study the comparative performance of diverse cultivars of *R. damascena* regarding flower yield and its components at CSIR-National Botanical Research Institute (CSIR-NBRI), Lucknow. Twenty clonal genotypes were selected from base population of *R. damascena* stock maintained in sodic soil of Distant Research Centre of CSIR-NBRI at Banthara. The correlation and path coefficient analysis were analysed in these genotypes for six characters viz., plant height, plant spread, branches per plant, flowers per raceme, number of flowers per plant, weight of flower and flower yield per plant. The flower yield/plant was positively and significantly associated with number of flowers/plant and branches/plant, while number of flowers per plant was significantly and positively correlated with branches/plant. The plant spread was negatively correlated with flower per plant, flowers per raceme and flower yield per plant. Path coefficient analysis indicated that flowers/plant had a very high positive direct path followed by plant height and branches/plant. Flowers/raceme showed medium positive direct path, though had negative genotypic correlation with flower yield/plant. Considering the major contributors, a multiple selection index of medium plant height, prolific flowering branches/plant, more number of flowers/plant and flowers /raceme should be considered to develop the desired plant types for high flower yield of Damask rose.

P-1.33

Genetic studies in relation to improvement of gladiolus, grown on partially reclaimed sodic soil

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Gladiolus (*Gladiolus grandiflora* L.) is one of the economically important and common flowering plants, largely cultivated worldwide. It is very popular as a cut flower, both with the consumer and the florist alike because of its many spike forms, colours and colour combinations, an advantage in every floral arrangement. The aim of the study was to evaluate the performance of various Gladiolus cultivars under the sodic soil conditions of Uttar Pradesh to find the most suitable variety. Twenty five cultivars of Gladiolus were evaluated for their adoptability and performance in partially reclaimed sodic soil. The extent of variability, heritability and correlation coefficients for its floral characters were determined in a group 25 varieties of Gladiolus. High heritability coupled with high genetic

advance and coefficient of variability were observed for plant height, tillers/clump, spike length, corm weight, corms/clump, plant diameter and florets/spike. Spike length was positively correlated with all the characters like plant height, leaf length, leaf width and average corm weight except tillers/clump at genotypic level. Florets per spike was significantly and positively correlated with plant diameter, leaf width, tillers per clump and corms per clump. The maximum leaf length and width were noticed in White Goddess and Green Wood Packer, respectively. However maximum corms per clump was obtained from J V Gold and maximum average cormel was obtained from Friendship. Spike length, the main focal point of Gladiolus was positively and significantly associated with plant height, leaf length and width and average corm weight.

P-1.34

Evaluation of litchi cultivars in tarai region of Uttarakhand, India

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The litchi (*Litchi chinensis* Sonn.) is one of the commercially important fruit crops of Uttarakhand. Majority of early established orchards are having only one cultivar "Rose Scented" belonging to the Tai So group. In order to encourage its commercial development in Uttarakhand, many cultivars were introduced from various litchi growing regions of the country to evaluate their performance under local conditions. Regularity of fruiting, fruit cracking resistance, fruit size along with higher pulp percentage, yield potential and commercial potential were considered priority for the commercial suitability of a cultivar. Cultivars evaluated included 'Rose Scented' and 'Calcuttia' from Uttarakhand, 'Late Bedana'and,' Early Bedana' from Punjab, 'Shahi', 'Purbi', and 'Mandaraji' from Bihar, 'Bombai', and 'Bombai Selection' from West Bengal.

Among all the varieties evaluated, cultivar Rose Scented significantly registered maximum plant height (283.77cm), stem girth (35.67 cm) and canopy spread (220.12 cm and 228.60 cm) while minimum plant height (230.60 cm), stem girth (30.83 cm) and canopy spread (193.26 cm and 196.63 cm) were recorded in Mombai, Early Bedana and Purbi respectively (Table 1). Different varieties did not differ significantly with respect to initial fruit set and fruit drop percentage (Table 2). Significantly maximum panicle length (32 cm), No. of mature fruit/ panicle (15.3), fruit yield (73.65 kg tree^{-1}) and fruit cracking (20.12 %) were recorded in Rose Scented while maximum male flower was observed in Purbi (74.44 %). However, maximum average fruit weight (25.50 g), pulp weight (20.15 g), TSS (22.1 ^{0}B) and minimum acidity (0.39 %) were recorded in Late Seedless. Minimum No. of mature fruit panicle^{-1} (9.8), average fruit weight (19.40 g) and yield (38.80 kg tree^{-1}) were recorded in Bombai. However, maximum seed weight (4.61 g) was noted in Bombai selection while maximum peel weight was recorded in Early Bedana (4.58 g) and maximum seed:peel:pulp was registered in Bombai (0.12). Maximum acidity was recorded in Shahi (0.60 %) while maximum ascorbic acid was obtained in Calcuttia (28.2 mg g^{-1}). Based on these evaluations, the cultivars Rose Scented, Calcuttia, Early Bedana, Lare Bedana and China were deemed the most reliable in bearing and commercially viable.

P-1.35

Diurnal variations in mitotic cycle of allium cepa roots treated with ammonium nitrate

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Nitrogen (N) is considered to be the most indispensable as well as limiting factor for plant development,

therefore to congregate its demands for increased crop productivity, N fertilizers are applied in soil. Plants can utilize nitrogen in any one of the two common forms: ammonium nitrogen (NH_4^+-N) or nitrate nitrogen (NO_3^--N). Ammonium nitrate an inorganic N fertilizer, contains N in both nitrate (NO_3^-) and ammonium forms (NH_4^+). The haphazard use of N fertilizers may stimulate array of chromosomal variations in the plant systems which may impose mitotic disturbances. In present study, the pattern of mitotic activity of *Allium cepa* L. as an effect of ammonium nitrate exposure at day (11am to 2 pm) and night (11pm to 2 am) time were studied. Locally obtained medium sized healthy onion bulbs were taken and brownish bottom plates were removed carefully leaving the ring of root primordia intact and kept on distilled water filled test tubes for germination. When germinated roots were1-2 cm, the bulbs were placed on ammonium nitrate solution containing 0.5 mg N ml^{-1}. Squash technique was used for the mitotic preparations. The ammonium nitrate treated roots showed significant difference with their control counter parts with reference to mitotic index, active mitotic index, phase index. Results will be discussed.

P-1.36

Variability of spine gourd and *Dolichos* bean in Tripura

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Vegetable cultivation in Tripura is mainly done throughout the year comprising different winter and summer vegetables including various local land races of traditional vegetables such as bamboo shoots, basalla, *Amaranthus* and different types of colocasia and taro. A vast range of variability is found in all these local types of vegetables and these are very much popular among the Tribal as well as non Tribal people of Tripura. Similarly a wide range of variability is alos found in Spine gourd (*Momordica dioica* Roxb.) and *Dolichos* beans (*Lablab purpureus* L.) in different parts of the state. These two vegetables are widely grown and popular cucurbitaceous and Leguminous vegetables in Tripura. Spine gourd is grown during summer and rainy season, while *Dolichos* bean is sown during August- September and crop is harvested during November to January-February. Spine gourd is locally known as Kakrol or Karkol and Dolichos bean is known as Sem, Sim or Soi. Weather condition is very favourable for cultivation of these two vegetable crops in Tripura which experiences warm and humid climate with temperature ranging from 25-35°C. Spine gourd and another smaller variant as Sweet gourd is also found in the farmers field. Variability in spine gourd is observed in the fruit size, shape, skin color, spine softness, spine length, spine density on the skin, fruit lobe etc. Some of the salient traits of the local collection are 125-20g fruit weight, 12-7.5 cm fruit length and 60-40 cm fruit diameter. Fruit shapes were oblong, round, pyriform, round oblong and round with prominent elongated lobe at calyx end. Colour varied from dark to light green. Under *Dolichos* bean also pod length varied from 15.5-6.5 cm, pod width varied from 1.8-3.5 cm, weight of 10 green pods varied from 50-160g and nos. of pod/cluster varied from 5-10. Pod shapes were tubular, flat as well as roundish. Some were straight, semi curved or sickle type curved. Skin were smooth or rough. Skin colour varied from deep green, light green, deep reddish pink. There is colour variation on stem, flowers and seeds also. ICAR Research Complex Tripura centre is collecting all these different types of spine gourd and *Dolichos* beans for further study.

P-1.37

Use of biotechnology in agriculture-merits and demerits

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Agricultural biotechnology is a collection of scienti?c techniques used to improve plants, animals and microorganisms to enhance their value. Agricultural biotechnology has been practiced for a long time, as people

have sought to improve agriculturally important organisms by selection and breeding. An example of traditional agricultural biotechnology is the development of disease-resistant cultivated varieties by cross-breeding different crop types until the desired disease resistance was present in a resulting new variety. Biotechnology has helped to increase crop productivity by introducing such qualities as disease resistance and increased drought tolerance to the crops. In some cases, an effective transgenic crop-protection technology can control pests better and more cheaply than existing technologies. For example, with Bt engineered into a corn crop, the entire crop is resistant to be vine-ripened and still be shipped without bruising. Research is under way to make similar modifications to broccoli, celery, carrots, melons, and raspberry. Genetic engineering has allowed new options for improving the nutritional value, flavor, and texture of foods. Transgenic crops in development include soybeans with higher protein content, potatoes with more nutritionally available starch and an improved amino acid content, beans with more essential amino acids, and rice with the ability produce beta-carotene, a precursor of vitamin A, to help prevent blindness in people who have nutritionally inadequate diets.

Some consumers and environmentalists feel that inadequate effort has been made to understand the dangers in the use of transgenic crops, including their potential long-term impacts. Many individuals, when confronted with conflicting and confusing statements about the effect of genetic engineering on our environment and food supply, experience a “dread fear” that inspires great anxiety. The majority of foods do not cause any allergy in the majority of people. Food-allergic people usually react only to one or a few allergens in one or two specific foods. A major safety concern raised with regard to genetic engineering technology is the risk of introducing allergens and toxins into otherwise safe foods.

P-1.38

Embryo rescue: A technique to overcome the breeding barriers in fruit crops

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Embryo Rescue is one of the earliest and successful forms of *in vitro* culture technique that is used to assist in the development of plant embryos that might not survive to become viable plants. This technique nurtures the immature or weak embryo, thus allowing it the chance to survive. In contrast to conventional breeding methods, embryo rescue technique opened new vistas in plant breeding. It is very useful in wide hybridization, complete growth of embryo in plant, breaking dormancy of certain seeds where dormancy period is very long, development of seedless triploid types and shortening breeding cycle and inducing disease resistance in plants. This technology enables the recovery of an increased progeny; including progeny from interesting crosses that otherwise would be lost. Embryo rescue procedures have been very successful in overcoming barrier to wide hybridization in a wide range of plant materials. Success of immature embryo culture depends on several factors particularly plant genotype, embryo development stage and media composition. In mango hybrid, where minimizing fruit drop with growth regulator have not been successful and also number of flowers remaining in a panicle is very low then embryo culture could be used to rescue hybrid embryos. The embryo rescue was the unique tool which led to hybrid plantlets for four crosses: *Actinidia kolomikta* × *Actinidia chinensis*, *A. polygama* × *A. valvata*, *A. arguta* Issa × *A. polygama* and *A. kolomikta* × *A. deliciosa*. Embryo rescue from interspecific crosses in apple rootstocks *Malus prunifolia* and *Malus pumila* provided a rapid and uniform germination which consequently result in development of fully normal seedlings. Embryo rescue a biotechnological tool seems to be much reliable, increases breeding efficiency without any potential dangers to human health and the environment. This technique is useful in understanding embryo morphogenesis and precocious germination. As research continues with this technique, new and valuable uses will be developed to assist the biotechnological breeding of plants.

Technical Session 2:

Plant Protection and Biotic and Abiotic Stress Management of Horticultural Crops

O-2.1

Application of selected superior strains of microorganisms to minimize risks associated with fungicide based disease management in grapes

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Commercial grape cultivation in the humid tropical and sub-tropical areas in India is an expensive and high-risk enterprise because of the high incidence of three fungal diseases viz. powdery mildew, downy mildew, and anthracnose. These diseases not only affect the productivity of vines but also the fruit appearance and quality which reduces their market value. Disease management is mainly chemical based and a large number of fungicide applications are required when disease pressure is high due to favourable environmental conditions. This high fungicide use poses multifaceted problem of increased cost of cultivation, fungicide residues at harvest, and of the pathogens becoming resistant to single-point-of-action fungicides.

Many species of *Trichoderma* and *Bacillus*, especially *B. subtilis* are known to suppress diseases directly by parasitism and lysis; or indirectly by inducing systemic resistance in plants through triggering of their defense mechanisms. Generally, all these three diseases of grape occur during warm, wet and humid weather conditions, which means that a superior biocontrol strain would be that with wide-spectrum of activity against all three of them. Utilizing the enormous functional diversity existing in the microbial populations in nature, we have attempted to systematically evaluate a large microbial population and identified few strains which show potential for multiple disease control, suppress fungicide resistant strains of the pathogen, as well as ability to enhance the degradation of fungicide residues on fruits. Application of such superior strains in viticulture would be of great commercial interest to ensure a safer, environment-friendly, and sustainable solution to the problems of food safety and fungicide resistance management.

O-2.2

Role of genetic resources for protection of biotic and abiotic stresses in tomato

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Tomato (*Lycopersicon esculentum* Miller; new name *S. lycopersicum L*) is widely grown throughout the world because of its adaptability and versatility. India is the second largest producer of tomatoes in the world with acreage of 865000 ha and production and productivity of 16·8 mega tonnes (mt) and 19·5 mt/ha, respectively (Kumar *et al;* 2011). This crop is facing several biotic (leaf curl virus, early blight, fusarium and bacterial wilt and root knot nematode) and abiotic (high and low temperature, draught, excess moisture and salinity) stresses for its cultivation in northern part of Uttar Pradesh, India. The utilization of wild species is one of the option for management of biotic and abiotic stresses in vegetable crops including tomato. Because of wild species have resistant / tolerant genes. Though wild species in tomato are available in nature but utilization is very limited except *L. hirsutum* f. *glabaratum(New name: S. habrochaites)*, *L. peruvianum* (New name: *S. peruvianum*) inspite of several wild species like *L. pimpinellifolium (New name: S. pimpinellifolium)*, *L. cheesmanii (New name: S. cheesmaniae),*, *L. cerasaeformae (New name:S.cerasaeformae)*,*L. pennelli (New name:L.. pennelli)*,*L. glandulosum(New name: S. glandulosum)* may be interspecific incompatability or incongruity. Crossability behavior in tomato indicated that *L. esculentum* hybridize freely with *L. pimpinellifolium* and *L. cheesmani* giving coloured fruited tomato. It is compatable with *L. hirsutum* f. *glabaratum*, *L. hirsutum* f *typicum*, *L. parviflorum* and *L. chimelwskii,* only used as female parent. The successes of *L. esculentum* , *L. peruvianum* and *L. esculentum X L. chilense* require special aids like embryo culture.

O-2.3

Holistic management of biotic stresses for commercial vegetable production

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Vegetable crops provide nutritional security and have immense potential to fetch remunerative return to the farmers in very short period of time. Diversified agro climatic conditions in the country and increasing demand of vegetables in the domestic market encouraged the farmers towards their commercial cultivation round the year. The area, production, productivity and availability of vegetables in the country have increased significantly due to introduction of high yielding varieties and hybrids and also adoption of integrated nutrient and pest management practices by the farmers. Vegetable crops are grown in an area of 9.20 million ha with the total production of 162.18 million tonnes. The share of India in world vegetable area is 12.16 per cent while 11 per cent in production. The average productivity of vegetable crops in India is 17.36 tonnes/ha. The demonstrations conducted by Krishi Vigyan Kendra, Dehradun on integrated crop management proved that the productivity of vegetable crops can be enhanced two to three fold from the present productivity level in the country. The low productivity of vegetables in India is mainly due to poor adoption of high yielding hybrids and varieties. Besides, incidence of pests and diseases is also one of the major constraints in production of vegetable crops affecting quality and productivity both. The major pests, causing severe damage are fruit borer in tomato, shoot and fruit borer in brinjal and okra, fruit fly in cucurbitaceous vegetables, leaf curl mite in chilli, tomato, brinjal, leaf webber in cabbage and cauliflower, bacterial and fusarium wilt in tomato, chilli, brinjal and capsicum, late blight disease in tomato and potato. Most of the farmers use chemical pesticides for the control of various pests and diseases in their vegetable crops but still they are not aware about the judicious use of chemical pesticides like selection of appropriate chemical, its dose, time and method of application etc. In some parts of the country, due to unavailability of effective and eco friendly chemical pesticides, farmers are helpless to use spurious pesticides which do not provide relief to them from ravages of different pests and diseases. To promote the application of selective and safer chemical pesticides and other eco friendly strategies of pests and disease management in vegetable crops, adoption of Integrated Pest Management practices has an immense scope to reduce the number of application of chemical pesticides, besides encouraging use of other alternate approaches including resistant varieties against biotic stresses.

Some potential hybrids/ varieties of commercially important vegetable crops through assessment and evaluation under the Horticulture Technology Mission have been identified. They are Sonal, Shakti, VRO-6, BSS-893 in okra, Nandini and Malini in cucumber, Multistar and Kingstar in parthenocarpic cucumber, Nilgiri, Yamuna, Varun in cabbage, Madhuri and Girija in cauliflower, Lahar, Soldier, in chilli, Chhaya in brinjal, Agri found light red and Agri found white in rabi onion, Amanshree in bittergoard, Arka Rakshak and Heamsohna in tomato, Indra, California wonder, Swarna and pasarella in capsicum, Varad in bottlegourd, Lohit and Satya in smoothgourd, Agri Found Parvati in garlic for mountain regions. Besides, some selective insecticides viz. Thimethoxam 25% WG 0.01%, Imidacloprid 17.8% SL 0.01%, Spinosad 2.5% SC 0.005%, Spinosad 45% SC 0.02%, Indoxacarb 14.5% SC 0.01%, Acetamiprid 0.01%, Emamectin benzoate 0.002%, Novaluron 10% EC 0.005% have been found effective against economically important pests in vegetable crops, hence farmers should select these insecticides in proper fashion under IPM programme. Acaricide namely hexythiazox and propargite performed very well in management of leaf curl mite in okra and brnjal. Bait spray of malathion + molasses effectively minimized the incidence of fruit fly in cucurbits. Among fungicides, Thiophanate methyl 70% WP 0.1%, Difenoconazole 0.05%, Carbendazim 0.1%, Carbendazim+Mancozeb 0.1% Copper oxychloride 0.3%, Mancozeb 0.2% have shown their effectiveness against major diseases in vegetable crops. Foliar application of NPK 19:19:19 has been found effective in promoting vegetative growth of the crops. However, use of NPK 0:0:50 improved the physical attributed of the fruits which fetched premium price in the market. Spraying of humic acid also significantly increased the flowering and fruit setting in vegetables.

With respect to promote greater IPM implementation, special emphasis is necessary to generate increased awareness and transfer of available practicable and sound IPM strategies. The strategic steps will include determination of farmers pest management attitude and practices, IPM trial demonstrations and appropriate training of extension personnel and farmers.

O-2.4

Silencing the Stress with Molecular Silencers

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The horticulture crops are one of the primary source of nutrition and commercial products used regularly by human beings. These crops are constantly under attack from various biotic and abiotic stresses. Thus, we need to identify genetic, biochemical & structural mechanisms associated with abiotic and biotic stress resistance in horticulture crops in order to combat them in a scientific and logical manner. In recent times, the study on molecular biology of small non coding RNAs (ncRNAs) has been pivotal in providing us more knowledge about the lesser known mechanism in plants for transcriptional and post transcriptional regulation of gene expression. Both the transcriptional and post transcriptional gene silencing (PTGS) are important tools for either translational repression or mRNA degradation through which small RNAs especially, a 21-24 nucleotide long RNAs regulate the gene expression in response to various biotic stresses including virus infections. RNA interference (RNAi) technology gains specificity based on sequence homology, when dsRNAs called small interfering RNAs (siRNAs) silence its complementary mRNA in plants. Some of the transgenic horticulture crops produced by using siRNA are Golden mosaic virus resistant Pinto bean (approved by Brazil, 2011), Papaya ring spot virus resistant Papaya (approved by USA, 1996; Canada, 2003; Japan, 2011), high oleic acid Soybean line MON87705 (approved by New Zealand, 2010). siRNA strategy is a nonchemical potential alternative to synthetic pesticides to manage virus infections and its vector and a novel technology that reduce economic losses due to biotic stress on horticulture crops. Our research focuses on the application of siRNA strategy conferring resistance to biotic stresses caused by plant viruses in horticulture crops in India.

O-2.5

Effect of safer insecticides and botanicals against okra, leaf hopper, (*Amrasca biguttula biguttula*ishida)

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The present investigation on the response of safer insecticides against Brinjal leafhopper, *Amrascabiguttulabiguttula*Ishida., attacking Okra crop was under taken to determine the efficacy of different insecticides during *Zaid*2011 at farmer field of KrishiVigyan Kendra, Hardoi. The four sprayings were applied during the whole crop period at 30, 45, 60, and 75 days after sowing of crop. The spray of all the treatments effectively reduced the incidence of leafhopper. The insecticides Imidacloprid (17.8% SL), Malathion (50% EC), and Quinalphos (25% EC) gave most effective performance by providing 80.00, 76.00 and 73.24 per cent reduction in population over control respectively. The Neemarin, AchookandBioneem were also better effective to minimize pest population and provided 68.40, 55.50 and 38.66 per cent reduction in the leafhopper population over control.

P-2.1

Common beneficial predators and parasitoids in mango orchards

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There are a number of beneficial predators and parasitoids which help reduce mango insect pest damage. The common species found in mango orchards and provide a brief description of their contribution. Predators, there are a number of ladybird beetles in mango orchards. The adults and larvae feed on aphids, red-banded thrips, leafhoppers, scales, mealybugs and lepidopteran eggs. Lacewing larvae play a very important role in controlling, mango leafhoppers, aphids, mites, immature scales, mealybugs and small caterpillars. There are many species of spiders in mango orchards. Spiders are general predators, feeding on a range of insects including mango insect pests such as mango leafhoppers, mango tip borers, red-banded thrips, planthoppers, moths, bugs and flower caterpillars, etc. Hoverflies look like bees, but they only have one pair of wings, and maintain a stationary position in flight. Hoverfly adults are efficient pollinators, and their larvae feed on mealybugs and aphids. There are several species of predatory bugs that feed on caterpillars, leafhoppers, pest bugs, aphids and insect eggs. Preying mantids and mantispids feed on many insect pests such as grasshoppers, leafhoppers, planthoppers, fruit spotting bugs, tea mosquito bugs and moths. Parasitoids, there are many species of parasitic wasps that parasite eggs, pupae and larvae of insect pests. They play an important role in the mango orchards in controlling the main insect pests such as planthoppers, mango tip borers, fruit spotting bugs, scale insects and flower caterpillars.

P-2.2

Postharvest diseases is the worldwide problem of storage crop materials

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There are many postharvest diseases that can infect crops during storage, transport and marketing. Diseases that appear after crop harvesting are known as postharvest diseases. Postharvest diseases lead to economic loss by reducing quality/ market value. Due to lack of sophisticated postharvest storage facilities postharvest diseases affect a wide variety of crops. Many factors like environmental conditions, mechanical damage etc contribute to postharvest losses in fruits, vegetables and other stored crop products. Many species of bacteria and fungi are responsible for postharvest diseases. *Penicillium* is a common postharvest diseases pathogen. Blue mould diseases of different fruits like berries, pome fruits, stone fruits, citrus and mango caused by various species of *Penicillium.* Green mould disease of citrus fruit also caused *Penicillium digitatum.* Several species of *Aspergillus* like *A. niger, A. flavus, A. terreus, A. culmorum, A. fumigates, A. nidulans, A. tamarrii* cause postharvest diseases in groundnuts (*Araches hypogaea* L.). Bacterial soft rot of fruit and vegetables caused by various species of *Erwinia.* Other bacteria like *Bacillus polymyxa, Pseudomonas syringae* and *Xanthomonas campestris* also responsible for bacterial soft rot.

P-2.3

To study the powdery mildew disease of pea caused by *Erysipheae pisi*

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Powdery mildew is a common disease of pea and cause diseases on many types of plants. A wide variety of vegetable crops are affected by powdery mildews, including artichoke, beans, beets, carrot, cucumber, eggplant, lettuce, melons, peas, peppers, pumpkins, tomatoes, and turnips. Powdery mildews generally do not require moist conditions to establish and grow, and normally do well under warm conditions; thus they are more prevalent than many other leaf-infecting diseases under California's dry summer conditions. Powdery mildew first appears as white, powdery spots that may form on both surfaces of leaves.

All powdery mildew fungi require living plant tissue to grow. Special resting spores are produced, allowing overwinter survival of the species. Powdery mildew spores are carried by wind to new hosts. Moderate temperatures (60° to 80°F) and shady conditions generally are the most favourable for powdery mildew development. Spores and fungal growth are sensitive to extreme heat (above 90°F) and direct sunlight.

Powdery mildew disease of pea cause by ***Erysiphe pisi*** **(syn = *Alphitomorpha pisi* = *Ischnochaeta pisi;* anamorph: *Oidium arachidis*)**, a fungus that can be seed-borne but usually survives as conidia on living plants. Normally the disease does not cause serious losses if peas are planted in spring or an early-maturing cultivar is planted. When peas are recropped on the same ground, the fall planting sometimes develops problems. Symptoms, the first symptom is powdery white mycelium and spores on leaf and stem surfaces. On some cultivars, affected areas may die. All cultivars are dwarfed if infested early. Affected pods of some cultivars, including 'Oregon Sugar Pod', develop small brown to black necrotic spots.

Cultural control done by sowing early maturing cultivars. Many resistant cultivars are available. Rotate plantings at least 1 year. Chemical control by bicarbonates is registered to control powdery mildew. Kaligreen at 2.5 to 3 lb/A on 7- to 10-day intervals and may be applied up to the day before harvest. MilStop (85% potassium bicarbonate) at 2 to 5 lb/A. Cinnacure at 0.25 to 1 gal/A on 7- to 1-day intervals.

Copper products are not effective as stand-alone materials. Care must be taken to avoid build-up in the soil. By formulation of wettable Sulphur such as Sulfex and Thiovit at 3 kg/ha Elosal 8 WP three time at 10 days interval Karathane (Dinocap- 0.05%), Dikar (Manocap), Mososide (Binapacryl) and Morestan (Quinomethionate) 0.03 % Calixin followed by Karathane (0.2%) and Bavistin (100 ppm) Grow resistant varieties like JP-83, PM-2, JP-4, and JRS-14.

Sulfur formulations are registered. Sulfur is fungitoxic in its vapor phase and, therefore, is effective only when air temperatures promote volatilization. Sulfur volatilizes above 65°F but becomes phytotoxic above 95°F. Using it above 85°F is not recommended. Although sulfur reduces sporulation of established infections, it is primarily a protectant and must be applied before infection. Begin applying when weather conditions are appropriate and continue at weekly intervals.

P-2.4

Management of tomato fruit borer, *helicoverpa armigera* hübner (biotic stress) through bio intensive approach in tomato eco-system

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Tomato (*Lycopersicon esculentum* Mill.) is one of the most popular and commercially important vegetable crops in India. It is infested by different insect pests, among these insect pests, the damage caused by fruit borer, *Helicoverpa armigera* Hübner surpass the loss caused by all other insect pests together and it has been reported that the loss due to this pest range from 20-50 per cent crops in India. Without plant protection products, cultivated plants are defenceless against pests and diseases. Fungi, animal pests and weed competing for nutrients, water and light endanger agricultural production, diminish the yield and impair quality. The result: the supply and range of plant-based food products is reduced. That is why, prices go up and the supply with food products is threatened. If the use of plant protection products is reduced by 75%, the production of fruit and vegetables drops by more than 30-35 per cent. The use bio intensive approaches are the better potion for the management of the particular crop pest, with combination of bio agents and botanical insecticide (NSKE) against *H. armigera* Hübner in tomato eco-system. These approaches do not any type of detrimental effect to our environment and soil micro organism, which play an important role in biotic stress management.

P-2.5

Effect of newer insecticides on insect pest complex of brinjal, *Solanum melongena* L.

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The eggplant or aubergine or brinjal (*Solanum melongena* L.) is one of the most important solanaceous vegetables in south-east Asian countries including India. This important crop is subjected to attack by many insect pests throughout its growth period which act as limiting factor in its profitable cultivation. The important insect pests are shoot and fruit borer (*Leucinodes orbonalis* Guenee), lace-wing bug (*Urentius sentis* Distant), hadda beetle (*Epilachna vigintioctopunctata* Fabricius), jassid (*Amarasca biguttula biguttula* Ishida), brinjal stem borer (*Euzophera perticella* Rag.), white fly, (*Bemisia tabaci* Genn.), while its minor pests include aphid (*Aphis gossypii* Glover), brinjal leaf roller (*Eublemma olivacea* Walker), jassid (*Hishimonas phycitis*), all these biotic stress are responsible for decreasing the production of horticultural crops. The present study was conducted at Entomology Block of Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi in the year 2011-2012 to study the effect of newer insecticides against insect pest complex of brinjal. The result reveled that overall efficacy of the of insecticides MAIBA - 01 @ 2500 g *a.i.*/ha provided excellent protection and given highest yield (16900 kg/ha.) followed by its lower dose i.e. MAIBA - 01 @ 1250 g *a.i.* with yield of (16122 kg/ha). Fipronil 80 WG recorded the lowest reduction in whitefly, jassid and shoot and fruit borer population with yield of (12257 kg/ha).

P-2.6

Abiotic stress: The field environment and stress combination

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Farmers and breeders have long known that often it is the simultaneous occurrence of several abiotic stresses i.e., temperature, relative humidity, rainfall, sunshine hours etc., rather than a particular stress condition, these are the most lethal to horticultural crops. Surprisingly, the co-occurrence of different stresses is rarely addressed by molecular biologists that study plant acclimation. Recent studies have revealed that the response of plants to a combination of two different abiotic stresses is unique and cannot be directly extrapolated from the response of plants to each of the different stresses applied individually. Tolerance to a combination of different stress conditions, particularly those that mimic the field environment, should be the focus of future research programs aimed at developing transgenic crops and plants with enhanced tolerance to naturally occurring environmental conditions. Abiotic stress conditions cause extensive losses to agricultural production worldwide. Individually, stress conditions such as drought, salinity or heat have been the subject of intense research However, in the field, crops and horticultural plants are routinely subjected to a combination of different abiotic stresses. In drought stricken areas, for example, many crops encounter a combination of drought and other stresses, such as heat or salinity. Recent studies have revealed that the molecular and metabolic response of plants to a combination of drought and heat is unique and cannot be directly extrapolated from the response of plants to each of these different stresses applied individually. Studies of simultaneous stress exposure in different plants are well documented in various agronomic and horticulture journals. In addition, tolerance to a combination of two different abiotic stresses is a well-known breeding target in horticultural crops.

P-2.7

Plant protection of horticultural crops management through non-conventitional tools

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Use of molecular markers for gene tagging, transfer of genes from wild taxa, development of transgenes resistant to the biotic and abiotic stresses, micro-propagation, etc. are the potential areas. Biotechnological interventions for mass multiplication and gene transfer, identification and sequencing of genes are required to be generated on which the country will rely on for resolving its problems for food security. Regeneration protocols for development of transgenic plants in ber and pomegranate will be developed. This unit is to work on genetic improvement through selection and hybridization in selected crops like ber, pomegranate, aonla, tamarind, anona, under exploited fruit crops, cucurbitaceous, leguminous (khejri and beans) and solanaceous (chilli and brinjal) for biotic and abiotic stress. The regeneration protocols for development of transgenic plants in horticultural crops will also be developed. Work on agro-techniques such as propagation, planting systems, canopy management, plant architecture engineering, fruit growth and development, crop diversification, protected cultivation, tissue sampling techniques, organic cultivation, soil culture fertigation and weed management. Work on advances in nursery techniques, planting systems, crop rotations, inter culture, off-season production, role of plant growth regulators,

seed production, organic cultivation, water management through micro-irrigation system, protected cultivation is being carried out. Work on basic and applied research on integrated disease and pest, nematode and virus management of commercial arid and semi-arid fruit and vegetable crops. Constraint analysis, transfer, impact assessment & refinement of technology, capacity building of the farmers and developmental agencies will be carried out. Genetic improvement in the traditional fruits such as ber, pomegranate, aonla and vegetables such as chilli, tomato and cucurbits to induce resistance against abiotic stresses with particular reference to drought and heat should further boost their production in the regions. Since arid zone agro-climate offers a great potential for production of high quality produce, there is great opportunity for production of horticultural crops for export purpose.

P-2.8

Use of novel insecticides in horticultural crops

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The extensive use of conventional insecticides has resulted in the development of severe pest resistance to insecticides, out-break of secondary pests, pesticide residues, hazard to the users and detrimental effect on environment. The novel insecticides viz. Neonicotinoids, Diamides, Oxadiazines, Tetronic acid derivatives, Phenyl pyrazoles, Pyridine, Avermectins, Spinosyns,Pyrroles insect growth regulators (IGRs), etc. are used in horticultural crops which possess good controlling properties of insect pests at low rates or doses, high level of selectivity, greater specificity to target pests along with low toxicity to non-target organisms and the environment replaced many conventional/ old compound . The novel insecticides under chloronicotinyl are Imidacloprid, Acetamiprid, Nitenpyram, Thiamethoxam, Thiacloprid, Clothiamidin, Dinotefuran. Imidacloprid is the first neonictoinoid to be commercialized and being used over 140 crops. It is effective against sucking and chewing pests. It inhibits nicotinic acetylcholine by binding with nicotinic acetyl choline receptor (nAchR). The insecticide commonly used under phenyl Pyrazoles is Fipronil. Fipronil has contact action on both chewing and sucking insects. Its mode of action is the neuroinhibition of GABA-gated chloride channels. Fipronil exhibits broad activity against various insect pests such as diamondbackmoth, *Spodoptera* spp. It is sold under the brand name of Regent of Byaer Crop Science. In horticulture crops a number of insecticides being used which is derived from soil microorganism viz. Avermectins, Abamectin, Emamectin benzoate, Milbemycins, spinosyns, Diabroctins. Insect growth regulators viz. Diflubenzuron, Teflubenzuron, Flufenoxuron, Novaluron, Buprofezin are used with many good attributes of it. Juvenile hormone mimics like Pyriproxyfen and Hydroprene are used in horticultural crop. So, with the advent of newer molecules of insecticides have led to various advantages over conventional insecticides.

P-2.9

Plant drought stress: Effects, mechanisms and management

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Scarcity of water is a severe environmental constraint to plant productivity. Drought-induced loss in crop yield probably exceeds losses from all other causes, since both the severity and duration of the stress are critical. Drought stress reduces leaf size, stem extension and root proliferation, disturbs plant water relations and reduces

water-use efficiency. Plants display a variety of physiological and biochemical responses at cellular and whole-organism levels towards prevailing drought stress. CO_2 assimilation by leaves is reduced mainly by stomatal closure, membrane damage and disturbed activity of various enzymes, especially those of CO_2 fixation and adenosine triphosphate synthesis. Injury caused by reactive oxygen species to biological macromolecules under drought stress is among the major deterrents to growth. Plants display a range of mechanisms to withstand drought stress. The major mechanisms include water loss by increased diffusive resistance, enhanced water uptake with prolific and deep root systems and its efficient use, and smaller and succulent leaves to reduce the transpirational loss. Among the nutrients, potassium ions help in osmotic adjustment; silicon increases root endodermal silicification and improves the cell water balance. Low-molecular-weight osmolytes, including glycinebetaine, proline and other amino acids, organic acids, and polyols, are crucial to sustain cellular functions under drought. Plant growth substances such as salicylic acid, auxins, gibberrellins, cytokinin and abscisic acid modulate the plant responses towards drought. Polyamines, citrulline and several enzymes act as antioxidants and reduce the adverse effects of water deficit. At molecular levels several drought-responsive genes and transcription factors have been identified, such as the dehydration-responsive element-binding gene, aquaporin, late embryogenesis abundant proteins and dehydrins. Plant drought tolerance can be managed by adopting strategies such as mass screening and breeding, marker-assisted selection and exogenous application of hormones and osmoprotectants to seed or growing plants, as well as engineering for drought resistance.

P-2.10

Improvement of horticultural crops for abiotic stress tolerance

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Improvement of horticultural crops has traditionally focused on enhancing a plant's ability to resist diseases or insects. Research on crop resistance or tolerance to abiotic stresses (heat, cold, drought, salt, pH, etc.) has not received much attention. "Adaptive research" aiming at adapting the horticultural industry to climate changes is becoming popular and is now one of the emphasis areas of funding agencies. The warmer climate threatens the production of many horticultural crops, especially those cool-season species. Growing crops above their optimal temperature range may lead to cellular damages and the development of physiological disorders. Warmer springs might make crop seedlings emerge faster, but they could be vulnerable to damage from late spring frosts or freezes. The migration of salt water into groundwater is being exacerbated by increasing freshwater demands that are depleting coastal aquifers and the projected sea level rise caused by global warming. Therefore, there is an urgent need to mitigate these abiotic stresses through development of new heat, cold, drought and salt tolerant vegetable and fruit crop varieties that will thrive in future conditions. Plant diversity is the key for the future horticulture industry to buffer attacks from diseases, insects, and environmental adversities. Transgenic plants have shown great promise in tolerance to abiotic stresses such as heat, cold, drought, and salt. The changing environments pose serious and imminent threats to global agriculture and place unprecedented pressures on the sustainability of horticulture industry. On one hand, the climate change makes crop production more difficult. On the other hand, population growth and health-conscious consumers demand more and better horticultural products. The challenges and opportunities coexist for our dynamic and resilient industry. In addition to curbing carbon emission and conserving resources, we should mitigate abiotic stresses and adapt to the warming planet.

P-2.11

Screening of snapmelon genotypes for drought stress on the basis of enzymatic activities

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Snapmelon (*Cucumismelo*var. *momordica*) is an importantcucurbit crops often cultivated in arid and semi-arid regions of the world, drought stress is the major abiotic stress phenomenacausing crop yield loss worldwide. Earlier we screened 30 diverse genotypes of snapmelon under field condition on the basis of visual scoring (1 to 5 scale), drought tolerant efficiency (%), physiological parameters (RWC, photosynthesis, chlorophyll fluorescence, stomatal conductance,transpiration rate and electrolyte leakage) and horticultural traits.On the basis of above parameters, 4 tolerant and 2 susceptible accessions were selected for validation through pot experiment based on enzymatic activities *i.e*., super oxide dismutase (SOD), ascorbate peroxidase (APX), glutathione reductase (GR), guaicol peroxidase (POD)and catalase (CAT).Water stress was imposed by withholding water application for 7 days (soil water content (SWC) 26.65%), 14 days (SWC, 12.72%), 21 days (SWC, 8.32%). Drought stress was started after 25 days of sowing. A separate set of same lines were well watered and kept as control (SWC, 34.60%).Leaf samples from each treatment along with control were collected. In all the accessions SOD, APX, GR, POD,CAT, activity shows increasing trend in all treatments.Out of the accessions, BAM-VR-312 was found most tolerant to drought stress. SOD, APX, GR, POD and CAT activity after 21 days of water stress was maximum in BAM-VR-312 (58.46 u/gfw, 24.22 µmolascorbate oxidized min^{-1} mg^{-1}protein, 76.82 µmol NADPH oxidized $min^{-1}mg^{-1}$ protein, 42.12 µmol H_2O_2 reduced $min^{-1}mg^{-1}$ protein and304.25 µmol H_2O_2 oxidized $min^{-1}mg^{-1}$ protein, respectively), while activity for same parameters recorded lowest in most susceptible genotype BAM-VR-314 (22.44 u/gfw, 6.13 µmolascorbate oxidized min^{-1} mg^{-1}protein, 14.88 µmol NADPH oxidized $min^{-1}mg^{-1}$ protein, 17.22 µmol H_2O_2 reduced $min^{-1}mg^{-1}$ protein and143.69 µmol H_2O_2 oxidized $min^{-1}mg^{-1}$ protein, respectively). This could be concluded that rise in antioxidant activities with increasing days of water stress exposure in snapmelon, underlying the oxidative stress injury and subsequent tolerance to drought. In future, these findings based on antioxidant activities may serve as in-vitro selection criteria for drought tolerance in snapmelon. The genotype BAM-VR-312 can be utilized in breeding programme for development of drought tolerant snapmelon.

P-2.12

A new record of thread lace wing (Neuroptera: Nemopteridae: Crocinae) from Uttar Pradesh, India

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Neuroptera is a small order under class Insecta comprising of lace wings, antlions and owl flies. It is an important order of biological significance as predator, green lace wing and widely used in biocontrol programme for the management of sucking pests, however this order also includes lesser known nemopterids (spoon and thread lace wings). Hind wings of nemopterids are modified as spoon or thread like structure. They are crepuscular, inhabiting crevices in rocks and buildings. They are weak fliers and feed on soft-bodied insects (psocids and dermestids). Species distribution of Nemopteridae was largely influenced by vicariant events and restricted to Southern hemisphere. Five adult specimens of insects belonging to the subfamily Crocinae were collected from overhangs of building in Central Institute for Subtropical Horticulture (CISH), Rehmankhera, Lucknow during April-

May 2014. They were found streaming in the air in up and down motion similar to mayflies. The collected specimens measured 6-8mm in length and had all the characteristic features of subfamily Crocinae *viz*., posterior cubitus (CuP) and first anal veins (1A) of forewing is fused and possess an elongated rostrum. Hind wings are four times the length of body and 2.5 times as long as fore wings. The collected specimens show close resemblance with genus *Croce* MacLachlan 1885 under which only *C. filipennis* was reported from India (Bengal, Maharashtra, and Madhya Pradesh) but the actual identity of our specimen is yet to be ascertained. However, the discovery is the first report of Crocinae from Northern plains.

P-2.13

Improved physiological adaptation to drought stress in cleopatra mandarin by AM fungal inoculation

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There is a growing interest to understand the involvement of Arbuscular mycorrhizal (AM) fungi on physiological attributes that make the plant more tolerant to environmental stresses, particularly drought which is a major concern in agriculture management throughout the world. Thus pot culture studies were carried out by inoculating AM fungi *Glomus intraradices* in Cleopatra mandarin (*Citrus reshni* Hort. Ex Tan.) seedlings under well-watered and drought stress conditions in glasshouse at Indian Agricultural Research Institute, New Delhi, India. The results evinced increased growth in AM plants, which could be attributed to the improved water and nutrient uptake and altered root exudates. Drought stress induced generation of superoxide radicals and hydrogen peroxide was lower, while total glutathione and antioxidant enzyme activity in leaf and microbial activity in rhizospheric soil were higher in AM plants, as compared to control. Mycorrhizal colonization was positively correlated with antioxidant metabolite and enzymes, rhizospheric microbial activity and microbial biomass carbon and negatively correlated with reactive oxygen species under drought stress, which indicated that its inoculation could enhance plant defence system and alleviates oxidative damages to membrane lipids and proteins. From our study, it can be concluded that *G. intraradices* increase the drought stress tolerance in Cleopatra mandarin and the result would be better if inoculation done at seedling stage which help in improving seedling vigour and health.

P-2.14

Augmenting yield of guava through bio control of guava fruit fly to ensure nutritional security

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Guava is the second fruit crop after mango in terms of area and production in the Bareilly District. Approximate 30-40% Guava fruit is badly affected by the attack of fruit fly (Bactocera dorsalis). Chemical Control of fruit fly is not recommended because the repining of Guava fruit continued up to 3-4 month. There might be the more chances of pesticide residue etc. To tackle this frontline demonstration on “Bio Control of Fruit Fly in Guava” has been conducted on farmer’s field, used five fruit fly traps in one acre area. These traps were hanged on the twigs of the trees in the treatment plot, to attract the male insect of the Guava fruit fly. While in control plot farmers did not use any practice to check the fruit fly.

The observations were recorded on no. of fruit fly affected fruits, yield per ha and Benefit-cost Ratio. The observations were tabulated and analyzed. The highest yield was 140.40 Q/ha in treatment field, against 74.25 Q/ha in farmer's practice. The average yield of the treatment field was 114.9 Q/ha and increased 54.74% over the local check. The gross return of treated field was Rs. 91,920/- as compared to the control field which was Rs. 60200/- the net return was Rs. 47,120/- which is Rs. 25,120/- more, over the farmer's practice. The Benefit cost ratio was found to 2.05:1.00, while in farmer's practice it was 1.57:1.00/. The study revealed that the use of bio control traps in controlling the Guava fruit fly is cheaper, easy to operate and very effective. It is also safe practice for our environment. Adoption of Biocontrol of fruit fly has been popularized in the Bareilly, district and adjoing area of Uttar Pradesh.

P-2.15

Strenghthing IPM model in brinjal through promotion of pheromone trap

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Brinjal or eggplant (*Solanum melongena* L.) is an important, popular and principal vegetable crops in warm area. The crop is largely grown in small plots or as inter crop both for cash and domestic consumption by small farmers to earn money for their family.

The major constraint for cultivation of brinjal is Fruits and shoot borer i.e. *Leucinodes orbonalis* and noticed in all location in adopted vllages of KVK, Gwalior. A Study was undertaken to manage this insect through IPM. Farmers of adopted villages were acquainted with IPM technology through trainings and demonstration. Front line demonstration on IPM in brinjal against fruit and shoot borer conducted at farmer's field during kharif 2012 with the objective to find out method which is cost effective and compatible to agriculture situation of the farmer. The treatment consisted of destruction of infested shoot, use of pheromone trap and need based application of Profenophos 50WP@1.5ml/li. Result of demonstration indicated that IPM treatment increased yield i.e. 32.7% over control. The demonstration heighlight various merit and demerit of technology which reduces dependence on pesticide and offer advantage like saving labor and time.

P-2.16

Lenticel browning in mango and its control

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Mango (*Mangiferaindica*L.)is called as 'King of fruits' in our country and cultivated over 2.5 million ha with a production of 18 million tonnes annually contributing22.1% of the total fruit production andshares 56% of its global production. It is exported to the tune of about Rs.210 cr. annually, but its post-harvest lossesare still very high about 25 to 30 percent which is a major concern. Although, several postharvest problems are limiting its better marketing and export, lenticel browning (L.B.) is one of them, which accounts for quality loss in specific mango cultivars, it only affects the appearance but not the internal quality of the fruit. Lenticels are the macroscopic structure present on the fruit and responsible for the gaseous exchange, their browning occurs due to combination of physical (harvest maturity,harvesting method), and biochemical factors (terpenes, phenolic compounds, polyphenol oxidase enzyme) which ultimately lead to the loss of external appearance of fruits and edible quality significantly.

Hence, several techniques such as adequate use of detergents, hot water treatment, edible coatings, ascorbic acid etc., have been standardized world over to reduce LB so as to improve the physical appearance of fruits to increase better marketing in local market and export of such an important commodity. Similarly, screening of cultivars and standardisation of preharvest and postharvest techniques the effective controls can further be explored for decreasing the incidence of LB and maintenance of the sensory quality of mango fruit.

P-2.17

Soil solarization in relation to plant disease management

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Plant diseases cause 20-25% losses in crop production worldwide. Management of plant diseases by chemical can be spectacular but the accumulation of harmful chemical residues sometimes causes serious ecological problems so soil solarisation are alternative methods of soil borne disease management. Soil solarisation, a hydrothermal process, occurs in moist soil when covered by plastic film and heated by exposure to sunlight during the warm months. The process changes physical, chemical, and biological properties and thereby improves soil heath. It can be an alternative to soil fumigants (agricultural chemicals that have significant environmental risk, a negative impact on beneficial soil microorganism, and that are not user-friendly). Soil solarization is a simple, safe and effective alternative to toxic , costly soil fumigants and to the lengthy crop rotation needed to control many damaging soil borne pathogens and pests. In addition, this procedure may provide good weed control , improve soil tilth , and increase availability of essential plant nutrients soil solarization is that light received from sun is in the form of electromagnetic short wave ,which easily pass through the transparent polythene films and reach to soil . as a result ,earth is heated up and emits long wave radiation which however , cannot pass through transparent polythene films and result in trapping of heat that increase temperature and produce a green house like effect. Non-pesticidal and simple method. No health or safety problems associated with use. No registration is required. Crops produced are pesticide-free and may command a higher market price. Controls multiple soil borne diseases and selects for beneficial microorganisms. Tends to increase soil fertility. Use a clear, UV-stabilized plastic (polyethylene or polyvinyl chloride) tarp or sheeting 0.5 to 4 mils thick. The tarp material must be flexible enough to stretch across the soil surface. Using two layers of thin plastic sheeting separated by a thin insulating layer of air increase soil temperatures and the overall effectiveness of a solarization treatment. The edges of the sheet must be buried to a depth of 5 or 6 inches in the soil to prevent blowing or tearing of the tarp by the wind. Long, hot, sunny days are needed to reach the soil temperatures required to kill soil borne pests and weed seed. The longer the soil is heated, the better and deeper the control of all soil pests and weeds will be. During hot summers, a trapping period of 4 to 6 weeks should be all that's needed to control nematodes and soil borne plant pathogens. Other benefits such as populations of beneficial, growth-promoting and pathogen- antagonistic bacteria and fungi quickly decolonize solarised soil, adding a biological control component to soil solarization. Plant-pathogenic fungi weakened by high soil temperatures are more susceptible to these antagonists. *Rhizobium* bacteria are also sensitive to high soil temperatures, but reduced nodulation of the roots of legumes such as peas or beans in solarised soils should be temporary. Improved soil tilth and the increased availability of essential plant nutrients such as nitrogen, calcium and magnesium may also account for increases in plant growth following soil solarization.

P-2.18

Evaluation of newer molecule of insecticides against citrus leaf miner *Phyllocnistis citrella* stainton in nursery

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The present investigation was undertaken to assess the efficacy of different newer molecule of insecticides against citrus leaf miner in nursery on Nagpur mandarin grafts. The experiment was conducted during September-October 2012 at Centre of Excellence for Citrus (Indo- Israel Project) Horticulture Section, College of Agriculture, Nagpur. The investigation was conducted with treatments; Abamectin 1.9 EC (0.003%), Acetamiprid 20 SP (0.04%), Diflurobenziron 25 WP (0.08%), Dimethoate 30 EC (0.04%), Imidacloprid 17.8 SL (0.005%), Spinosad 45 SC (0.03%), Thiamethoxam 25 WG (0.06%) and Control (water spray). Observations were recorded with counting infected and total leaves from randomly selected five plants from each block and revealed that, the infestation of citrus leaf miner was mostly observed on sprouted leaves of citrus. Similar trend of the effect of different new molecules of insecticide was observed against citrus leaf miner in nursery at 3 DAS and 7 DAS of each application. Amongst the different new molecule of insecticides tested, Thiamethoxam 25 WG (0.06%) was significantly superior over all treatments recording cumulative lowest (4.50 per cent) leaf miner infestation. The Abamectin 1.9 EC (0.003%) was second in order of merit which exhibited 6.22% leaf miner infestation and found significantly superior to the following treatments *viz*, Spinosad 45 EC (0.03%), Acetamiprid 20 SP (0.04%), Imidacloprid 17.8 SL (0.005%), Diflubenzuron 25 WP (0.08%), and Dimethoate 30 EC (0.03%) recorded cumulative per cent leaves infestation of citrus leaf miner in the range of 9.71 to 14.57 per cent, respectively.

P-2.19

Response of inorganic, organic and bio-fertilizers on the production and quality of onion

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Onions which are known for diffusing flavor in our diet grown in India for both domestic market as well as international market. Conventional methods of fertilization have undoubtedly helped in improving both bulb yield and quality. But lately, routine management practices in India appear to be incapable of maintaining yields over the long-term. A gradual shift from using purely organic sources to introducing some proportion of inorganic fertilization is gaining acceptance. Therefore, integrated nutrients management has become necessary for increasing productivity of onion by sustaining the soil productivity at low cost of input. In view of the following facts, an experiment was conducted to assess the effect of integrated nutrient management, as compared to solely application of inorganic fertiliser, on onion production and quality in 2013-14. It was revealed from the data that application of 50% recommended dose of NPK along with 50% recommended dose of the vermicompost results in maximum vegetative growth (Plant height, Number of leaves, Neck thickness) and bulb growth (Bulb weight, Bulb length, Bulb diameter and bulb size) which is at par with (50% recommended NPK + 50 % FYM), recommended dose of NPK and (50 % recommended dose of NPK + 50% pressmud) and Similarly, maximum yield per hectare were found in (50% recommended NPK + 50% vermicompost) while minimum yield was observed in control. Maximum quality bulbs (TSS, vitamin C, Reducing Sugars, Non reducing Sugars and Total Sugars) were also found in (50% recommended

NPK + 50% vermicompost) followed by (50 % recommended dose of NPK + 50% FYM). Therefore, it is concluded that judicial application of organic fertilizer (vermicompost) along with chemical fertilizer will produce higher yield along with quality bulbs.

P-2.20

Evaluation of different inoculum levels of root knot nematode on soybean cultivars

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Twenty five soybean varieties / germplasm were evaluated reaction (Relative susceptibility and resistance) against root knot (*Meloidogyne incognita*) nematode. Out of twenty five varieties / germplasm, two BRAGG and JS 73-22 against *Meloidogyne incognita* gave very resistance reactions andPK-472, NRC-2 and JS20-34 found highly susceptible against *M. incognita.* (Sharma and Ashok Kumar1978), **in present investigations.** Effects of different levels of root knot nematode *Meloidogyne incognita* on growth parameter of soybean were shoot height, number of foliage, fresh and dry shoot weight, fresh and dry root weight, root length and increased number and size of galls females and egg mass population. Pots inoculated with the highest level i.e.10000 nematode / pot exhibited severe stunting with large galls (*M. incognita*). The progressive level of inoculation showed stunted in shoot weight, decreased foliage number, reduced fresh and dry shoot and root weight and root length. The cotyledon at lower levels (10 and100 N) of inoculums tend to be reduced the root length and plant height as compared to un inoculated. Similarly the emergence of the foliage was delayed by few days in inoculated plants when compared with un inoculated and 10 and 100 N level of Inoculum. Further, at 1000 and 10000 N levels, there was drastic reduction in shoot height, number of foliage, fresh and dry shoot weight, fresh and dry root weight, root length and increased number and size of galls in *Meloidogyne incognita*. Lowest level (10 N) showed stimulating effect on growth of the soybean plants.

P-2.21

Isolation and charactarization of protease and lipase producing bacteria isolated from agricultural soil and ice product from market

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The biosphere contains a very large number of extremophilic microorganisms with enzyme capable of functioning in unusual condition. Many kinds of cold active enzymes from cold adapted microorganism have been isolated from soil of cold regions. It is an important industrial enzymes accounting for 60% of total enzyme sales worldwide. They represent a very large and complex group of enzymes, which differ in properties such as substrate specificity, active site, catalytic mechanism, pH, temperature optima and stability profile. The proteases which are cold active are used in various industries like food, detergent and pharmaceuticals etc. In the present study twenty (15) protease producing bacteria and 8 lipase producing bacteria has been isolated from agricultural field and ice product from market. To compare and have a contrast picture 8 isolates from cold products and fifteen isolates from agricultural samples were analyzed and discussed briefly about purification and characterization of protease activity and lipase activity shown by above isolates. The study will give clear picture about implications of biotechnological implication shown by cold adapted bacteria as well as other isolates.

P-2.22

Silicon in enhancing the resistance of plants to biotic and abiotic stresses

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Although silicon (Si) has not been recognized as an essential element for plant growth, the beneficial effects of Silicon have been observed in a wide variety of plant species. The beneficial effects of Silicon are usually expressed more clearly in Silicon-accumulating plants under various abiotic and biotic stress conditions. Silicon is effective in controlling various pests and diseases caused by both fungi and bacteria in different plant species. Silicon also exerts alleviative effects on various abiotic stresses including salt stress, metal toxicity, drought stress, radiation damage, nutrient imbalance, high temperature, freezing and so on. These beneficial effects are mainly attributed to the high accumulation of silica on the tissue stirface although other mechanisms have also been proposed. The beneficial effect of Si is more evident under stress conditions. This is because Si is able to protect plants from multiple abiotic and biotic stresses . Numerous studies have shown that Si is effective in controlling diseases caused by both fungi and bacteria in different plant species. For example, Si increases rice resistance to leaf and neck blast, sheath blight, brown spot, leaf scald and stem rot . Silicon also decreases the incidence of powdery mildew in cucumber, barley and wheat; ring spot in sugarcane; rust in cowpea; leaf spot in Bermuda grass (*Cynodon dactylon*) and gray leaf spot in St. Augustine grass (*Stenotaphrum secundatum*) and perennial ryegrass. In a well-studied rice–*Magnaporthe grisea* pathosystem, the incubation period was lengthened by Si accumulation, whereas lesion length, rate of lesion expansion, and disease leaf area dramatically decreased . Silicon accumulation in plants is controlled by the ability of roots to take up Si. Silicon uptake is probably a complicated process and might be controlled by multiple genes in rice. Subcellular localization of *Lsi1* shows that this transporter appears to be responsible for the transport of Si from an external solution to the root cell. Therefore, there is a possibility that genes responsible for Si efflux exist and these should be cloned and characterized in the near future. Some gramineous plants such as maize and wheat also accumulate Si, although at a lower level compared with that of rice. Unfortunately, molecular mechanisms underlying Si uptake in these plants are unknown and, hence, Si uptake genes in other gramineous plant species need to be isolated and characterized. Furthermore, given that most plants, particularly dicots, cannot accumulate Si in large enough amounts to be beneficial, genetically manipulating the Si uptake capacity of the roots might help plants to accumulate more Si and, hence, more able to overcome both biotic and abiotic stresses.

P-2.23

Screening of some promising pigeonpea genotypes against major insect pests

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The present investigations on comparative performance of some newer varieties/genotypes are carried out during the Kharif season 2013-14 at the Entomology Trials Field, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. Among 24 pigeonpea genotypes a wide range of variation of pod (21.00 to 38.50%) and seed (12.29 to 19.87%) damaged by pod fly. the per cent of pod (8.5 to 21.50%) damaged by pod bug. The per cent of pod (5.50 to 12.50 %) damaged by Lepidopterous pod borer were recorded to with check BAHAR genotype,

Respectively whereas, The per cent pod damage by pod fly in the genotypes screened was found that pod damage ICPL 85063 (21.00%) had rating of 4 on the scale which depicts it is least susceptible than local check, BAHAR. The per cent pod damage by pod bug in the genotypes screened was found that genotype ICPL 85063 (8.50%) showed a rating of 4 on the scale, hence found to be least susceptible as compared to local check, BAHAR. The per cent pod damage by Lepidopterous pod borer in the genotypes screened was found that genotypes ICPHaRL 4985-4 (7.00%), ICPL 20062 (7.00%) and ICPL 85063 (5.50%) gave a rating of 4 on the rating scale and were found to be least susceptible against Lepidopterous pod borer when compared to local check, BAHAR.

P-2.24

Evaluation of newer fungicides and bio-agents for management of mango graft rot

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Grafting is a commercial method of propagation of mango (*Mangifera indica* L.) planting material. Under controlled conditions, it is done during April and May with great success. However, under natural conditions, it is also done during the months of July and August. In the process of grafting, scion sticks are covered with polythene cap (narrow envelop) up to the union of root stock and scion to maintain higher humidity for better success and avoiding drying. However, high moisture also favours graft rot by different pathogenic fungi viz. *Botryodiplodia theobromae*, *Rhizoctonia solani*, *Macrophomina phaseolina*, etc. or infection of root stock by *Sclerotium rolfsii* at ground level. Failure in perfect root stock-scion union is mainly due to presence of the pathogenic fungi. Scion sticks dip treatment in carbendazim or thiophanate methyl solution is generally suggested to protect grafts/union rot but this single treatment is partially effective and does not protect union rot up to the satisfactory level. Therefore, four fungicides (azoxistrobin, difenconazole, propiconazole and thiophanate methyl) at three different concentrations (0.05, 0.1 and 0.2%) and two bio-control agents i.e. *Trichoderma harzianum* and *T. viride* at two concentrations (500 and 1000 cfu/ml) were evaluated as soil drench 10 days before grafting followed by scion sticks treatment before grafting and single spray of the fungicides after removal of caps. *Trichoderma* spp. treated grafts were sprayed with thiophanate methyl @ 0.1%. At stage of cap removal, 12-28 per cent scion sticks were found rotten in various treatments. Isolation made from rotten grafts revealed the presence of *Botryodiplodia theobromae*, *Rhizoctonia solani* and *Macrophomina phaseolina*. Final data was recorded after five months of grafting. Maximum successful healthy grafts (52.0%) were obtained with complete package treatment (i.e. soil drenching, scion sticks treatment and one spray after cap removal) of thiophanate methyl (0.05%) followed by 48.0 per cent in propiconazole (0.1%), 46.0 per cent in *T. viride* (1000 cfu/ml), 40.0 per cent in difenconazole (0.05%) and 38.0 per cent in *T. harzianum* (1000 cfu/ml) and azoxistrobin (0.05%) as compared to 20.0 per cent in untreated control. Results suggest that complete package with thiophanate methyl is the best treatment and is followed by propiconazole or *T. viride.* These results can be used to protect mango propagules against graft rot at nursery stage with higher success rate of grafting.

P-2.25

An expert system for mango disease diagnosis and management

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India ranks first among mango producing countries accounting for about 50 per cent of the world's mango production. The crop is affected by large number of diseases at all stages of its growth. On an average, the crop suffers 10-15 per cent yield loss due to different diseases. If diseases are not identified correctly or control measures are not adopted at right time, the loss may reach up to 90 per cent. Keeping in view the limitations of mango growers in diagnosis of the different diseases and timely decision for the management of the different diseases, a decision support tools for diagnosis and integrated management of major diseases of mango has been developed at CISH, Lucknow. It describes development of a rule-based expert system. It is an object oriented approach of presenting rules in knowledge base of expert system in the form of Object-Attribute-Value that allows developing searchable knowledge base without the need of expert system shell software. Initially this system is developed for five major diseases (powdery mildew, anthracnose, bacterial canker, phoma blight and red rust) of mango, which may further be extended to different diseases of mango. This expert system is devised to show typical symptoms of the disease, weather parameters critical for rapid development of the diseases and suitable integrated disease management measures. After diagnosis, it also advises the management options of the different diseases. Expert system also include weather based forewarning of powdery mildew disease, which takes into account three weather parameters i.e., maximum and minimum temperatures, relative humidity and wind speed to find out whether weather is conducive for development of powdery mildew or not? If weather parameters are positive, then the system advises its management options. It is a good enough for providing appropriate advice for early diagnosis and integrated management of diseases for enhancing mango productivity. It would be helpful in early and accurate identification and management of diseases that would combine biological, physical and chemical management methods. The system will serve as an effective knowledge dissemination tool and will empower orchardist for effective decision making for the timely management of the different diseases.

P-2.26

Role of brassinosteroids in responses to environmental stresses in rice (*Oryza sativa* L.)

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Rice (*Oryza sativa*) is a model monocot system, staple food for more than one third of populationof the world. Abiotic stress is a major factor around the world in limiting plant growth and productivity thus Brassinosteroids are plant hormones with pleiotropic effects so they influence diverse growth and developmental processes. Rice being a Model system they provide a better means to study the potential effect of this new plant hormone. Brassinosteroids (BRs) are polyhydroxylated steroidal plant hormones that play an important role in the regulation of various plant growth and development processes. Recently, using genetics, proteomics, genomics, cell biology, and many other approaches, more components involved in the BR signaling pathway were identified. Furthermore, the

physiological, cellular, and molecular mechanisms by which BRs regulate various aspects of plant developments are being discovered. Researches have shown that BR biosynthetic or signaling mutants clearly indicates their role as a plant steroids are essential for regulating a variety of physiological processes including cellular expansion and proliferation, vascular differentiation, male fertility, timing senescence, and leaf development. Moreover, BRs regulate the expression of hundreds of genes, affect the activity of numerous metabolic pathways, and help to control overall developmental programs leading to morphogenesis. On the other hand, the potential application of BRs in agriculture to improve growth and yield under various stress conditions including drought, salinity, extreme temperatures, and heavy metal (Cd, Cu, Al, and Ni) toxicity, is of immense significance as these stresses immensely hamper the normal metabolism of plants. Seeing this important role of BRs, an attempt has been made to cover the various aspects mediated by BRs particularly under stress conditions and a possible mechanism of action of BRs has also been suggested. The mode of action of BR regulation to stress response occur as a result of a complex sequence of biochemical reactions such as activation or suppression of key enzymatic reactions, induction of protein synthesis, and the production of various chemical defense compounds. BRs open up new approaches for plant resistance against hazardous environmental conditions.

Technical Session 3:

Precision Farming: Protected Cultivation and Organic Horticulture

O-3.1

On farm production of quality inputs for sustaining production of mango in north Indian conditions

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Significant increase in production and productivity through area expansion under fruit crops has witnessed a sharp rise in past 20 years with use of agro-chemicals in India. The use of chemical fertilizers have partially polluted the environment through nitrate and killing beneficial micro-flora and fauna of the soil, thereby deteriorating the physical, chemical and biological properties of soil. Micro-nutrients and soil organic carbons are not sustained by chemical fertilizers usage and resulted in large scale multi nutrients deficiencies in soils of almost all the regions. Looking at the impact of green revolution, awakening has been created in many countries of the world to minimize the use of harmful agro-chemicals in the production of fruits. Increasing consciousness about conservation of environment as well as checking health hazards caused by harmful agro-chemicals has brought a paradigm shift in consumers' preference towards safe quality food, particularly in the developed countries. In organic production, most of the out sourced organic inputs do not meet the standard. Keeping above points in view organic inputs viz; biodynamic, NADEP, vermi compost, biodynamic liquid pesticides vermi wash and some other preparations were produced using locally available materials. Maximum nutrient level (N-2.15 %, P - 2.29 %, K- 0.53 %, Ca-1.72 %, Zn-168 ppm, Cu-61 ppm, Fe-3545 ppm, Mn-252 ppm and Na-027%) was recorded in vermicompost and minimum (N-0.70%, P-0.19%, K-0.37%, Ca-0.24%, Zn-75 ppm, Cu-34 ppm, Fe-222 ppm, Mn-3134 ppm) in FYM. The highest number of *Azotobacter* sp (1.5×10^6 cfu g^{-1}) and *Azospirillum* (1.4×10^7 cfu g^{-1}) was recorded in cow pat pit and lowest (1.0×10^3 cfu g^{-1}) in BD-501. Other organic preparations which contained good number of *Azotobacter* sp. were BD- 505 (9.0×10^5 cfu g^{-1}), BD- 507 (5.4×10^5 cfu g^{-1}), *Amritpani* (3.6×10^5 cfu g^{-1}), *Panchagavya* (2.8×10^5 cfu g^{-1}), BD -506 (1.01×10^6 cfu g^{-1}), and BD -500 (8×10^4 cfu g^{-1}). Similarly, highest number of *Azospirillum* sp. (1.30×10^6 cfu g^{-1}) was recorded in cow pat pit. A good number of *Azospirillum* sp. was recorded in BD -507 (3.2×10^3 cfu g^{-1}), *Panchagavya* (1.7×10^5 cfu g^{-1}) and BD -500 (3.0×10^4 cfu g^{-1}).

Microbial analysis of rhizospheric soil of *Ficus benghalensis* contained maximum number of *Azotobacter* (1.50×10^6 cfu g^{-1}) and *Azospirillum* (1.40×10^6 cfu g^{-1}) followed by *Ficus religiosa* which contained *Azotobacter* (1.0×10^5 cfu g^{-1}) and *Azospirillum* (8.5×10^5 cfu g^{-1}). Total colonies of microbes, P-solublizers and N-fixers were observed in biodynamic preparations and other organic formulations. Maximum bacterial count (8.3×10^5), fungal count (6.0×10^3) in BD-500, P-solublizers (6.1×10^5) and N fixers (7.0×10^5) in CPP . Fourteen bacteria and 13 fungi were isolated from biodynamic preparations 500-507, while sixteen bacterial species and 17 species of fungi were isolated from biodynamic bio pesticides prepared with neem, caster, pongamia, calotropis, lantana, vermiwash and amritpani.

O-3.2

Organic horticulture: Facets and dimensions

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Farming has its beginning some 10000 years ago. It had been in practice in traditional form until early 1800s.. Forest gardening, a traditional food production system which dates from prehistoric times, is thought to be the world's oldest and most resilient agroecosystem.http://en.wikipedia.org/wiki/Organic_farming - cite_note-8 It was natural farming system. With the synthesis of chemical fertilizers during the 18th century, it trickled slowly

and slowly in the agriculture. It was initiated with superphosphates and then ammonia-based fertilizers were mass-produced. These early fertilizers were cheap, powerful, and easy to transport in bulk. Similar advancement took place in chemical pesticides in the 1940s. The use of fertilizers on short term may be beneficial but on long term basis, it is not beneficial. It inflame the problem of soil compaction, loss of organic matter, reduced population of soil dwelling micro-organism, loss of soil fertility etc. Moreover, the effect of fertilizer is not health safe. Hence, the work began in the late 1800s and early 1900's as to develop ways to remedy these side effects, while still maintaining higher production.

In Central Europe Rudolf Joseph Lorenz Steiner - an Austrian philosopher , whose *Lectures on Agriculture* were published in 1925 created biodynamic agriculture, an early version of what we now call organic agriculture. The system was based on Steiner's philosophy of anthroposophy rather than on a solid grasp of science. In the late 1930s and early 1940s Sir Albert Howard and his wife Gabrielle Howard, both accomplished botanists, developed organic agriculture. Sir Albert Howard is widely considered to be the "father of organic farming", because he was the first to apply scientific knowledge and principles to these various traditional and more natural methods.

Increasing environmental awareness in the masses has transformed the originally supply-driven organic movement to a demand-driven one. The farmers are getting premium prices and some government are also providing subsidies to promote organic cultivation. In present paper, attempt has been made to highlight various facets of organic farming in detail.

O-3.3

High density planting: An approach for enhancing the fruit productivity

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Planting of fruit trees rather at closer spacing than the recommended one within unit land area, using certain special techniques with the sole objective of obtaining maximum crop yield per unit area without sacrificing quality is often referred as "high density planting". In high density planting (HDP) trees are planted very close together. Plant density may varies with the region, species to be grown, crop variety, rootstock used, cost of planting material, labour charges, assumed return from the orchard and techniques adopted for different horticultural operations for a crop. During last four decades, the importance of high density planting for higher productivity of fruit crops have been realized and now it has become one of the most successful tools of the Hi-Tech horticulture ensuring efficient use of land, water, nutrients and solar radiation with higher production per unit area. HDP offers early cropping and higher yields, improved fruit quality, reduced labour costs, enhanced mechanization in production with efficient use of different production resources leading to higher income per unit area. It can be achieved by the use of dwarfing rootstocks and genetically dwarf cultivars available in different crops, proper and timely use of growth retardants and mechanical methods for plant size control along with using incompatible rootstocks according to the situation. The various researches carried out in different parts of the country it has been found that under HDP of mango 1600 plants/hectare, in guava 2222 plants/hectare, in Citrus up to 3000 plants/hectare, in papaya 6400 plants/hectare, in banana 4500 to 7000 plants/hectare and in ultra-high density guava 5000 plants/hectare were found beneficial for getting higher yield with good returns.

O-3.4

Sensors, liquid nutrition and precision farming for higher horticultural production

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The technical evolution in the horticultural production is accompanied by changes in cultural practices, moisture sensor, liquid fertigation, new genotypes and new chemical treatments. The successes of the past have generated new possibilities for further reduction of production costs under more severe market constraints or environmental pressure. Technological developments (electronics and sensors) create the possibilities for a more precise production system. This technological development also requires a better understanding of the biological processes and of the properties of the biological materials. This can be used in concurrent engineering work in which biology, electronics, software and mechanics are bundled for new procedures in a quality assurance system of horticultural production. It leads to a horticultural production technology that enables to deliver products with a precisely specified quality using accurate and precise cultural practices, nutrition and water. It would be of great help to have sensing techniques that can predict the future quality of products.

O-3.5

Bio-efficacy studies of chloremequat chloride (Lihocin 50% sl) in grapes

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Excess vigour was recorded in grafted vines which has adverse effect on fruitfulness.Chloremequat chloride(CCC) is known for reducing the unwanted longitudinal shoot growth with reduction in internodal distance which aids in better source-sink relationship and as a result fruitfulness increases.Experiment was carried out in research farmyards of National Research Centre for Grapes, Pune on Vitis Vinifera cv Thompson Seedless grafted on Dogridge rootstock to study the bioefficacy of CCC (Lihosin 50% SL) in increasing the yield in grapes. Treatments were imposed at various growth stages (April-October). Results on bioefficacy of CCC showed significant differences in treatments with respect to parameters like cane diameter, internodal distance, shoot length, leaf area and pruning weight after 90 days after April pruning. The parameters studied after harvesting like bunch weight, pedicel thickness, skin thickness, TSS and acidity also showed significant differences. The highest cane diameter, leaf areaand reduced internodal length at 15-16 leaf stage was recorded with one application of CCCafter April pruning at 3-5 leaf stage @ 500 g.a.i/ha.No symptoms of any abnormality, toxicity werefound either on the leaves, canes/ shoots or berries whenCCC was applied up to 1000g a.i/ha.The residue analysis of leaf,petiole and cane samples was also done at harvestingstage and found below MRL in most of the samples.

P-3.1

Effect of plant growth regulators on gladiolus cv. American beauty in protected condition

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The trial was conducted under protected condition at the Horticulture Instructional Farm (Green House Unit), Department of Horticulture, JAU, Junagadh. Lowest days to sprouting (5.13 days), maximum numbers of sprouts per corm (3.24) and highest sprouting percentage (81.07 %) were registered in Thiourea 1000 ppm (T_1). Similarly, earliest spike emergence (60.64 days), maximum number of spikes per plant (2.26) and highest length of spike (74.30 cm) was noted in Thiourea 1000 ppm (T_1). However, maximum number of florets per spike (12.13) and highest diameter floret (10.42 mm) was found in Thiourea 2000 ppm (T_2). In case of corm production, maximum number of corms per plant (3.13), maximum average size of corms per plant (53.52 mm), maximum number of cormels per plant (10.01) and weight of cormels per plant (7.38 g) were noted in treatment GA_3 @ 50 ppm (T_6).

P-3.2

Effect of vermicompost, sulphur and micronutrients on growth and yield of garlic (*Allium sativum* L.) var. 'G-282.'

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A field experiment entitled 'Effect of vermicompost, sulphur and micronutrients on growth and yield of garlic (*Allium sativum* L.) var. G-282' was conducted during the *rabi* season in 2012-13 at the Department of Vegetable Science, College of Horticulture & Forestry, Jhalawar. The experiment consisted of eighteen treatment combinations with three levels of vermicompost (control, 10 and 15 t ha^{-1}), two levels of elemental sulphur (control, and 25 kg ha^{-1}) and three levels of micronutrients (control, $ZnSO_4$ @ 0.4% and Boric acid @ 0.2%) in Factorial Randomized Block Design with three replications. Application of 15 t ha^{-1} vermicompost, 25 kg ha^{-1} sulphur and $ZnSO_4$ @ 0.4% individually produced maximum plant height, number of leaves per plant, leaf length, neck thickness, total chlorophyll content of leaves, fresh weight of bulb, diameter of bulb, number of cloves per bulb, clove length, fresh weight of 50 cloves, dry weight of 50 cloves, yield of bulb per plot and estimated yield of bulb per hectare, as compared to control. The combined effect of vermicompost @ 15 t ha^{-1} (VC_2) and sulphur @ 25 kg ha^{-1} (S_1) was found significant on plant height, total chlorophyll content of leaves, neck thickness, fresh weight of bulb, bulb diameter, clove length, bulb yield in kg/plot and estimated bulb yield in qt/ha. The combined effect of vermicompost @ 15 t ha^{-1} (VC_2) and $ZnSO_4$ @ 0.4 percent (M_1) was found significant on plant height, total chlorophyll content of leaves, leaf length, neck thickness, fresh weight of bulb, bulb diameter, clove length, bulb yield in kg/plot and estimated bulb yield in qt/ha.

The interaction effect of vermicompost @ 15 t ha^{-1} along with sulphur @ 25 kg ha^{-1} and $ZnSO_4$ @ 0.4 percent i.e.$VC_2S_1M_1$ was found significant on total chlorophyll content of leaves, neck thickness, fresh weight of bulb, bulb diameter, fresh and dry weight of 50 cloves, bulb yield in kg/plot and estimated bulb yield in qt/ha as compared to control.. However, it was found statistically at par with $VC_2S_1M_2$ i.e. vermicompost @ 15 t ha^{-1} along with sulphur @ 25 kg ha^{-1} and boric acid @ 0.2 percent.

P-3.3

Impact of NAA and GA_3 on growth, yield and quality of onion (*Allium cepa* L.) cv. NHRDF-Red-2

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Bio-regulators play a vital role in plant metabolic activities which ultimately influence the vegetative growth, flowering, fruiting, quality of produce and overall performance of crop. In the present experiment two bio-regulators viz. Naphthalene acetic acid (NAA) and Gibberellic acid (GA_3) were applied to see their effect on performance of onion crop cv. NHRDF-RED-2 under Lucknow condition having high pH (8.2) soil. The experiment comprised of 12 treatments [T_0–control (water spray), T_1-Gibberellic acid (GA_3) @ 50 ppm, T_2- (GA_3) @ 100 ppm, T_3- GA_3 @ 150 ppm,T_4- Naphthalene acetic acid (NAA) @ 50 ppm, T_5- (NAA) @ 100 ppm, T_6- NAA @ 150 ppm, T_7- GA_3 @ 50 ppm + NAA @ 50 ppm, T_8- GA_3 @ 50 ppm +NAA @ 100 ppm, T_9- GA_3 @ 50 ppm + NAA @ 150 ppm, T_{10}- GA_3 @ 100 ppm + NAA @ 50 ppm, T_{11}- GA_3 @ 100 ppm + NAA @ 100 ppm and T_{12}- GA_3 @ 150 ppm + NAA @ 150 ppm] and replicated thrice with Randomized Block Design (RBD). It was found that the combined application of Gibberellic acid @ 100 ppm & Naphthalene acetic acid @ 100 ppm (T_{11}) was better in the comparison to the other treatments for satisfactory improvement of vegetative growth (maximum plant height- 46.47, 71.37 and 76.50 cm and basal diameter - 1.12, 1.84, and 2.05 mm at 30, 60 and 90 DAT, respectively), yield (3.26 kg/plot and 60.34 t/ha.) and quality parameters (TSS 12.03^{0}brix, Ascorbic acid 11.80 mg/100gand pH 6.99) of onion cv. NHRDF-RED-2 followed by T_9 (GA_3) @ 50 ppm + NAA @ 150 ppm)grown under Lucknow condition.

P-3.4

Effect of enriched material (Tata Geo Green) & FYM along with graded level of chemical fertilizer on the quality and yield of potato (*Solanum tuberosum* L.)

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Potato popularly known as the king of vegetables has emerged as fourth most important food crop in India after rice, wheat and maize India ranks second among potato producer countries and contribute about 10-11% of world potato production after China. Globally, the total area of potato under cultivation is 186.3 million ha with production of 3300 million tonnes and productivity 17.7 tonnes ha.$^{-1}$. In India total area under potato cultivation is 18.63 million ha with the total production of 423.39 million tonnes and productivity 22.7 tonnes ha.$^{-1}$ While in Uttar Pradesh area, production and productivity of potato is 5.56 million ha, 135.76 million tonnes and 24.4 tonnes ha^{-1}, respectively (Anonymous 2011).The nutritive value of potato/100g of edible portion as reported by Gopalan*et al.* (1987).

Data presented in table showed that maximum tuber yield (301.60q/ha) was recorded with treatment T2 receiving TGG @ 3.75 t/ha + RDF which is significantly superior to over all the treatments except treatment T6, T5, T3 and T1. Various levels of TGG (Enriched) showed significant improvement in yield as well as nutrients availability as compared to 100% recommended dose of chemical fertilizers supplied through inorganic fertilizers alone. Tuber yield and availability of nutrients (OC, N,P and K) showed impressive improvement through use of TGG(

Enriched) in combination with inorganic fertilizers. Improvements in tuber yield and nutrients status were relatively more under the treatments having TGG (Enriched) as compared to FYM. Application of various levels of TGG along with 75 and 50% RDF increased the tuber yield from 10.14% to 12.95% and 0.7% to 0.90% respectively over FYM with 25 and 50 % reduction of RDF respectively. ‘

P-3.5

Precision horticulture and sustainability

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Precision Horticulture (PH) can help in managing fruit crop production inputs in an environmentally friendly way. By using site-specific knowledge, PH can target rates of fertilizer, seed and chemicals for soil and other conditions. PH substitutes information and knowledge for physical inputs. This indicates PH can contribute in many ways to long-term sustainability of production horticulture, confirming the intuitive idea that PH should reduce environmental loading by applying fertilizers and pesticides only where they are needed, and when they are needed. Precision horticulture benefits to the environment come from more targeted use of inputs that reduce losses from excess applications and from reduction of losses due to nutrient imbalances, weed escapes, insect damage, etc. Other benefits include a reduction in pesticide resistance development. One limitation of the papers reviewed is that only a few actually measured directly environmental indices, such as leaching with the use of soil sensors. Most of the estimated inputs indirectly the environmental benefits by measuring the reduced chemical loading. Results from an on-farm trial provide an example of how site-specific information and variable rate application could be used in maintaining profitability while reducing N applications. Results of the sensitivity analysis show that PH is a modestly more profitable alternative than whole field management, for a wide range of restrictions on N application levels. These restrictions might be government regulations or the landowner’s understanding of environmental stewardship. In the example, variable rate of N maintains farm profitability even when nitrogen is restricted to less than half of the recommended uniform rate.

P-3.6

Effect of mulches on growth and yield of sponge gourd (*Luffa cylindrica* L.) cv. Pusa Chikni

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A field experiment was carried out at Agriculture research farm, Gumnawara, Institute of Agricultural Sciences, Kanpur Road, Bundelkhand University Jhansi (U.P.) during 2011. The experiment was laid out in randomized block design and replicated three times with seven treatments *i.e.* control (without mulch) (T_1), mulching with goat manure (T_2), white polythene mulch (T_3), grass mulch (T_4), farm yard manure mulch (T_5), black polythene mulch (T_6) and rice straw mulch (T_7) were examined. The results revealed that the maximum vine length of sponge gourd (125.00 cm.) was proclaimed in treatment T_6 (black polythene mulch) followed by T_5 and T_3 whereas treatment T_1, T_2 and T_7 were found statistically at par to each other. The maximum number of leaves, number of nodes, vine girth and vine spread (50.67, 49.67, 1.45 and 42.33 cm) were noticed in Black polythene mulches (T_6) at 50-57 DAS.

The minimum number of days (38.67 DAS) to flowering was observed in black polythene mulch (T_6), whereas flowers were latest appeared under control. Fruits with highest length and fruits with maximum diameter (18.27 cm and 11.20 cm respectively) were obtained in treatment T_6 followed by T_5 and T_3. The treatment T_6 (Black polythene mulch) gave the fruits with maximum weight and highest fruit yield 125.00 g and 213.47 q/ha respectively.

P-3.7

Seasonal variations of dehydrogenase activity and soil organic carbon in high density guava orchard

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Microbial enzymes in the soil are responsible for decomposition and conversion of organic substances and are key factors in determining soil fertility. Estimation of soil enzymatic activity is very sensitive, simple, rapid, and accurate and gives information on the status of microbial activity of the soil; therefore, is considered to be key factor for assessments of soil quality. The present study was undertaken to assess the seasonal variations of dehydrogenase activity in relation to soil organic carbon in a twenty years old guava cultivar Allahabad Safeda planted at four different spacings (1.5 x 3.0, 3.0 x 3.0, 3.0 x 6.0 and 6.0 x 6.0 m) in active root zone at 0.5 and 1.0 m from tree trunk. A wide range of dehydrogenase activity (0.38 to 2.37 µg TPF g^{-1} hr^{-1}) across the tree density, season and distance from the tree trunk was recorded. Temporal variability was recorded mainly due to climatic factors particularly rainfall and temperature. The activity gradually increased from January to March because of increase in soil and air temperature and decreased drastically to the lower value in the pre-monsoon months of April and May because of lower antecedent soil moisture content. The activity again increased in the following monsoon months and reached to the highest level in the month of July due conducive soil moisture and temperature. The activity however, decreased gradually during winter months as coolers season restrict enzymatic activity due to low soil temperature. Highest monthly average dehydrogenase activity (1.63 & 1.53 µg TPF g^{-1} hr^{-1}) was recorded in the medium density (3.0 x 3.0) plantation at 0.5 and 1.0 m from tree trunk respectively. The soil organic carbon ranged between 0.22 to 0.65 per cent. The monthly average soil organic carbon content (0.52 & 0.51 %) was also highest in the medium density (3.0 x 3.0) at 0.5 and 1.0 m from tree trunk respectively. Majority of soil samples had soil organic carbon content below the critical level (0.5%). The correlation studies revealed positive and significant relationship between dehydrogenase activity and the soil organic carbon content (r = 0.87**). Thus, indicated positive effect of soil organic carbon on microbial activity and therefore judicious soil organic matter management in high density plantations should be adopted in order to sustain the optimum soil biological activity.

P-3.8

Effect of bio-organics and mineral fertilizers on soil biological properties, fruit yield and quality of sapota

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A field experiment was conducted during 2010-11 at Main Garden, Department of Horticulture, Dr. PDKV, Akola (M.S.) to optimize plant nutrients by integrated nutrient management and to find their effect of soil biological

properties, fruit yield and quality of sapota. The experiment was laid out in Randomized Block Design with three replications with 10 treatments consisting two levels of NPK fertilizers (75 and 100% of recommended dose i.e. 1500:1000:500 g NPK), biofertilizers (Azotobacter, Azospirillium and PSB), vermicompost and FYM in different conjoint combinations and tested in comparison with Control.

On the basis of statistical analysis of recorded data, maximum soil biological properties viz., soil microbial population, soil microbial biomass carbon, dehydrogenase activity and CO_2 evolution were observed when part of plant nutrient requirements was met through conjoint application of 1125:750:375 g NPK + 15 kg vermicompost + 250 Azotobacter + 250 g PSB/plant. Similarly maximum fruit yield in terms of number of fruits per plant (1569.33) and fruit yield kg plant^{-1} (197.53) as well as better fruit quality in respect of fruit weight (125.87 g), fruit size, TSS (23.16^{0}B) and total sugars (18.03%) were recorded in same treatment application.

P-3.9

Effect of different mulches on growth, yield and quality of fig

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The experiment entitled, **"**Effect of different mulches on growth, yield and quality of fig" was conducted at 'Central Research Station " Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola with the objectives to study the effect of different mulches on growth, yield and quality of fig, to study effect of different mulches on weed intensity and to find out suitable mulch for better growth, yield & quality of fig. The experiment was laid out in Randomized Block Design with seven treatments such as black polythene, silver polythene, bicolour polythne, dry grass, wheat straw, leaf litter and control, replicated three times. The result of the investigation indicated that among different mulching treatments maximum shoot length, no. of new shoot, leaf area, quality attributes like fruit diameter, weight and volume of fruit, biochemical attributes such as TSS, acidity, ascorbic acid, reducing, non reducing and total sugar, soil temperature, soil moisture, weed count found in black polythene followed by dry grass mulch than other mulching treatments. Organic carbon was higher in dry grass mulch followed by leaf littre and wheat straw, also the dry matter production was higher in these treatment over rest of the treatments.The benefit cost ratio was observed higher in dry grass mulch followed by black polythene mulch than others. So present study revealed that better growth, yield and quality of fig can be very well achieved with black polythene mulch among the inorganic mulches and dry grassmulch gives better performance under organic mulches.

P-3.10

Effect of post-shooting sprays of sulphate of potash and growth regulators on bunch characteristics and yield of banana cv. Nendran

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An investigation was carried out at the Department of Fruit Crops, Tamil Nadu Agricultural University, Coimbatore with an objective to improve the bunch characters and fruit yield of banana cv. Nendran (AAB). The investigation consist of post-shoot application of SOP (2 %) and growth regulators (50 ppm GA_3, 25 ppm 2, 4-D, CPPU and Brassinostroid @ 2 ppm) at the time of last hand opening and 15 days after first spray under split plot design with three replications. The combined foliar sprays of 2 per cent SOP and 2 ppm Brassinosteroid significantly increased the bunch characters *viz*., bunch weight (11.35 kg), finger weight (215.40 g), finger length (29.10 cm), pulp weight

(180.22 g) and peel weight (40.45 g), pulp to peel ratio (5.13), fruit volume (209.55 ml) and total bunch yield (29.38 tonnes/ ha) with relatively higher benefit: cost ratio (2.87). Thus, the overall study clearly indicates the benefit of giving post-shoot application of SOP in combination with growth regulators which improves bunch characters and fruit yield with economically cost viable.

P-3.11

Precision Farming: Scope, present status and strategies for horticultural crops

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Rapid socio-economic changes in some developing countries, including India, are creating new scopes for application of precision agriculture (PA). The implications of dramatic shifts for economic development, urbanization and energy consumption in some developing countries are immense. High-tech nature of traditional PA technologies developed in advanced countries created a real challenge for engineers to search suitable PA technologies for developing countries. It precisely establishes various operations, such as the best tillage, application of fertilizer, sowing, irrigation, harvesting etc., and turns traditional extensive production to intensive production according to space variable data. Precision farming not only may utilize fully resources, reduce investment, decrease pollution of the of the environment and get the most of social and economic efficiency, but also makes farm products, the same as industry, become controllable, and be produced in standards and batches. However, precision farming has been confined to developed countries. Land tenure system, smaller farm size (<1ha) and crop diversity have limited the scope of precision farming in India. However, there is a wide scope for precision farming in irrigated/ commercial/fruit and vegetable crops/high value crops. It is apparent that there is a tremendous scope for Application of PA in cash crop, plantation crop, etc. has been discussed. Application of some medium and low-tech PA tools such as chlorophyll meter and leaf colour chart. in small farms has been included. Precision farming in India as well and it is necessary to develop database of agriculture resources, which will act as decision support system at the farm (<1 ha) level. Hard' PA utilizes all modern technologies such as GPS, RS, and VRT. Three components, namely, 'single PA technology', 'PA technology package' (for the user to select one or combination) and 'integrated PA technology', have been identified as a part of adoption strategies of PA in the developing countries.

P-3.12

Effects of foliar spray of gibberellic acid, CPPU and urea on apple nursery production under protected conditions

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The present investigations entitled "Effects of foliar spray of gibberellic acid, CPPU and urea on apple nursery production under protected conditions" was conducted at the experimental field of Department of Fruit Science, Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan during 2013-14. Foliar spray of GA_3 (50, 100 and 150 ppm), CPPU (5, 10 and 15 ppm) and urea (0.5, 1.0 and 1.5 %) was given at 4-5 leaf stage and repeated 4-5 week after budding. The results revealed that foliar application of urea at 1.5 per cent was the best treatment for increasing seedling height (82 cm), diameter (5.92 mm), root growth (9.67 m), proportion of buddable seedlings (92 %) and growth of budded plants which resulted 95 per cent saleable plants in a year under protective conditions. Foliar spray of 1.0 per cent urea also registered better seedling and root growth, which resulted into 91.83 per cent

buddable seedlings and 88 per cent saleable plants. Whereas, the untreated control attained the minimum seedling growth with 75 per cent buddable seedlings and 70.17 per cent saleable plants in one year under protected conditions.

P-3.13

Effect of different sources of organic manures and biofertilizers on growth, yield and quality of strawberry (*Fragaria* x *ananassa* Duch.) Cv. Chandler

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The present experiment was carried out to evaluate the effect of different levels of organic manures (Farm Yard Manure, vermicompost and pressmud) and biofertilizers (*Azotobactor*, Phosphate Solubilizing Bacteria and *Azospirillum*) on growth, yield and quality of strawberry Cv. Chandler at Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, U.P., India, during the year 2007-08. Maximum plant height (17.59 cm), maximum plant spreading (25.68 cm), maximum number of primary branches plant^{-1} (7.50), maximum number of secondary branches plant^{-1} (17.35), days taken first flowering (61.06), days taken from planting to first fruit setting (72.80), maximum fruit weight (11.75 g) and maximum fruit yield plant^{-1} (0.295 kg) were found with the combined application of vermicompost and phosphate solubilizing bacteria. Similarly, the treatments combination of vermicompost and phosphate solubilizing bacteria also significantly affected the total soluble solids (TSS) (10.75 ^{0}Brix), titratable acidity (0.82 %), vitamin C (57.24 mg/100gm fruit), reducing sugar (4.65 %), total sugars (5.95 %) and juice content (79.50 %). Conclusively, the application of vermicompost with Phosphate solubilizing bacteria was found most effective to improve the growth, yield and quality of strawberry Cv. Chandler.

P-3.14

Precision farming in horticulture: An innovative tool for higher crop production

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Precision farming is horticulture such a new emerging, highly promising technology, spreading rapidly mainly in the developed countries and has gained momentum in 21st century. It involves the application of technologies and principles to manage spatial and temporal variability associated with all the aspects of horticultural production for improving crop performance and environmental qualities. In short it means adding the right amount of treatment at the right time and the right location within a field. Philosophy behind the precision farming is that production inputs (seed, fertilizer, water, chemicals, etc.) should be applied as needed and where needed for the economic production. Currently there are 22 Precision Farming Development Centers (PFDC) have been established in different agro-climatic region in the country. In coming years, precision horticulture may help the Indian farmer to harvest the fruits of frontier technology without compromising the quality of land and produce. In the overall perspective, with the introduction and adoption of modern technologies, horticulture sector is expected to achieve a vertical growth. Precision horticulture is play a crucial role in the higher crop production with genetic improvements in crop traits will also play a crucial role in meeting global demand for food, feed, fiber and fuel in the near and distant future.

P-3.15

Effect of organic manures and biofertilizers on growth and quality of black carrot *(Daucus carota* L.*)* Cv Pusa Ashita

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A field experiment was carried out to assess the Effect of organic manures and biofertilizers on growth, and quality of black carrot *(Daucus carota* L*.)* cv. Pusa Ashita, was conducted at the Horticultural Research Farm of the Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, Lucknow during the year 2013-14. Maximum plant height 31.02 cm. Maximum length of leaves (11.80 cm) was observed with the application Vermicompost 1 ton/ha+PSB 1.25kg /ha + FYM 2.5 ton/ha +Azospirillum 250g/ha ($T_{12).}$The total soluble solid (T.S.S.) was recorded highest (9.57°B) in case of vermicompost (@4 tonnes/ha 100% (T_3) The carotene content of root (mg /100g) was recorded highest (4.56 mg/100g) in the case of vermicompost 50%+PSB 50 % ($T_{7).}$The ascorbic acid (mg/100g) was recorded highest (3.11mg/100g) in the case of Azospirillum 25% +Vermicompost 25% +FYM 50% (T_{11}). The total sugar (%) was recorded highest (8.40%) in case of vermicompost (@4 tonnes/ha) 100 % (T_{12}).

P-3.16

Role of information and communication technology for development of horticulture

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At the start of the 21st Century we are faced with the emerging problem of global fooddemand and exceeding the Earth's carrying capacity with the current way of horticulturalproduction. Moreover, the issues of safety, health, quality and sustainability, underpinned bythe concept of transparency, have become increasingly important. In many globaldiscussions forums it has been acknowledged that ICT can and will play an important role inmeeting these challenges. Precision horticulture and modern society could play an important roles in acceleratingadoption of ICT technologies. Precision horticulture requires fast and accurate handling andinterpretation of GEO-data. Variation in soil and crop conditions are detected by varioussensors and translated into sites specific actions. External data bases have to be consulted.Simple web service should facilitate this decision making. Think of digital diagnosis of cropstress and associated crop care advice. Controlled traffic farming and robotics require robustcommunication and GNSS networks. Society want sustainable food production. This meansthat farmers and food chains have to proof with data that their production systems aresustainable and risks are minimized (tracking and tracing). So, farm data will be used outsidethe farm by various other parties with different objectives (supply chain, food chain,governments, logistics, and consumers). Social media allow new ways of promotion and sales offarm products.

P-3.17

Soil test based N, P and K fertilizer prescription under integrated plant nutrient system for cowpea in delhi

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A field experiment was conducted at research farm of Indian Agricultural Research Institute, New Delhi during s*ummer* – 2012 with twenty four treatments to develop fertilizer adjustment equation for targeted yield of cowpea (variety- Pusa Sukomal) under integrated plant nutrient system based on soil test crop response correlation approach. Graded doses of N, P_2O_5 and K_2O fertilizers (Low, Medium and High) were applied in three equal size strips (Strip I, Strip II and Strip III**)** by broadcast method in each strip to develop a fertility gradient in previous year (2011) grown maize crop for fodder purpose for stabilizing fertility gradient in the experimental field.

The main experiment was conducted in similar manner in case of fertility gradient using cowpea as test crop. Each strip was again divided into 24 equal size plots. Twenty one fertilizer treatments were selected from different combinations of four levels of N (0, 10, 20 and 30 kg ha^{-1}), P_2O_5 (0, 30, 60 and 90 kg ha^{-1}) and K_2O (0, 30, 60 and 90 kg ha^{-1}) nutrients for cowpea crop. These treatments randomly divided in three groups (A, B and C) for doses of FYM @ 0, 5 and 10 t ha^{-1} treatment, each group contains seven fertilizer treatments then add one control (unfertilized) in each group.

Soil test data, cowpea green pod yield and NPK uptake by cowpea were used to comput four important basic parameters, viz. nutrient required to produce a ton of cowpea green pod yield (NR), contribution of nutrients from soil (% CS), contribution of nutrient from fertilizer (% CF) and contribution of nutrients from organic manures (% CFYM). The nutrient requirement for producing one ton green pod yield of cowpea was 30.1, 3.8 and 28.3 kg of N, P and K respectively. The per cent contribution of nutrients *i.e.* N, P and K from soil, fertilizer and farm yard manure (FYM) were found to be 61.0, 130.1 and 27.2 for nitrogen, 46.7, 25.1 and 13.4 for phosphorus and 58.4, 78.2 and 47.5 for potassium respectively. These parameters were used to prepare the ready reckoners of fertilizer doses for varying soil test values and desired targeted green pod yield of cowpea for NPK alone and integration with FYM. As per the IPNS based fertilizer prescription equation, for obtaining 6 tone ha^{-1} green pod yield of cowpea on a Typic Haplustept considering the average soil test values of 250, 20 and 200 kg ha^{-1} of available N, P and K, respectively, the requirement of fertilizer nutrient will be 11.3, 38.0 and 19.09 kg ha^{-1} of N, P_2O_5 and K_2O, respectively, along with 10 t FYM ha^{-1}.

P-3.18

Assessment of pore water conductivity in different fertigation regimes in Dashehari mango orchard

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Irrigation water is becoming precious and scanty day-by-day for mango fruit production. Water management is an important aspect in its life cycle to avoid any kind of moisture stress particularly during fruit developmental stages. The aim of this study was to assess the pore water conductivity in commercial mango cultivar Dashehari grown widely in Lucknow region under different fertigation stages. Treatments consisted of NPK application in basin irrigation (control), NPK fertigation from the beginning of September to the end of October, NPK fertigation at the time of flowering, NPK fertigation at the time of fruit setting and NPK fertigation from the beginning of September

to second week of May. Spatio-temporal variations in pore water conductivity were evaluated *in-situ* in 240 soil sites at 0-15 and 15-30 cm depth using a WET sensor. Wide variations were recorded across depths and treatments. A range of 105.7 to 180.7 and 111.7 to 155.3 mS m^{-1} at 0-15 and 15-30 cm soil depths was recorded during FBD period (Nov-Dec). Marginally higher EC_p was recorded during flowering periods (Feb-March) that ranged between 133.0 to 164.3 and 114.0 to 153.7 mS m^{-1} while during fruit developmental stages (March-June), 135.7 to 201.3 and 133.3 to 193.3 mS m^{-1} were observed at corresponding soil depths. Application of NPK fertigation from the beginning of September to second week of May showed higher mean EC_p values (155 and 145 mS m^{-1} respectively) as compared to 129.4 and 127.5 mS m^{-1} in control (NPK application in basin irrigation). The observations on temporal as well as spatial variations in EC_p indicated higher values (224.7 and 207.7 mS m^{-1}) in the monsoon season of the year. Further, it was inferred that EC_p was positively related to soil water content. The classical histographic analysis indicated that higher values of EC_p distributed around 150 mS m^{-1} with a frequency percentage of 15 to 22%. Thus, pore water conductivity may be useful for optimizing fertigation schedule in mango orchards.

P-3.19

Effect of various organic manures on growth, yield, quality and storage life of onion (*Allium cepa* L.)

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Onion is an important spice commodities consumed all over the world in various forms. Organic farming is a holistic production management system which promotes and enhances agro- ecosystem health, including biodiversity, biological cycles and soil biological activity. It emphasizes the use of management practices in preference to the effective utilization of organic manures and other organic wastes. In view of the increased awareness about organic farming , pesticide residue free food production, increased availability of organic inputs, investigation on these aspects have thus become imperative to assess their combination and their effect on yield, quality and post harvest storage life of onion. Onion is an important bulb spice grown commercially for local demand and also for export. The field experiment was conducted at kvk instructional farm Narayangaon Pune (M.S.) during Rabi season 2011-12.The results from the present experiment revealed that inorganic treatment consisting of 100% recommended dose of NPK fertilizer with chemical plant protection measures recorded the highest marketable bulb of 284q/ha . Among the various organic manures applied Farm Yard Manure(FYM) package recorded relatively higher yield 238q/ha than other organic manures evaluated. However, almost 22-40 % lesser marketable yield was recorded in organic farming system in comparison with inorganic production system in onion crop. From the quality aspects it was observed that organically nourished plots recorded better quality than inorganic package. However there was no significant difference between treatments. With regards to post-harvest storage life of onion Physiological loss in weight (PLW) and rotting have been found to be highly influenced by different organic manures application. It was observed from the results that minimum weight loss was noticed in bulbs harvested from plots which received organic manures in comparison with inorganic farming. The weight loss increased with the extended period of storage. The maximum storage losses of bulbs were noticed in inorganic farming after 150 days of storage. However there was no significant difference between treatments. Among the various organic and inorganic cultivation practices, soil available NPK and S content (kg/ha) were higher side in inorganic fertilizers applied plots than organic manures applied plots in onion crop. The influence of organic sources of nutrients on the soil biological properties was studied through the assessment of soil microbial population. It was observed soil bacteria, fungal and actinomycetes population was higher in soil nourished with organic manures than inorganic fertilizers applied plots.

P-3.20

Studies of INM for sustainable onion production (*Allium cepa L.)*

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The present field experiment was carried out at kvk instructional farm Narayangaon Pune(M.S.) in Randomized Block Design with three replications to evaluate the integrated nutrient management(INM) modules for onion crop. The experiment was conducted using onion cv. N-24-1 in clay loam soils during Rabi 2012-13. The results revealed that combined application of 75% recommended dose of fertilizer (RDF) +7.5 tones FYM+3.75 tones Poultry manure /ha recorded significantly higher marketable yield (48.8 tones/ha) over inorganic fertilizer applied treatments(46.5tones/ha). Application of 100% RDF along with 20 tones /ha of FYM registered 47.5 tones/ha marketable bulb yields. Marketable bulb yield recorded in other INM treatments were at par with inorganic fertilizer alone applied treatment. The highest pyruvic acid content (5.5micromols/g fresh weight) was recorded in inorganic fertilizers treatment. Bulbs harvested from INM treatments recorded lower pyruvic acid level (less than 4micromoles/ g fresh weight) than inorganic fertilizer alone applied treatment. Storage losses were significantly less in only inorganic fertilizers and bio-fertilizers (15.60%) applied treatments followed by 75% RDF and 15 tones/ha FYM(18.45%) over other treatments. No rotting loss was observed for the first two months. The increase in weight loss after 3rd month was mainly due to rotting. The present study revealed that inorganic fertilizer treatment registered yield at par with the treatment received both organic manures and inorganic fertilizers. Overall economic returns in INM treatments were decreased due to the addition of organic manures. However, application of organic manure is most essential to supply micro and secondary nutrients removed by the crops to sustain onion production and maintain soil health.

P-3.21

Effect of foliar spray of nutrients on fruit drop, yield and quality of mango (*Mangifera indica* L.) fruits cv. Amrapalli

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The present investigation “Effect of foliar spray of nutrients on fruit drop, yield and quality of mango (*Mangifera indica* L.) fruits cv. Amrapalli” was carried out at Main Experiment Station, Department of Horticulture, Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during the year 2013-2014.

The experiment was carried out on 21 year old mango orchard planted under sodic soil condition. The experiment was laid out in Randomized Block Design (R.B.D.) with 7 treatments and replicated in 3 times, considering two plants as a unit per treatment. The observations were recorded for Flowering and fruiting behaviour, Physical and yield attributing characters of mango fruits. Observations gathered with respect to maximum (7.60) number of fruits per shoot at pea stage**,** fruit retention (10.27%), fruit yield (51.00 kg/tree), fruit length(12.03 cm), fruit width(7.59 cm), fruit weight (338.33 g), fruit volume (350.00 cm^3), pulp weight (253.44 g), stone weight (39.33g), pulp per cent (77.65 per cent) and pulp: stone ratio (3.15) was obtained with the foliar application of $ZnSO_4$(0.4%). However, the minimum value was obtained with the application of water spray (control).

P-3.22

To screen out the promising mulch material and ideal spacing for runner production in strawberry cv. Chandler under Lucknow conditions

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Screening of promising mulch material and ideal spacing was carried out at the Horticulture Research Farm of the Department of Applied Plant Science, BabasahebBhimraoAmbedkar University,Lucknow, during the years 2007-2008 and 2008-2009. For this, six different mulch materials (dry neem leaves, paddy straw, dry grass, red polyethylene, green polyethylene and transparent polyethylene) were combined with the two spacings (30 x 30 cm and 30 x 15 cm). This experiment was laid out in two way factorial Randomized Block Design with three replications. Findings of the experiment indicated that the maximum number of runner production was found in red polyethylene mulch with the spacing 30 x 30 cm in the first year (2007-2008). Whereas, the minimum number of runner production was found in the control.

P-3.23

Effect of foliar feeding of nutrients and plant growth regulators on physico-chemical attribute of phalsa (*Grewia subinaequalis* D.C.)

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Phalsa (*Grewia subinaequalis* D.C.) belongs to family 'Tilliaceae'. Phalsa is native to India, fruit is known as berry. It has high nutritional and medicinal value containing iron, vitamin 'A', 'C' and phosphorus. The fruits are very delicious, tasty and used for table purpose. It is mostly consumed as fresh fruit and has cooling effect on human system. The fruits are excellent for making juice, syrup and squash.

During the studies, the treatments increased vegetative growth and fruit yield significantly. The maximum fruit size, weight of fruits (50 fruits), juice percentage , pulp: stone ratio, total soluble solids, sugars ascorbic acid and lowest acidity were recorded with foliar application of GA_3 @ 20 ppm+ NAA @ 50ppm + $ZnSO_4$ @0.4% + Urea @ 2% whereas minimum with control followed by GA_3 @20ppm + Urea @ 2%. Considering the importance of phalsa there is greater need to initiate the nutrient management programme to increase fruit size, uniform ripening, fruit yield and to improve the quality of fruits.

P-3.24

Effect of Irrigation and fertigation in high-density mango (*Mangifera indica* L.)

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The investigation on Irrigation and fertigation in high-density mango (*Mangifera indica* L.) var. "Amrapali" spacing at 2.5mx2.5m. The mango plants were subjected to two levels of irrigation (30% and 60% evaporation

replenishment rate) and two level of fertigations (75% and 50% recommended dose of fertilizer) applied through drip irrigation system. Fruit yield (9.50 t/ha.), number of fruits per plant (95.92) and fruit volume (250cc) were higher with 60% of evaporation replenishment rate as compared to 30% of evaporation replenishment rate fruit yield (7.00 t/ha.) number of fruits per plant (60.58) and fruit volume (225cc). The higher fruit yield (11.65 t/ha.) and number of fruits per plant (95.88) at 75% recommended dose of fertilizer, fruit yield (7.90 t/ha.) number of fruits per plant (60.38) were lower under 50% recommended dose of fertilizer. However, the interaction effect of 60% evaporation replenishment rate and 75% of recommended dose of fertilizer reported highest fruit yield (13.50 t/ha.) number of fruits per plant (90.13) as compared to other interactions. The acidity (0.35%), peel weight (50.42 g), pulp weight (175.89 g), stone weight (35.05 g), peel to pulp ratio (3.80) and pulp to stone ratio (3.60) were higher at 60% evaporation replenishment rate as compared to 30% of evaporation replenishment rate. Whereas, higher TSS was reported at 40% of evaporation replenishment rate (19.58^{o}Brix). Similarly, TSS (18.00^{o}Brix), peel weight (50.18 g), pulp weight (185.83 g), stone weight (45.06 g), peel to pulp ratio (3.90) and pulp to stone ratio (3.75) were higher at 75% RDF as compared to 50% of RDF.

P-3.25

Variation for fruit characters under polyhouse and open field conditions in tomato (*Solanum lycopersicon* L.)

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A study was conducted during Kharif-2013 in tomato using eight genotypes and 3 replications under polyhouse and open field conditions simultaneously to study the fruit characters of tomato at Vegetable farm, Institute of Agricultural Sciences, Banaras Hindu university, Varanasi. The genotypes used for the study were Kashi Vishesh, Kashi Amrit, Punjab Chhauhara, EC109762, EC676789, EC677047, EC677083 and EC581017. The results showed that there was considerable variation for all fruit characters under open field and polyhouse conditions. Fruit length, fruit width, fruit weight, stemend scar size and pericarp thickness was higher for the tomatoes grown under polyhouse condition compared to tomatoes gown under open field conditions. But open field grown tomatoes had higher total soluble solids (TSS) compared to the tomatoes grown under polyhouse conditions. Pericarp thickness under polyhouse and open field conditions for Kashi Vishesh was 11.98 mm and 6.48 mm respectively, for Kashi Amrit was 6.36mm and 2.10mm respectively and for Punjab Chhauhara was 9.08mm and 4.56mm respectively. Under polyhouse and open field conditions TSS for Kashi Vishesh was 3.00 and 3.80 respectively, for Kashi Amrit was 3.00 and 5.20 respectively and for Punjab Chhauhara was 3.20 and 5.00 respectively. Thus, the higher values of fruit length, fruit width, fruit weight, pericarp thickness increases the yield of tomato under polyhouse conditions compared to open field conditions. High TSS increases the amount the finished product and small stem end scar size had its relation with higher shelf life.

P-3.26

Cultivation of floricultural crops under protected or greenhouse condition

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A greenhouse is a covered structure which protects plants from vagaries of weather or environment *i.e.* wind, precipitation, excess solar radiation, temperature extremes and considerable attack of pest and disease. Modern greenhouse structure are being designed and built with higher gutter. The higher structures provide better air circulation and more even temperatures at bench level. Another advantage made possible in modern structures is the used of automated system, such as energy curtains. In strict sense, greenhouses are the structure in which optimum environmental condition are maintained round the year so that regular supply of flowers is maintained.

Under cool temperate condition the criterion is to admit plenty of light and air inside the house and hence construction is made north to south so that the broader sides are exposed more to the morning and the evening sun and the structures get less of the midday sun in the summer. In temperate countries, it is often advised to position the greenhouse from east to west also in the ground that the house gets the slanting rays of sun in the winter when the plants need it more. For Indian plains, it will be best to construct the greenhouse from north to south so that longer sides face east and west to avoid the scorching mid day sun.

For cooling of greenhouse, Fan pad cooling system, Pad size and Fog cooling system is used and Metalic frame. Polythene, sash bars, etc. are the source of heat loss through conduction. There are different types of greenhouse structures *i.e.* Lean to type, Even span type, Uneven span type, Curvilinear and curved eave type, Ground to ground type, Quonset type, Lath house and Low tunnel etc. are used. Indo-American hybrid seed company has made greenhouses for cultivation of ornamental plants before 1970.

P-3.27

Performance of air layering in litchi cultivars as influenced by IBA concentrations and application dates

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Litchi is an important sub-tropical fruit due to its good taste, flavour, juicy pulp and attractive colour. In India,it is cultivated on 78 thousand hectares area, having an annual production of 497 thousand metric tons with a productivity of 6.40 metric tons/ha. In India, major litchi growing belts are Bihar, Uttrakhand, West Bengal, Punjab, Uttar Pradesh, Assam, Jharkhand and Tripura. Propagation of litchi by seed is not usually recommended, since litchi is highly heterozygous and are characterized by a long juvenile period of 10-12 years and produce fruits of inferior quality. Therefore, to overcome the problem, asexual method of propagation is used. The most convenient, common and commercial method of propagation is air layering and Indole butyric acid (IBA)is widely used for promoting rooting. Asexual propagation leads to retention of desirable characteristics, creation of uniform rootstock and mass production of identical plants quickly and efficiently and all these can be fulfilled through air layering.

However, the major bottleneck associated with this method of propagation is the high mortality of layers after severing them from the mother plants and establishment in the nursery on their own root systems. The use of plant growth regulators like IBA, NAA etc. have been advocated for accelerating rooting in litchi layers. The time of layering plays an important role in rooting and production of quality layers.However, there is need to extend the duration of air layering, so that more number of healthy plants can be produced to meet out the growing demand of litchi saplings for area expansion. Keeping above facts in mind, the experiment was carried out with two commercially important litchi cultivars Calcuttiaand Rose Scented with the objectiveto study the effect of different IBA concentrations and application dates on the rooting, root characteristics, shoot characteristics and survivability of air layers.

Two commercial cultivars viz. Rose Scented and Calcuttia were selected separately for this experiment. The healthy 15-year-old mother plants were selected and marked in the litchi orchard. Layering operation was done on different dates viz. 3rd July, 18th July, 2ndAugust, 17thAugust 2012. To perform air layering, a ring of bark, about 2-3 cm wide just below a bud was removed from a healthy and vigorous twig of about one to two year old and of pencil thickness. Two combinations of IBA viz. 300 ppm and 600 ppm were applied on rings just after removing the barks. Cotton piece was used to apply IBA solutions at the distal cut surface of the layers.The rooted layers were detached from the mother plants after 60 days from the date of air layering. The rooted layers were transplanted in the poly bags under shade net immediately after detaching from the mother plants. Observations were recorded upon detachment of air layers from mother plant and 30 and 60 days after planting in poly bags. Experiment was laid out in Two Factorial Randomized Block Design (RBD) with five replications.

In litchi cv. Rose Scented and Calcuttia, the minimum days (27.41 and 27.44, respectively) to root appearance was recorded in layers made on 2nd August with 600 ppm IBA treatment. Also, average number of roots per air layer were found maximum (39.50 and 45.50) when air layering was performed on 2ndAugust with 600 ppm IBAin Rose Scented and Calcuttia, respectively. In both the cultivars Rose Scented and Calcuttia, maximum length of roots (8.30 and 8.36 cm., respectively) was observed in air layers with IBA 600 ppm treatment when air layering was done on 17th August. Air layers prepared on 17th August produce maximum leaflets per air layer (4.28 and 4.44, respectively) when layers were treated with IBA 600 ppm.

P-3.28

Effect of low tunnel polyhouse on raising of early seedlings of water melon (*Citrullus lanatus* Thumb) cv. Madhuri

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A field investigation the effect of Low Tunnel Polyhouse on raising seedlings of water melon was carried out in the Department of Horticulture, Kulbhashkar Ashram Post Graduate College, Allahabad during 2011-12.Consedering the crop value and increasing demand of water melon in big cities emphasis on its cultivation in off season under protected structure is being made to catch early market. Low Tunnel Poly house (LTP) technology is a simple, economic and profitable technology for off season cultivation of cucurbits, especially water melon during winter season in Northern Plains of country. Allahabad is situated on the bank of Ganga – Yamuna rivers and farmers grow water melon in KACHHAR of these rivers to get handsome price but the farmers who grow water melon in upper land away from Ganga –Yamunabasin, harvest their crop in the month of May –June and get low price due to glut of melon fruits in the market. The main hurdle of these farmers is to sowing of crop in field from last week of February and early sowing cause greater mortality of seedlings in open field due to low temperature. LTP may prove the ray of hope to the farmers for raising early crop by growing seedling under LTP.The trial was done with a view to raising water melon seedlings in winter month under three conditions to assess environmental factors on seed germination, growth and survival of seedlings. Seeds were sown in polythene bags(10 cm size) under low Tunnel Polyhouse in the last week of December. Seeds were also sown in field and polybags in open conditions as control. It was observed that highest germination (90 %), minimum mortality (8.3%) and maximum

survival of seedlings (92 %) were recorded in polybags under LTP.Under open polybags the values were 50%, 46% and92.50% respectively. Under open field condition germination and mortality was 25% and 100% respectively. It may be advocated that water melon seedlings under Low Tunnel Polyhousesurvive better and extra-early crop can be taken with remunerative price.

P-3.29

Effect of organic manures, bio-fertilizer and micronutrients on growth, yield and quality of onion (*Allium cepa*) cv. NHRDF Red-2

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A field experiment was conducted during the rabi season of 2013-2014 at the Babasaheb Bhimrao Ambedkar University, (A Central University) Vidya - Vihar, Rae Bareli Road, Lucknow-226025 (U.P.), India, to find out the effect of the organic manures, bio-fertilizer and micronutrients on growth, yield quality of onion cv. NHRDF Red - 2. The experiment was designed in a Randomized Block Design with three replications. There were 12 treatments combinations along with control viz., T_0 (Recommended dose of fertilizers), T_1 (Poultry manure), T_2 (Vermicompost), T_3 (Azotobacter), T_4 (VAM), T_5 (Azotobacter + R.D.F (50%) + Zinc), T_6 (Azotobacter + R.D.F (75%) + Zinc), T_7 (VAM + R.D.F (50%) + Boron), T_8 (VAM + R.D.F (75%) + Boron), T_9 (R.D.F (25%) + VAM +Poultry manure (50%) + Azotobacter + Boron), T_{10} (R.D.F (25%) + VAM + Vermicompost (50%) + Azotobacter + Boron), T_{11} (R.D.F (25%) + VAM + Poultry manure (50%) Azotobacter + Zinc), T_{12} (R.D.F (25%) + VAM + Vermicompost (50%) Azotobacter +Zinc). The results of this study clearly revealed that there were significant effect of various treatments on the growth, yield and quality attributes of onion. The number of leaves per plant (12.15), plant height (73.02 cm), neck thickness (22.00 mm), bulb length (6.46 cm), bulb diameter (7.20 cm), yield (398.36 kg/ha^{-1}), were the maximum in treatment T_{12} and T.S.S (14 ºB), vitamin 'C' (12.11mg/100g), reducing sugar (6.23%), total sugars (10.52%), non-reducing sugar (4.28%) were the maximum in T_{10} treatment combination as compared to other treatments.

P-3.30

Effect of foliar feeding of nutrients on yield and quality of aonla (*Emblica officinalis Gaertn*) cv. Chakaiya

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The present investigation entitled on "Effect of foliar feeding of nutrients on yield and quality of aonla (Emblicaofficinalis Gaertn) cv. Chakaiya" was carried out at the MES and laboratory of Department of Fruit Science, NDUAT, Kumarganj-Faizabad (U.P.) during the year 2012-13. The experiment was conducted in RBD with eight treatments and three replication consist of various levels of each nutrients ZnSO4 (0.5%), CuSO4 (0.5%), Borax (0.5%), FeSO4 (0.5%), MgSO4 (0.5%), Urea (2.0%), K2O (2.0%) and control (water spray). The foliar applications of these nutrients were applied two times before flowering and after fruit set. The effect of foliar spray of nutrients on physio-chemical attributes of aonla fruits. The observations were recorded on per cent fruit drop and fruit retention, fruit size, fruit weight, and fruit quality. The result shows that the foliar application of ZnSO4 (0.5%) was found to be most effective in reducing the intensity of fruit drop, high fruit retention, improving the fruit size and fruit weight, increase of Vitamin-C content and highest fruit yield as compared to other treatments.

P-3.31

Effect of micro nutrients on yield and quality of strawberry (*Fragaria x ananassa Duch)* cv. Chandler

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The present investigation entitled "Effect of micro nutrients on yield and quality of strawberry (*Fragaria x ananassa Duch*) cv. Chandler." was carried out at the form of NDUAT, Govind Nagar. The statistical design was RBD consisting as eight treatment and three replication. The result shows that the treatment $ZnSo_4$@0.25% + Mn SO_4 @ 0.25% Cu So_4 @ 0.25% + $CuSO_4$ @ 0.25%. were found superior over the plant height, No. of leaves, flowers and No. of Fruits per plant.

The fruit quality like TSS, total sugars & Ascorbic acid were also significantly increased and acidity were drastically decreased by the application of combined application of $ZnSO_4$ @ 0.25% + Mn SO_4 @ 0.25% $CuSo_4$@ 0.25%

P-3.32

Assessment of interactions of plant growth with fish guano, an organic fertilizer

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Fertilization is the most expensive cultural practice for the increasing numbers of organic vegetable growers. Guano is a natural organic fertilizer used in organic farming management when supplementary nitrogen is needed. Fish guano, an organic fertilizer, is a natural deposit of excreta. It is rich in nitrogen, phosphate, potassium and also have small quantity of potash and lime. The guano was found to be nitrified in soil more rapidly then organic fertilizers. The objective of this research work was to discover the potential of fish guano to produce healthy and productive tomato plants using fish guano in combination of Farm Yard Manure and NPK to determine plant length and number of leaves. For this, tomato seedlings of 13-3cm were collected from nursery and planted along with soil (negative control), alone in FYM and NPK (positive control) and combination of three dosages of fish guano with soil and FYM (1:1) (soil+ FYM : fish guano; 100:0.75, 100:1.00, 100:1.25) experimental. Experiment sets were arranged in completely randomized block design with three replicates for 30 days duration. Results revealed that interactive combination of higher dose (100:1.25) of fish guano with FYM was significantly superior in enhancing plant length and number of leaves as compared to their respective positive and negative control. The outcome of this observation clearly indicated that the fish guano is rich in all the macro and micronutrients that temperate plants require for an ideal cultivation. Hence ably serve as plant fertilizer, soil builder, soil cleanser, fungicide, nematocide, and compost activator. This work suggested that fish guano has significant benefits over conventional fertilizers for the temperate crop/vegetables.

P-3.33

Yield and quality response of aonla (*Emblica officinalis* Gaertn) cv. Chakaiya to foliar application of plant growth regulators and micro-nutrients

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The present investigation entitled on "Yield and quality response of aonla (*Emblica officinalis Gaertn*) cv. Chakaiya to foliar application of plant growth regulators and micro-nutrients" was carried out at the Department of Horticulture & Forestry, NDUAT, Kumarganj-Faizabad (U.P.) during the year 2011-12. The experiment was conducted with seven treatments consist of 2 levels of each plant growth regulators (20ppm NAA and 50ppm GA_3) and micro-nutrients (0.25% Borax and 0.5% $ZnSO_4$) in RBD with four replications. The foliar application of these nutrients were applied two times after fruit set in the month of mid of June and July. The observations were recorded on per cent fruit drop and fruit retention, fruit size, fruit weight, pulp: stone ratio and fruit quality at different stages of fruit development. The minimum per cent of fruit drop (71.34%) and maximum per cent of fruit retention (25.68%) was recorded with 20ppm NAA+0.25% Borax+0.5% $ZnSO_4$. Significant increase in fruit size, fruit weight, pulp: stone ratio (13.35%) were also recorded due to treatments (T_5 and T_6) as compared to other treatments. The maximum TSS (8.97%), reducing (2.68%), non-reducing (2.26%) and total sugars (4.95%) were recorded with treatment of 50ppm NAA+0.25% Borax+0.5% $ZnSO_4$. While the highest Vitamin 'C' (5630m/100g of fruit pulp) and fruit yield (103.32 kg/tree) were recorded with 20ppm NAA+0.25% Borax+0.5% $ZnSO_4$ as compared to other treatments.

P-3.34

Integration of biofertilizers to ensure fresh strawberry production in central Uttar Pradesh

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Central Uttar Pradesh is a sub-tropical region characterized by high temperature due to which commercial strawberry cultivation has not been found feasible till now. Since, strawberry (*Fragaria* x *ananassa* Duch.) is a highly remunerative crop which yields returns in a very short duration, a study was conducted during 2009–11 at Department of Applied Plant Science (Horticulture), BBAU, Lucknow to ensure the fresh strawberry production in central Uttar Pradesh by adopting good agricultural practices and integration of biofertilizers. The treatments consisted of control, *Azotobacter* (100%), *Azospirillum* (100%), FYM, *Azotobacter* (50%) + *Azospirillum* (50%), *Azotobacter* (100%) + NPK (50%), *Azospirillum* (100%) + NPK (50%), *Azotobacter* (50%) + *Azospirillum* (50%) + NPK (50%), *Azotobacter* (100%) + FYM, *Azospirillum* (100%) + FYM, *Azotobacter* (50%) + *Azospirillum* (50%) + FYM, *Azotobacter* (50%) + *Azospirillum* (50%) + NPK (50%) + FYM. The results indicated that integration of biofertilizers with inorganic fertilizers may not only achieve highest strawberry yield and benefit: cost ratio but also improved the quality of fruits and fertility of soils and the treatment T_8 [*Azotobacter* (50%) + *Azospirillum* (50%) + NPK (50%)] may be of interest for commercial growing of strawberries in U.P. with higher strawberry yield, better quality fruits, overall acceptability by the consumers and a benefit to the farmers.

P-3.35

Effect of post-shooting sprays of sulphate of potash and certain growth regulators on bunch characters and fruit yield of banana cv. Nendran (AAB)

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An investigation was carried out at the Department of Fruit Crops, Tamil Nadu Agricultural University, Coimbatore with an objective to improve the bunch characters and fruit yield of banana cv. Nendran (AAB). The investigation consist of post-shoot application of SOP (2 %) and growth regulators (50 ppm GA_3, 25 ppm 2, 4-D, CPPU and Brassinostroid @ 2 ppm) at the time of last hand opening and 15 days after first spray under split plot design with three replications. The combined foliar sprays of 2 per cent SOP and 2 ppm Brassinosteroid significantly increased the bunch characters *viz*., bunch weight (11.35 kg), finger weight (215.40 g), finger length (29.10 cm), pulp weight (180.22 g), pulp to peel ratio (5.13) and total bunch yield (29.38 tonnes/ ha) with relatively higher benefit: cost ratio (2.87). Thus, the overall study clearly indicates the benefit of giving post-shoot application of SOP in combination with growth regulators which improves bunch characters and fruit yield with economically cost viable.

P-3.36

Biofertilizers in vegetable cultivation

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Azatobacter and Phosphate solubilizers are the main biofertilizers used in vegetable cultivation.Azatobacter is free living nitrogen fixing bacteria which fixes 25-30Kg nitrogen/ha.It also produce harmone like Indole Acetic Acid and vitamins like Biotin,folic acid and different B-groups are also formed.The application of Azatobacter along with organic matter and fertilizer ensures good germination,growth and production.The application of Azospirillum @2Kg/ha. As basal in combination with 75% recommended nitrogen gave very high yield of chilli.In onion application of Azospirillum at 500gm/ha seed treatment and 1Kg/ha seedling dipping and 5Kg/ha soil application gave highest yield.Phosphate solubilizing biofertilizer play very significant role in vegetable production.it help in solubilizing insoluble phosphate.around 95-99% of the total soil phosphorus are in soluble which are not directly available to plants.The phosphorus solubilizers containing bacteria or fungi may convert in soluble form of phosphorus to soluble form by producing organic acid seed/set/seedling/soil treatment are done.

P-3.37

Economic utilization of sodic land through off season vegetable cultivation under protected condition

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In Uttar Pradesh, a large area affected by salinity/alkalinity, comes predominantly in wasteland category and covers an area of 2.19 lakh km^2. To meet the ever increasing food demands, these soils have to be reclaimed and made suitable to cultivate economic crops. The chemical based reclamation is technically difficult and costly; and such reclaimed soils revert back to sodicity after some time. Therefore, considering the need of a simple technique to economically utilize sodic lands without going into the technicalities of their physical and chemical properties, a model playhouse with misting and cooling facilities was developed on 250m^2 sodic land. Inside polyhouse, off season cultivation of vegetables was initiated in discarded cement bags, filled with appropriate soil mixture. Such a model offers distinct advantages of quality, productivity and favorable market price of produce to the growers. The bags were filled with soil, vermi-compost, press mud, rice husk, coco peat and neem cake in an appropriate proportion and placed on the bricks at 60 x 60 cm distance inside the polyhouse. Off season production of vegetables under polyhouse conditions involves their protection mainly from adverse environmental conditions such as temperature, hails, scorching sun, heavy rains, snow and frost. This can play a better role in improving quality, advancing maturity as well as increasing fruiting span and productivity. This model can support round the year cultivation and production of vegetable crops. Vegetables like sponge gourd, bitter gourd, bottle gourd, capsicum, cucumber and tomato can be grown inside polyhouse during winter season while cauliflower, cabbage, cucumber, carrot during summer season. Vegetable growers having small sodic land in the peri-urban areas can substantially increase their income by protected cultivation of vegetables in the off-season.

P-3.38

Organic food : New way of healthy living

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Organic farms do not consume or release synthetic pesticides into the environment—some of which have the potential to harm soil, water and local terrestrial and aquatic wildlife. Organic farms are better than conventional farms at sustaining diverse ecosystems, i.e., populations of plants and insects, as well as animals. When calculated either per unit area or per unit of yield, organic farms use less energy and produce less waste, e.g., waste such as packaging materials for chemicals. Natural products vary in their nutritional composition both in their raw and processed states. At a qualitative level, this variability partly underlies the differences in sensory properties of food such as taste, texture and smell. However, at a quantitative level, the inherent variability also adds considerable complexity to research on the nutrient composition of foods. Fruit and vegetable crops vary in their nutritional composition depending on numerous factors such as the growing conditions and season, the fertilizer regime and the methods used for crop protection (e.g., use of pesticides and herbicides). That the consumption of organic food may reduce the risk of heart attacks and cancer. Benefits of organic brown rice - brown rice is a good source of health beneficial nutrients such as fiber and essential minerals. Brown rice is high in nutrients, while low in calories, making it a very healthy food.

P-3.39

Effect of bio-fertilizer on morphological and nutritional status of aonla (*Emblica officinalis* Gaertn.) seedling and grafted plants

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The Indian gooseberry (*Emblica officinalis Gaertn.*) belongs to family Euphorbiacea, native to tropical South-East Asia, particularly Central and South India. It is considered to be the second richest source of vitamin-C, 600 mg/100g next to barbedose cherry and it also contains high amount of minerals, i.e. iron, calcium and phosphorus. A number of value added processed fruit products, herbal and cosmetic products are manufactured from the fruits. The experiment was carried on "Effect of Bio-Fertilizer on Morphological and Nutritional Status of Aonla (*Emblica officinalis Gaertn.*) Seedling and Grafted Plants'' during the year 2011 and 2012 at Biotech Networking Facility Centre (Council of Science and Technology) Bakshi Ka Talab , Lucknow (U.P.).

The study was conducted in two sets of experiments, one is seedling plants and another is on grafted plants each consisting 8 treatments (T_1=Control, T_2=Arbuscular Mycorrhizal Fungi, T_3=Azospirillum, T_4=Trichoderma ,T_5= Phosphate Solubilizing Bacteria,T_6= AMF+Azospirillum, T_7= AMF + PSB T_8= AMF+Trichoderma). The experimental data were recorded on various aspects plant height, plant girth, growth performance, survival of grafts and nutritional status in aonla seedling and grafted plants. Among all the treatment combination T_6 treatment were found superior in seedling and grafted plants in respect to plant height, plant girth, growth performance, survival of grafts and nutritional status and slightly reduced by T_5, T_7, T_8, T_3, T_2, T_4, T_1. It was found that most ideal combination of biofertilizer is AMF+ Azospirillum in aonla seedling and grafted plants.

Technical Session 4:

Post-Harvest Handling, Food Technology and Value Addition in Horticultural Crops

O-4.1

Value addition of mango solid wastes

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Mango is one of the major fruit crops of India which accounts for 52% of world's production and is processed into various products. At present mango is processed maximum there by generating huge quantities of solid and liquid wastes. Indian mango processing industry is facing the problem of mango waste disposal. If a factory is processing 5 tonnes of Totapuri mangoes per hour say working for 8hours a day, about 6 tonnes of peel and almost same amount of stone would be available as waste. Solid waste is comprised of mango peel, stones, stalk, trimmings and fibrous materials obtained during preparation of raw material. This constitute about 40-50% of total fruits waste, of which 12-15 percent, 5-10 percent is pulper waste and 15-20 percent is kernel. This waste is either used as cattle feed or is dumped in open areas where it adds to environmental pollution. There is an immediate need to utilize this waste. Mango peel is a rich source of pectin and fibre, while the kernel is rich in starch and oil. CISH has developed a number of value added products such as pectin, fibre, starch, bioethanol, enzymes, protein enriched feed, cosmetic product , pigments from mango peel and stone. There is a need to upscale these technologies. Making value added products out of mango processing waste will prevent post harvest losses, environmental pollution and strengthen our economy. It will make functional foods available to us from waste which we have been throwing because of unawareness about the preciousness of these wastes. Total utilization of horticultural crop biomass and processing wastes/residues will lead to environmental protection along with employment and revenue generation.

O-4.2

Recent advances in post-harvest management of fruits

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India is bestowed with diverse agro-climatic conditions and occupies second position in fruit production after China. The fruit occupies an area of 6.98 million hectares with production of 81.3 millions mt. The fruits contributes approximately 12.6 per cent of global fruit production. Despite of being a second largest producer of fruits, India waste around 6-18 per cent of valuable produce during post-harvest practices and supply chain. The major causes of losses are lack of awareness about post-harvest handling, gaps in cold chain and poor marketing infrastructure. Fruits are highly perishable in nature and requires tender care after harvesting, because the biological activities are still going on even after harvesting of produce and during maturation, ripening and senescence. The good agricultural practices are pre-requisite for maintaining the quality and safety of produce.

In the recent past, tremendous advances in post-harvest management of fruits have taken place in India , which has made a positive impact in reducing the post-harvest losses of fruits and assure the availability of fruits to masses at affordable prices. Some of the advances such as use of harvesting devices like clippers or secateurs and use of plastic crates at farm level have proved beneficial in minimizing the losses. The use of pre-cooling especially forced air-cooling, hydro-cooling and vacuum-cooling are recent introduction in the post-harvest chain of fruits. The storage technology such as controlled atmospheric storage has revolutionized the horticultural industry. The use of different eco-friendly packaging materials i.e CFB cartons, polymeric films and heat shrinkable films have played a great role in improving the quality of fruits to a greater extent. Some technologies like vapour heat treatment, hot water treatment in mango, wax coating in citrus and apple are well known post-harvest treatments

across the world. The introduction of automatic grading lines and colour sorting lines have made a great impact on systematic marketing of fruits. With the use of recent post-harvest machinery and technologies, India has made a stride in exporting its major fruits like mango, grapes, pomegranate, apple etc. to middle east and few European countries.

O-4.3

Value addition in grapes: Indian scenario

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The area under grape growing Grape is increasing very fast and grape cultivation is being adopted by unconventional areas also. India has become leader in tropical grape growing world by covering an area of 117.6 thousand ha with a production of 2.48 million tonnes. Beside domestic consumption of fresh grapes, a total quantity of 192,616 tonnes was exported to more than 80 countries during 2013-14. Main importing countries are Netherland, Russia, UAE and UK. More than 25 per cent of produced grape is being processed in the form of raisins, wines, juice, brandy, drakshasav etc. Among these processed products, grape drying has become passion in Sangli, Solapur and Nashik districts of Maharashtra; and Bijapur and Bagalkot districts of Karnataka. By using advance techniques, the raisins produced in these areas being exported. The processors are not producing only quality raisins, they are supplying raisins fulfilling food safety norms also. The establishment of wineries in India was started from Maharashtra. The wines made in Nashik region are well known and this industry has extended in other regions of Maharashtra (Pune, Sangli and Solapur), Karnataka (Bijapur, Bagalkot, Bangalore and Mysore) and Champhai region of Mizoram. The wine policies adopted by Maharashtra and Karnataka states are helping in growing of wine grapes in new areas as well as strengthening the wine industry by attracting foreign investment also. To making wine industry more profitable, use of winery waste is demand of time. Use of winery waste or winery by-products will help in production of wines without polluting soil and water bodies. The use of winery waste will not only increase the earning of the industry, it will help in reducing the impact of winery waste on environment; specially soil and water. The research conducted at ICAR- NRC for Grapes revealed that addition of fine wine lees which was collected from second racking of Cabernet Sauvignon wine was found to enrich the ice cream in various nutritional, functional and rheological parameters. The data collected from organoleptic test also proved improvement in acceptability of fine wine lees added ice cream. Almost same trend was found in case of sugar fee ice cream also. The cookies produced by addition of wine grape pomace powder were registered with improved nutritional and functional properties apart from more acceptability based on organoleptic test. The innovative ideas and research conducted at ICAR-NRC for Grapes to enrich the food products by use of winery by-products will certainly help in strengthening the industry.

O-4.4

Evaluation of bael (aegle marmelos correa) germplasm of central Uttar Pradesh for processing industries

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Bael is a very useful tree for planting. It grows throughout subtropical and arid region. Marmelosin is most probably the therapeutical active principal constituent of bael fruit. Product like candey, RTS, squash and preserve prepared from pulp of bael. The pulp can be preserved by canning. Freezing and addition of $SO_{2.}$ Preserved pulp

can go very well with ice cream and confectionary preparation. Rich biodiversity is observed in bael in central Uttar Pradesh and therefore an experiment was conducted in the laboratory of Department of Horticulture Janta College, Bakewar (Etawah) during the year 2011-12 to evaluate seven germsplasm. The experiments was laid out in the completely randomized design (CRD) with five replication and seven treatment/genotyps (G_1, G_2, G_3, G_4, G_5, G_6, G_7) were collected from different lacations of Etawah, Auraiya and Fatehpur districts of U.P.. Physico-chemical analysis of fruits revealed that the average fruit weight ranged from 184.66 to 1553.33 g, Fruit length and width from 12.33 to 19.40 cm and 6.66 to 12.43 cm respectively, volume of fruit from 105.00 to 903.33 cc, specific gravity from 1.14 to 1.75, shell thickness from 1.13 to 3.33 mm and pulp weight from 142.66 to 689.00 g number of seeds per fruit from 25.33 to 126.66, seed weight per fruit from 7.33 to 24.00 g, seed weight percentage from 1.24 to 9.20 %, pulp weight percentage from 85.22 to 92.66, pulp seed ratio 11.33 to 81.98 and fibers weight 1.23 to 2.43 g. Total soluable solids ranged from 30.00 to 41.33 Brix, acidity from 1.52 to 1.77 %, ascorbic acid from 4.76 to 7.13 mg (per 100g), TSS acid ratio from 18:41:1 to 26:57:1 reducing sugar from 3.76 to 5.16 % non reducing sugar from 6.73 to 11.26 % and total sugar from 10.56 to 16.43 %.

O-4.5

Effect of packaging containers and wrappers on shelf life and ripening of mango fruits cv. Dashehari during storage period

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The present investigation was undertaken to evaluate the effect of packaging containers and wrappers on shelf life and ripening of mango (*Mangifera indica* L.) fruits cv. dashehari during storage period at ambient conditions. CFB box (C_1), Wooden box(C_2) and Bamboo basket (C_3) were containers and ;Tissue paper (W_1), Blotting paper (W_2) and News paper (W_3) were wrapping materials. The experiment was laid out in Factorial Completely Randomized Design with total 12 treatment combinations and three replications. Pooled data of two consecutive years (2009 and 2010) showed that the all the three factors i.e. packaging container, wrapper and their interactions affected the shelf life of mango fruits significantly. Shelf life of fruits could be extended up to 12 days by using CFB box as container after wrapping the fruits with tissue paper (C_1W_1) in comparison to control (C_3W_0) having shelf life 6 days. Fruits kept in bamboo basket without wrapping was considered as control. Ripening (%) was observed on 0th day (on the day of harvesting), 4th day, 6rd day, 8th day, 10th day, 12th day and 14th day. the significant interactions between packaging containers and wrappers were observed. The minimum significant fruit ripening (51.58%) was observed of the fruits which were kept in CFB box after wrapping with tissue paper (C_1W_1) followed by C_1W_2 having ripening value 53.83% and 56.14% of fruits wrapped with news paper. The maximum ripening (67.33%) among fruits kept in Bamboo basket was observed of unwrapped fruits. On 8th day, the fruit ripening was more than 90% in C_1W_0, C_2W_0, and C_3W_3. Fruit ripening was attained 100% in control (C_3W_0) on 8th day only. On 10th day, the fruit ripening was more than 90% in C_2W_2, C_3W_3, and C_3W_1. On 12th day C_1W_2, C_1W_3 and C_2W_1 and on 14th day, C_1W_1 attained more than 90% ripening.

O-4.6

Concrete and absolute: Value added products from tuberose flowers- A study of varietal response

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Tuberose (*Polianthes tuberosa* L.), a versatile hardy crop is commercially cultivated for cut flower, loose flower and essential oil extraction. Concrete and Absolute are two value added products being extracted for varied

industrial use. The concrete contains waxes, the fragrant principles of flowers, colouring and albuminous matters and is considered as the basic perfumery material. The absolute obtained by separating waxes from concrete, represents the concentrated form of the flower perfume. The recovery of these products depends on different factors including variety. The present investigation was carried out at the Model Floriculture Centre of the University for two years. The experiment was laid out in a randomized block design with 12 varieties replicated thrice. The crop was subjected to standard uniform cultural practices throughout the growing season. For concrete extraction of tuberose, solvent extraction method is used. In this method flowers which were harvested in the morning (6 to 7am) (the florets were picked carefully as crushing would damage the concrete and oil recovery) and were soaked in hexane and left overnight. Hexane was decanted in the next morning. The flowers were rinsed 2 times with fresh hexane and the entire hexane fractions were combined and dried with sodium sulphate. This hexane solution was evaporated in a rotary evaporator at 50-55^0 C to get semi liquid yellow coloured concrete. For absolute extraction one part of tuberose concrete was dissolved with 9 parts of anhydrous ethyl alcohol at 30^{0}C. The solution was cooled at -10^{0}C for one minute. Thereafter the solution was spin dried for one hour at 800 rpm using centrifuge. The upper part of the solution recovered upon ultra filtration. The recovered solution was cooled in deep freezer for 1 hour and again spin dried for one hour to get upper part crystal clear solution (absolute). The Gas Chromatography and Gas Chromatography- Mass spectrometry were used to analyze the different components present. In the first year of study varieties Shringar and Kalyani Single resulted in maximum concrete per cent from closed florets (0.0230 %) while in the second year, varieties Shringar and Prajwal yielded maximum concrete per cent from closed florets (0.0246%). In GC and GC-MS analysis showed total 23 major compounds identified in *Polianthes tuberosa* L. var. Shringar for two year study. The single petalled varieties Shringar, Prajwal and Kalyani Single were found to be superior from other varieties in concrete per cent, concrete yield per square meter and absolute per cent. The GC and GC-MS analysis of the compounds present in the absolute of these three single petalled varieties was done and it was found that there is a difference in the compound's profile within same variety absolute in two years of investigation.

O-4.7

Effect of antibrowning and firming agents on quality of minimally processed pear

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Pear is commercial temperate fruit crop of India but little is consumed as fresh due to its extremely hard texture. Minimal processing could be a suitable alternative to stimulate consumption of fresh pear and reduce post harvest losses. However, susceptibility of fresh cut pears to enzymatic browning and textural defects limits the quality and shelf life of the product. The aim of this study was to evaluate different antibrowning and firming agents for a more appropriate treatment of minimal processed pears during their storage. Pear slices were dipped in solution containing ascorbic acid (1.0%), cysteine (0.5%), phosphoric acid (1.0%), $CaCl_2$ (0.5%) and calcium lactate (0.5%) alone or in combination. The treated slices were packed in polystyrene trays overwrapped with PVC film and stored at 4^{o}C. The quality of pear slices was assessed by the changes in colour, browning index, firmness, sensory quality, biochemical parameters and PPO activity of samples. The results showed that colour of fresh cut pear slices was retained better with ascorbic acid and cysteine treatment but the texture of the slice became soft over the time of storage. After 10 days of storage, the brightness L* value of fresh cut pear slices was significantly lower (61.08) when slices were treated with phosphoric acid. But over mature fruit did not respond well to antibrowning treatment as compared to the slightly immature fruit for inhibiting PPO activity. Treatment with calcium salts improved the firmness of fresh cut pear but had no effect on preventing the cut surface browning. However, addition of calcium salt in antibrowning solution had a synergistic effect on reducing cut surface browning. $CaCl_2$ treatment proved to be more effective than calcium lactate in maintaining the flesh firmness. Thus a combination of 1% ascorbic acid, 0.5 % cysteine and 0.5 $CaCl_2$ was found most effective treatment for reducing cut surface browning and maintaining the flesh firmness of minimally processed pear for longer period. For presentation in International Symposium on Innovations in horticulture for nutritional security, conserving biodiversity and poverty alleviation to be organized by Babasaheb Bhimrao Ambedkar University, Lucknow from 16-18 October, 2014.

O-4.8

Post harvest management and value addition in fruits and vegetables

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India has made milestones in fruits and vegetables production and the demand for these produce is on the rise, owing to increasing population, changing food habits, the nutritional value of horticultural crops and a greater emphasis on post harvest management, processing and value addition. Efforts geared toward improving production technologies for fruits and vegetables will become meaningful only if the effective post harvest technology is developed and wastage is reduced. It is said that a grain saved is a grain produced. Emphasis should, therefore, be placed to develop post-harvest handling, agro-processing and value-addition technologies not only to prevent the high losses, but also to improve quality through proper storage, packaging, handling and transport. The thrust should be on globalisation and increasing competitiveness, this approach will improve the agricultural export contribution of India, which is proportionately very low.

Furthermore, unless the horticultural industry is linked directly with the processing industry, neither the consumers nor the producers can benefit. Cost-effectiveness in production and post-harvest handling through the application of latest technologies is a necessity. The technology interventions should aim to achieve reduced production and processing cost, reduced production and post-harvest losses, upgrade value addition technology to achieve high quality products and develop technologies for economic utilisation of production agriculture and processing by products and waste. Work stress, safety and comfort of workers should receive proper consideration in the design and development of machinery for farm mechanisation and post-harvest processing.

Thus, proper growth of post harvest technology of fruits and vegetables is vital for development of India's economy. Many techniques developed to prolong shelf-life and to add the value in fruits and vegetables for reducing post harvest losses. There is need to develop area specific indigenous technology for diversification in processing sector to succeed the rainbow revolution.

P-4.1

Effect of pre-treatments on quality and stability of dehydrated red onion slices cv. Arka Kalyan during storage

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An investigation was conducted to study the effect of pre-treatments on quality and stability of dehydrated red onion slices. Significantly least OD value (0.31) was recorded for non enzymatic browning in the slices pretreated with 0.50 per cent sodium metabisulphite + 0.50 per cent citric acid (T_8) at 3 month after storage (MAS) whereas, highest OD value (0.83) for browning was recorded in the slices pretreated with 0.50 per cent KMS (T_2) at 3MAS. The best quality dehydrated red onion slices were obtained by treating with 0.50 per cent sodium metabisulphite + 0.50 per cent citric acid (T_8). The bacterial and fungal load was observed minimum (2.75×10^5 CFU/ g and 1.25×10^3 CFU/ g) in the slices treated with 0.50 per cent KMS + 0.50 per cent citric acid (T_6) after 3 MAS whereas, the bacterial and fungal population was recorded maximum (5.45 N$\times10^5$ CFU/ g and 2 3.40 $\times10^3$ CFU/ g) in untreated control (T_9) after 3 MAS.

P-4.2

Influence of varieties on physical characteristics of dehydrated red onion slices

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An attempt was made to study the influence of varieties on physical characteristics of dehydrated red onion slices. The minimum time taken for drying was observed in Agrifound Light Red (19.10 hrs). Highest TSS (15.00%), recovery (13.97%), dry matter content (13.20%) and lowest dehydration ratio (7.60) of dehydrated red onion slices was observed in Arka Bindu. Highest reconstitution ratio (0.73), rehydration ratio (5.10) and least OD value (0.38) for non enzymatic browning was recorded in Arka Kalyan at third month after storage. The lowest moisture content was observed in Agrifound Light Red (7.94%) at third month after storage. However, maximum time taken for drying was observed in Bhima Raj (25.67 hrs). Lowest TSS (11.00%), least recovery (10.03%) and lowest reconstitution ratio (0.43) were recorded in Agrifound Dark Red. The lowest dry matter content was recorded in Bhima Kiran (10.00%) and highest dehydration ratio (9.83) was recorded in N-53. Higher moisture content was observed in Bhima Red (8.28%) at third month after storage. The lowest rehydration ratio was recorded in Agrifound Dark Red (3.76) at third month after storage. Highest OD value for non enzymatic browning was recorded in Bhima Red (0.72) at third month after storage.

P-4.3

Postharvest physiology of jamun (*Syzigium cumini* Skeels) under modified atmosphere packaging

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The experiment was conducted at Department of Horticulture, Rajasthan College of Agriculture, during summer season in the year of 2011-12 and 2012-13 respectively. The fully matured but unripe fruit at colour turning stage were harvested and packed in low polythene bag (25 µ thicknesses) with two concentrations of oxygen (2% and 5%) in combination with three concentrations of carbon dioxide (5%, 10% and 15%) and environmental gaseous composition (21 per cent O_2 and 0.03 per cent CO_2) served as control. The fruits after treated stored at 6 ºC temperatures. The stored fruit examined at 3 days interval up to the 15 days of storage. Respiration rate, ethylene production, headspace gas compositions, firmness and tristimulus colour changes were monitored during storage period. The fruit served as control lost their quality attributes very rapidly as compared to fruit stored with MAP treatments. The results indicated that MAP conditions were more effective in reducing respiration and ethylene evaluation rate, reducing postharvest ripening, preventing microbial contamination and decreasing fruit decay in comparison with control treatment.

P-4.4

Physiological and biochemical responses of jamun-fruits to different storage conditions

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The investigation was carried out to study the effect of storagetemperature 6°C,12°C and room temperature ambient/room temperature (24 °C - 42 °C)) on physiological and bio-chemical properties of jamun. Results showed that weight loss (0.87%) per cent was gradually increased with time in storage and it was significantly higher (6.92) in fruits that were stored at room temperature ambient/room temperature (24 °C - 42 °C) as compared to fruits stored at 6°C or 12°C.The physiologicalcharacters (weight, moisture, head space, ethylene evolution, etc.) of the fruits were affected by the storage temperature and significant differences were found among all three storage temperatures. TSS was significantly higher (17.34) in fruits stored at room temperature as compared with those stored at 6°C or 12°C. Acidity(1.04) and vitamin C (45.53 mg) contents were also significantly affected by storage treatments. During storage, at all temperatures, TSS was gradually increased with temperature rising. On the contrary, vitamin C content was decreased while acidity did not show a consistent trend. Fruits could be safely stored without shriveling and with a minimum decrease in fruit quality at 6°C up to15 days.

P-4.5

Scope and future prospects of post harvest technology (PHT) in horticultural crops in India

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Magnitude of pH losses in fruit and vegetable is still to be minimized by proper cultural operations, harvesting, and transportation and storage facilities. Through the establishment of cold storage and other amenities at the growers and retailers level, there is a greater scope for fruit and vegetable processing industry. Presently mango, pineapple, citrus, grapes, tomatoes, peas, potatoes, cucumber are being processed on a major scale. There are about 4000 small and large scale processing units in the country which process only about 2.5% of the total fruit and vegetable as against 40-85% in developed countries. In India, there is a vast scope for growing fruit and vegetable throughout the year in one or other part of the country because the climatic conditions are highly suitable for growing various types of fruits and vegetables. They are the cheapest and other source of protective food supplied in fresh or processed or preserved form throughout the year for human consumption. Fruit and vegetable are available in surplus only in certain seasons and availability in different regions. In peak season due to improper handling practices, marketing, storage problems around 20-25% fruit and vegetable are spoilt in various stages. Avariety of fresh fruit and vegetable in India can be made available in plenty due to favourable agro-climatic situations. Hence there is no derth for raw material for processing. Product profile being developed in India at present is limited to few fruit and vegetable eg. Mango, Pineapple, Grapes *etc*. but there is a wider potentiality for processing of papaya, sapota, banana, jack, guava, aonla, carambola and other minor fruits. Similarly there is a greater scope for processing cauliflower, carrot, bitter-gourd onion, garlic, watermelon, muskmelon *etc.*

P-4.6

Processed horticultural waste – A hope for future

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In the present era, due to increased complexities in day-to-day life, in order to gain higher dose of nutrients through alternative sources other than the staple diet, there has been more focus on the processed food products and is being popularized on a mass scale. These industries may serve as a boost to the Indian economy. In India, the share of fruits and vegetables being processed is only 2% which is far behind the world scenario. Hence, government of India is emphasizing on establishment of more and more processing industries and conducting various training programmes to enable rural population (mainly) to take up these as an alternate income source. The wastes produced by these industries poses a threat to the environment and is a great challenge to tackle with. However, these waste materials may be utilized to produce various by-products such as pectin, alcoholic drinks, vinegar, chutney, fruit cheese etc. which have huge demand in the domestic as well as international market. Similarly, seeds of certain fruits and vegetables can be used to extract edible oil. In addition to this, these materials can also be utilized as cattle and poultry feed. Most of the fruits and vegetables are rich in healthy dietary fibres which can be extracted and can be consumed separately. Hence, appropriate utilization of these waste materials to produce various by-products will not only 'strengthen the Indian economy' but also help to cope up with the hunger-stricken population of the country.

P-4.7

To preparation of guava jelly and its nutritional analysis

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Guava (*Psidium guajava*) belongs to family Myrtaceae is widely grown all over the tropics and sub-tropics region in the world. Origin of guava is the tropical America but in this sub-continent, guava has been in cultivation since early 17th century. Guava is rich source of pectin and Vitamin C. The study was conducted for processing of jelly from guava juices at different stages of extraction. Sensory attributes and storage studies of the jellies were also evaluated. On the basis of sensory evaluation the guava jellies prepares from different extractions of juice considering, smell and taste, colour, texture and overall acceptability the jelly prepared from composite of first and second extractions of juice was more acceptable. Freshly prepared guava jelly, treatment T_1 obtained of best colour 20.4% the product T_1 has good taste for the initial stage eye appealing obtained for the best flavor recorded for T_1 at 21.0 and test are received for the initially stage at 20.6 respectively. 3 months of storage period, overall rating was slightly decreased, the best T_2 obtained 77.4% score prepared by 100% of, colour obtained by T_1, 20.0 test will be received that best response the T_2 obtained for 20.8 then after best flavor after three month for guava jelly at T_2 as 19.2 Guava jelly for good test and after 6 months of storage period, overall rating was also slightly. The best flavour after three month scored at T_1 and T_2 like that 21.0 and 20.6 then after test scoring at after three month for T_1 and T_2 at 19.2 and 20.0

Thus it is concluded from the above study the jelly prepared by 100% was judged the best among the whole colour lots as it is an initial stage scored 20.4% and after 3 month was found best overall for 20.0 for T_1. Guava jelly T_1 also having a good flavour at initial stage, but after some month result should be best for T_2, for 3 month result of the flavour are not good, and finally test was found for the judge at T_1 are best the initial stage compared to T_2. The last after three month test are not good then comparison to T_1 is better than T_2.

P-4.8

Horticultural beverages are alternative to synthetic drinks

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Soft drinks are generally of two categories: natural soft drinks and artificial or Synthetic soft drinks. Water is the main constituent of all beverages. Orange, lemon, grape, mango, pineapple and apple are generally used in making fruit juice. Particularly during summer natural fruit juices provide in addition to energy, some vitamins (beta carotenes, vitamin C) and minerals (potassium, calcium). Fruit juices are ideal beverages for those suffering from hypertension. However, they cannot be equated with fruits which also provide dietary fiber. Compared to natural fruit juices, synthetic drinks do not contain nutrients unless they are fortified. Generally, synthetic drinks are prepared using preservatives, artificial colours and flavours such as cola, orange, mango and lime, and mostly they are carbonated. Corbonated beverages contain phosphoric acid and may damage the enamel of teeth, and affect appetite if taken in excessive amounts. Water used for preparation of beverages should be free from disease-causing agents and harmful chemical impurities. Beverages like fruit juices and coconut water are better alternative to synthetic drinks. Tender coconut water is a nutritious beverage. It has a caloric value of 17.4 per 100 gm. The concentration of sugar steadily increases from 1.5% to about 5.5% in the early months of maturation and this

slowly falls to about 2% at the stage of full maturity. Tender coconut water contains most of the minerals such as potassium (290 mg%), Sodium (42 mg%), Calcium (44 mg%), magnesium (10 mg%), Phosphorus (9.2 mg%), iron (106 mg%), and copper (26 mg%). It is a Oral rehydration medium and keeps the body cools. However in patients with hyper kalaemia such as renal failure, acute adrenal insufficiency and in patients with low urine output,TCWshould be avoided.

P-4.9

Studies in post-harvest ripening-associated changes in fruit of *Manilkara zapota* var. Kalipatti without and with edible coating

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Understanding of biochemical changes occurring during ripening of fruits is a prerequisite in developing technologies for enhancing shelf life. Edible coating can be a cheap alternative for extending post-harvest life while keeping a low production and maintenance cost. Present study details about the physical, physiological and biochemical changes associated with post-harvest ripening in *Manilkarazapota*var.Kalipatti.The fruits are highly perishable due to their climacteric nature and rapidtissue softening of fruits limit their marketability. The detailed study of ripening associated changes of this commercially important fruit has not been documented. Fully mature fruits (90 days from anthesis) were handpicked from a 60 year old tree and studied in controlled laboratory conditions at 65±5 % RH and 24±2 ºC. Changes in fruit colour, texture softening, respiration rate, weight loss, vitamin C content, soluble solids, titrable acidity, chlorophyll content, sugar profile, total phenolic contentwere studied during its post-harvest ripening.It was observed that 'chroma' and 'hue value' decreased for peel and flesh respectively resulting from chlorophyll degradation whereas flesh firmness decreased along with increasein weight loss. Respiratory peak was observed on the second day after harvest whereas peak for sugars was obtained on sixth day. Total phenolic content and vitamin Cdecreased to a negligible concentration by the end of the fourth day after harvest. Also enzymes involved in ripening have been monitored during these studies.Further, edible coating formulation prepared using methyl cellulose and palm oil was applied over the fruit and changes during its post-harvest ripening were evaluated. Shelf-life enhancement with delayed ripening-associated changes is envisioned through edible coating.

P-4.10

Effect of cushioning and wrapping materials during post harvest storage for extending shelf life of mango (*Mangifera indica* L.)

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The effect of different wrapping materials on post harvest decay loss of mango fruits under ambient conditions (17–25°C (RH 70–80%) was studied. Results revealed that post harvest decay loss can be minimized significantly through proper wrapping of fruits during storage. The main aim of study was to find out the suitable low cost wrapping and cushioning materials for mango fruits such as wrapping of fruits with tissue paper, wrapping of fruits with cling wrap, wrapping of fruits with banana leaves, wrapping of fruits with teak leaves, cushioning of fruits with

neem leaves, cushioning of fruits with rice straw, cushioning of fruits with bamboo leavesand control. Above wrapping and cushioning materials were replicated three times under ambient conditions. Observations for all the parameters of these treatments were taken at zero day, four days and seven days after harvesting. The results showed that there was no significant effect of different wrapping and cushioning materials on size of fruits whereas fruit weight and fruit volume were significantly affected by treatments. Minimum per cent loss in weight was recorded from the fruits which were wrapped in cling wrap. There was significant effect of treatments on chemical parameters like TSS, sugar, ascorbic acid and pectin content. Maximum retention of ascorbic acid and pectin was recorded from the fruits which were wrapped in cling wrap. Cling wrap showed better results for chemical parameters followed by wrapping of Teak leaves. In overall quality, cling wrap showed best results accept in organoleptic evaluation while wrapping of Teak leaves showed better results in all treatments including organoleptic rating. Fruits without wrapping and cushioning showed poor results for all parameters.

P-4.11

Improvement in quality and colour of guava fruit bar with red fleshed variety 'Lalit'

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Guava (*Psidium guajava L.*) is a highly nutritious fruit and various processed products are made from guava. Most of the varieties utilized by the guava processing industry are white-fleshed, which have acute problem of browning during storage. Pink pulped guava varieties contain a carotenoid called as 'Lycopene' which can mask the browning of the products. Thus in the present study the existing popular variety 'Lalit' released from CISH, Lucknow was used for standardization of fruit bar by dehydration method using solar powered cabinet dryer. The study was carried out at College of Horticulture, Rajendranagar, Hyderabad during the year 2013-14. Guava bars were prepared as per F.P.O specification from red fleshed variety 'Lalit' alone and by blending white fleshed variety 'Allahabad safeda' in 3:1 ratio.

Guava bars were prepared from guava pulp extracted by heat process and by addition of sugar, citric acid, pectin, ascorbic acid and different concentration of Sodium benzoate i.e. 100, 150 and 200 ppm to the pulp and drying in the cabinet drier at 45±2ºC.' Among the seven fruit bars, the highest rating for colour, flavor, taste and overall acceptability were recorded in blended fruit bar of Lalit + Allahabad Safeda (3:1) with 100ppm Sodium benzoate, followed by 'Lalit' fruit bar with 150ppm Sodium benzoate. They retained higher total soluble solids, lycopene and ascorbic acid content and less moisture at ambient conditions. The browning was less in the blended bar. The study revealed that potential exists to improve the quality of fruit bars of white fleshed guava varieties by blending with red fleshed varieties.

P-4.12

Influence of different varieties and drying methods on quality of aonla powder

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The present investigation entitled "Influence of different varieties and drying methods on quality of Aonla powder" was carried out during 2013-2014 at Department of Horticulture, Dr. PDKV, Akola to study the effect of different varieties and drying methods on quality of aonla powder to find out suitable variety and drying method for preparation of aonla powder. An experiment was laid out in Factorial Completely Randomized Design with eight treatment combination consisting of four different varieties of aonla (Banarasi, NA-7, Krishna and Local) and two

levels of drying methods (solar drying and cabinet drying). Powder was packed in 200 gauge polythene bags and stored at ambient temperature and analyzed periodically at 15 days interval upto 60 days of the storage for their physiochemical parameters *viz*;, moisture content, fruit weight, fruit length, fruit breadth, fruit volume, seed-mass ratio, TSS, titrable acidity, ascorbic acid, sugars, recovery percent, sensory evaluation etc. Results revealed that, Banarasi cultivar has highest moisture content, fruit weight, fruit length, fruit breadth, fruit volume and seed-mass ratio. Aonla powder of Banarasi cultivar had highest TSS, ascorbic acid, total sugars, non-reducing sugars, and lowest reducing sugars. Minimum losses were observed in cabinet drying method for TSS, ascorbic acid and total sugars. Maximum recovery (33.33%) and sensory score was found in V_1A_2 treatment combination. Hence it is concluded that, Banarasi cultivar and cabinet drying method is most suitable for preparation of aonla powder.

P-4.13

Unnecessary harmful chemical preservatives

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Preservatives are the chemical substances that stops or delayed the growth of bacteria, spoilage and its discoloration. Although preservatives food additives are used to keep the food fresh and to stop the bacterial growth. But still there are certain preservatives in food that are harmful if taken in more than the prescribed limits. *BHT (*Butylated Hydroxy Toluene) harmful food preservative is expected to cause high blood pressure and cholesterol level. This can affect the kidney and liver function. It is found in butter, vegetable oils and margarine. Caramel is the coloring agent that causes the vitamin B6 deficiencies, genetic effects and cancer. It is found in candies, bread, brown colored food and frozen pizza. BHA (Butylated Hydroxy Anisole) is expected to cause the liver diseases and cancer. This food preservative is used to preserve the fresh pork and pork sausages, potato chips, instant teas, cake mixes and many more. Caffeine is found naturally in tea, coffee and cocoa. It is also added to many soft drinks. Caffeine promotes stomach-acid secretion (possibly increasing the symptoms of peptic ulcers), temporarily raises blood pressure, and dilates some blood vessels while constricting others. Excessive caffeine intake results in "caffeinism" with symptoms ranging from nervousness to insomnia. These problems also affect children who drink between 2 to 7 cans of soda a day.

P-4.14

Standardization of recipe and juice extraction method for preparation of ready-to-serve beverage from sapota (*Achras zapota* L.) cv. Kalipatti

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The experiment was carried out at the Post Graduate Laboratory of the Department of Horticulture, Junagadh Agricultural University, Junagadh. Matured freshly harvested sapota fruits of Kalipatti variety were taken for experiment and the juice was extracted with different methods for the preparation of RTS beverage. The prepared product was filled in glass bottles of 200 ml capacity and stored in dried place at ambient temperature for further study. The juice extracted from enzymatic method had highest recovery of juice (52%). Among various treatment combinations tried, the RTS beverage of 15% blended sapota juice with lime (4:1) + 15% TSS + 0.3% acidity with enzymatic method of juice extraction retained significantly highest score for colour, taste, flavour, appearance,

cloudiness, product setting at bottom, overall acceptance, reducing and total sugar up to 90 days of storage. The sensory rating parameters showed decreasing trend throughout the storage period. As far as the chemical parameters of the product is concerned during storage of RTS, the acidity, TSS, total and reducing sugar showed an increasing trend with increasing period of storage, while the ascorbic acid content and non-reducing sugar content showed decreasing trend under ambient conditions. As far as the relative economics of the treatment is concerned, the application of 15% blended juice of sapota and lime (4:1) + 15% TSS + 0.3% acidity with enzymatic method of juice extraction gave the highest net B:C ratio (2.09) as compared to other treatments.

P-4.15

Storage performance of hot water and sodium bicarbonate treated kinnow mandarin fruits under ambient conditions

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Citrus fruits are non-climacteric having low respiration rate. Citrus fruits have a relatively short post-harvest life in stark contrast to the climacteric fruits like mango, banana and sapota, which can be harvested before ripening. Due to its short shelf life, Kinnow fruits exhibit changes in fruit texture, colour, aroma and biochemical attributes besides, fruit quality parameters like fruit weight, fruit colour, taste, TSS, acidity and sugar are highly affected with storage, leading to lowering of fruit quality and resulted in post-harvest losses.Low temperature storage is generally used to slow down the deterioration in citrus fruits during storage but these are chilling sensitive and hence may be injured by chilling temperatures (Purvis, 1985 and Couey, 1989).The use of synthetic chemicals on harvested fresh produce is becoming more difficult to justify due to the concerns about human health risks associated with chemical residues, widespread occurrence of pesticide-resistant microbes, environmental problems associated with disposal of water used in packing operations and a lack of approved fungicides for the control of rots. Hence, there is an urgent need to develop alternative technologies to control decay in citrus, which should be safe to consumers, workers, and the environment (Palou *et al* 2002 and Venditti *et al* 2005). Several alternatives show promise post-harvest treatments like hot water treatments (Gautam *et al* 2003), hot water and sodium bicarbonate (Larrigaudiere *et al* 2002), are emerging technologies in reducing post-harvest losses.The advantage of hot water dipping is that it can control surface infections as well as infections that have penetrated the skin, without leaving no chemical residues on the produce (Fallik *et al*., 2000).

The present study was conducted at All India Co-ordinated Research Project on Tropical Fruits laboratory of Department of Fruit Science, Punjab Agricultural University, Ludhiana during the years 2011 and 2012. The fruits were subjected to hot water treatments at different temperature (45, 50 and 55°C), sodium bicarbonate at different levels (2% or 3%) and their combinations. The control fruits were kept untreated and all the fruits were stored at room temperature for 0-21days. Fruit weight loss weight loss, TSS and disease incidence increased significantly but the acid content declined thereafter.Hot water 50˚C alone andin combination with sodium bicarbonate (2%) retarded the changes associated with the storage duration in Kinnow mandarin, but exposure to high temperature (above 50°C) reversed the beneficial effects and enhanced the decline in physical and chemical quality attributes of fruits.

P-4.16

Determination of maturity indices for harvesting of pomegranate

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Pomegranate (*Punica granatum* L.) is an important fruit crop of arid and semiarid regions of the world. A key member of 'lythraceae' (sub-family 'punicoideae'), pomegranate is believed to have originated from Iran and highly adapted to climatic conditions of India. The versatile adaptability besides built-in drought tolerance paves the way for its sustainability under marginal lands. India has become one of the leading producers of pomegranate in the global arena, as the fruits are available throughout the year. During 2012-13, it is cultivated over 1.13 lakh ha with an annual production of 7.44 lakh tonnes and productivity of 6.6 tonnes/ha in India. Bhagwa, Ganesh, Ruby, Arakta, Mridula, Jalore Seedless etc., are some of the soft-seeded (mellowness) cultivars of pomegranate which are commercially cultivated in various regions of India. However, Bhagwa continues to be the predominant ruling variety with attractive, shining dark red rind and bold arils with dark red colour. Being a 'non-climacteric' fruit crop, the fruits of pomegranate have to be harvested when they attain appropriate maturity in the plant itself. Hence, an experiment was carried out during 2011-12 & 2012-13 to determine the maturity indices for harvesting of pomegranate cv. Bhagwa. The various maturity standards viz., days after full bloom, fruit weight, 100 aril weight, total soluble solids (TSS) content, titrable acidity, etc., were determined at fortnightly interval during different stages of fruit growth. The results revealed that maturity indices viz., harvesting of fruits at 180 days after full bloom, 310.25g of fruit weight, 34.03g of 100 aril weight, 15.95°TSS content and / or 0.48% titrable acidity are highly corresponding to appropriate maturity of pomegranate cv. Bhagwa during which harvesting should be done under Solapur conditions of Maharashtra.

P-4.17

Studies on development and storage of value added Bael syrup beverages incorporated with *Aloe vera*

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Bael (*Aegle marmelos* Correa) and Aloe Vera (*Aloe barbadensis* Miller.) are rich in medicinal and nutritional properties. Five blend combinations were made by blending Bael pulp and Aloe Vera gel in different ratios *viz.* 100% Bael pulp + 0% Aloe Vera gel, 0% Bael pulp + 100% Aloe Vera gel, 50% Bael pulp + 50% Aloe Vera gel, 75% Bael pulp + 25% Aloe Vera gel and 25% Bael pulp + 75% Aloe Vera gel. The syrups were prepared using 65 per cent sugar, 1.25 per cent acidity and 25 per cent blend from each blend combination. The syrup developed from 65 per cent sugar, 1.25 per cent acidity and 25 per cent blend (consisting 50% Bael pulp + 50% Aloe Vera gel) was found the best among the all blend combinations during organoleptic test by the panel of semi trained judges on 9-point Hedonic Scale. The total soluble solids, acidity, reducing sugar, total sugars and browning were increased whereas Vitamin C, non-reducing sugar and organoleptic quality decreased continuously during storage. The blended syrup was found acceptable up to five months when stored at ambient conditions. The findings suggests that Bael and Aloe Vera can be utilized for commercial processing of blend syrup using 65 per cent sugar, 1.25 per cent acidity and 25 per cent blend consisting 50% Bael pulp and 50% Aloe Vera gel, which can be useful for growers, processors as well as consumers by the taste, flavour, nutritive and medicinal properties of both the plants. The developed product can also be stored for five months at ambient temperature.

P-4.18

Studies on processing and storage of bael beverages

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Bael fruit is an underutilized indigenous fruit of India. Because of the hard shell, mucilaginous texture and numerous seeds, the bael fruit is difficult to eat out of hand. The excellent flavor, nutrition and therapeutic values of the bael lies an untapped potentiality for processing. In the present investigation, recipes for RTS (Ready to serve) and squash from bael was standardized. Recipe containing 2% aquous extract, 12% TSS and 0.3% acidity was found suitable for making RTS. For squash making, recipe containing 30% juice, 50% TSS and 12% acidity was found ideal. The browning of RTS and squash did not change upto 2 and 1 month of storage, respectively. Further, increase in browning of RTS and squash upto 6 and 4 months of storage, respectively were statistically insignificant. The findings of present investigation indicated that beal fruit can be very promising for producing the quality beverages like RTS and squash. These products might have excellent market potential because of their therapeutic values and reasonably longer shelf life.

P-4.19

Response of different concentration of gasses on storage life of guava (*Psidium guajava* L.)

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Quality parameters of guava (*Psidium guajava* L.) were measured after five weeks of storage. The main method used to store fruit was modified atmosphere (MA) storage with three levels of membrane size, and this method was compared to the storage under regular atmosphere with high humidity (HRA) and to regular atmosphere (RA). The gas composition was measured in regular daily intervals, monitoring the percent of oxygen and carbon dioxide. Due to its rapid deterioration, HRA and RA stored guava were tested after five weeks of storage, and MA stored guava after five weeks. Tested quality parameters were general appearance, mass loss, moisture content, soluble solids content, physical defects, market quality, smell, colour, and firmness. MA exhibited better overall storage performance in each of aforementioned quality parameters compared to HRA and RA storage methods. Fruit transpiration and respiration are affected by atmospheric and temperature conditions. Storage operations can be classified regarding to construction as O_2 control systems, CO_2 control systems and ethylene absorbent as natural or artificial

P-4.20

Post harvest management of guava cv. Sardar by enhancing shelf- life through the application of different nutrients

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Present investigation was carried out at Horticulture Research Centre, Patharchatta and Department of Horticulture, G.B. Pant University of Agriculture and Technology, Pantnagar to find out effect of pre-harvest nutrients sprays of calcium, boron, zinc on shelf life of guava cv. Sardar. Two foliar sprays of each nutrient concentration were done in the month of September and October, respectively.After harvesting in winter season physico-chemical attributes and organoleptic evaluations were carried out at the day of harvest and at 3 days interval during 9 days of storage.The minimum percentage physiological weight loss and minimum percent volume loss were found in 1 per cent calcium nitrate and maximum were found in control.The organoleptic evaluation was found highest in 1 per cent calcium nitrate followed by 1.5 per cent calcium nitrate at the day of harvest and also at 9th day after harvest, in comparison to other treatments including control. In all the treatments including control, in general, organoleptic rating was decreased with the increase in storage period.Calcium nitrate (1%)resulted maximum shelf-life of the fruits over all other treatments including control.

P-4.21

Preparation of honey based herbal banana powder by osmo-air drying

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India ranks first in the banana production in the world during the 2012-13. Osmotic dehydration of banana slices (5 mm) was carried out at different osmotic variables, viz., process temperature (30^0, 40^0 and 50 ^{0}C) and immersion time (24, 48 and 72 h), whereas, concentration of osmotic solution and sample to solution ratio were kept 60 ^{0}Brix and 1:5, respectively. Anovel concept of supplementing natural herbs, viz., honey, cardamom, ginger powder, Tulsi powder, cinnamon powder, and clove powder in osmotic solution. The osmosed banana slices were dried at 55 ^{0}C and 1.25 m/s air velocity using tray dryer. The observations of solid gain (SG), water loss (WL), water loss to solid gain ratio (WL/SG), weight loss and moisture content of banana slices during osmotic dehydration were recorded. Quality of honey based herbal powder was evaluated on physical (recovery, WSI, WAI), biochemical (ascorbic acid, acidity, protein, crude fibre, total sugar) and sensory (colour, flavour, taste, odour) characteristics. Highest water loss to solid gain ratio (7.01) obtained in the treatment with combination of 60 ^{0}Brix osmotic solution concentration, 30 ^{0}C process temperature and 72 h immersion time. It could be concluded that the best quality banana powder with highest WSI (71.38 %), WAI (595.04 %), ascorbic acid (15.00 mg/100 g), acidity (0.88 %), protein (4.12 %), crude fibre (1.85 %) as well as highest sensory score (8.74) were also obtained in treatment with combination of 60 ^{0}C osmotic solution concentration, 30 ^{0}C process temperature and 72 h immersion time, among all the treatments.

P-4.22

Effect of chitosan coating on the physical characteristics of guava (*Psidium guajava* L.) fruits during low temperature storage

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Among tropical fruits, Guava (*Psidiumguajava* L.) is known as “Apple of Tropics”. Due to its high nutritional value and low cost, is also known as “Poor man’s apple”. Being a climacteric fruit, it is highly perishable in nature anda significant quantity of produce is reported to go waste. Recently, there have been increased efforts to study new preservative compounds derived from natural sourceswith no known bad effects on human health. One such compound is Chitosan, which when coated over fruits, reduces the rate of respiration by creating an internal modified atmosphere and thereby retarding ripening and senescence.Chitosan, a deacetylated form of chitin, is a natural compound obtained from crustacean shells either by chemical or microbiological processes and can also be produced by some fungi. Hence to extend the shelf life and marketability of fruits, a study was conducted to know the effect of Chitosan coating on the physical characteristics of guava cv. Allahabad Safeda fruits which were pre-treated with Chitosan 1%, Chitosan 2%, Acetic acid 1% and then stored at12^{o}C temperature (90-95% RH) along with a set of untreated fruits.Various storage attributes were studied at successive intervals of storage. Among various treatments, 1% Chitosan treatment was found effective in extending the shelf life up to 21 days in storage condition and fruits also had good post storage ripening period for 2 days when brought to ambient conditions. At post storage ripening period (21+2 days), Chitosan 1 % treatment reduced the Physiological Loss in Weight (12.15%), retained greater firmness (6.71 kg/cm^{-2}),and shown reduced spoilage (33.4%), compared to the control. The surface colour was also maintained well (L: 68.21, a: 3.55, b: 46.94) during storage and post storage ripening period.

P-4.23

Storage studies of aonla fruit products for quality traits

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Aonla fruits are not consumed freely in fresh form because of its astringent taste. Therefore, various varieties of aonla were screened for their suitability into different products and accordingly the pulp of cultivars Chakaiya and NA7 was used for preparation of fruit beverages (RTS and squash) and sauce, respectively, while the fruits of NA7 were used for making preserve and pickle. Observations on total soluble solids, acidity, vitamin ‘C’ (ascorbic acid), browning and organoleptic quality of these products were recorded during storage at monthly interval. The total soluble solids of RTS, squash and preserve increased slightly during storage but in pickle and sauce it started declining after two months of storage. Acidity content of aonla products increased with the storage period. The vitamin ‘C” content of these products decreased continuously with the storage period. A progressive increase in browning of aonla products was also observed with the storage period. Organoleptic score of the aonla products declined continuously during storage. The acceptable quality of aonla preserve and pickle was maintained up to nine months, while sauce was acceptable up to six months and beverages (RTS and squash) up to four months of storage.

P-4.24

Maturity and shelf-life of kinnow mandarin as influenced by plant bio-regulators and nutrient application

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Citrus is an important genus of the family Rutaceae in the plant kingdom. Its fruits are used as table purposes as well as for making juice, squash, crush, syrup, cordial, pickles, marmalade, concentrate etc. Rapid strides are made for the enhanced production and increasing the area of cultivation but improper handling of produces resulting heavy post-harvest losses. Control of these losses alone may contribute a lot in increasing the availability of fruits. Application of plant bio-regulators and mineral nutrients can provide significant economic advantages to citrus growers when used in appropriate concentrations. Keeping this in view, an experiment was carried out in the Department of Horticulture, C.S. Azad University of Agriculture and Technology, Kanpur, (U.P.), India, to investigate the influence of pre-harvest application of different plant bio-regulators and nutrient on maturity and shelf-life of Kinnow mandarin. For this, pre-harvest spraying of GA_3 (50, 75 and 100ppm), NAA (10, 15 and 20ppm) and calcium nitrate (1.0, 1.5 and 2.0%) were done twice, firstly on 15th September and secondly on 15th November on twenty years old Kinnow mandarin plants and harvested fruits were stored at ambient temperature in 100 gauge thick perforated polythene bags. It was recorded that the pre-harvest spraying of GA_3 @ 100ppm significantly delayed maturity of fruits by 41.75 days as compared to control (took 255.20 days from flowering to maturity). After 45 days of storage of fruits, minimum physiological loss in weight (5.92%), fruit spoilage (6.19%), loss in fruit juice (15.29%), loss in ascorbic acid (7.49%), loss in TSS (6.20%) and loss in total sugars (7.20%) contents were recorded in calcium nitrate @ 2.0% pre-harvest sprayed fruits as compared to control.

P-4.25

Importance of lycopene for paste formation

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Lycopene is a lipobhilic, 40-carbon atom, highly unsaturated, straight open chain hydrocarbon containing 11-conjugated & 2-non conjugated double bonds. It is a red pigment found in tomatoes and belong to the â-carotene category. It is a strong antioxidant and has twice the ability to inhibit the oxidative activity of active O2 than â-carotene and also ten times higher than á-tocopherol. Lycopene is a potent neuroprotective, antiproliferative, anticancer, antiinflamatory, cognition enhancer. It is useful in various diseases like cancer, osteoporosis, cardiovascular diseases, diabetes. Lycopene is found in trans steric form in tomatoes. Thermal processing, leads to isomerisation and it changes from steric to cis form. Researches have confirmed that lycopene is absorbed more efficiently in the body when processed in juice, sauce, ketchup or paste. Therefore the purpose of the study was aimed to produce tomato paste from three different varieties viz, Kashi Abhiman Kajla and Kashi Vishesh and their lycopene content evaluated for six months so that the variety that retains most of the quality lycopene can be considered for formation of nutraceutical preparations, dietary interventions and other food products. Out of the three varieties Kashi Vishesh had the highest lycopene content 3.65 - 4.45mg/100g and was able to retain its quality during the storage period of 6 months.

P-4.26

Minimizing post harvest losses of horticultural crops through better postharvest techniques

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Post harvest losses in fruits and vegetables are very high (20-40%). Losses occur after harvesting is known as post harvest losses. It starts first from the field, after harvest, in grading and packing areas, in storage, during transportation and in the wholesale and retail markets. Deterioration can be rapid as the harvested product continues to lose water and is physiologically active. Maintain quality (appearance, texture, flavor and nutritive value), protect food safety, and to reduce losses between harvest and consumption are the three main objectives of applying postharvest technology to harvested fruits and vegetables. There are many interacting steps viz. harvesting and preparation for market (scientific harvesting, sorting, grading, washing, cleaning, waxing, edible coatings, pre–packaging etc.), packing and packaging materials; decay and insect control; evaporative cool storage, irradiation, temperature and relative humidity control (cold storage, modified atmosphere packaging, controlled Atmosphere storage); transportation of horticultural crops (cold chain, ventilated stores, refrigerated storages etc.) and handling at destination involved in any postharvest system for extension of shelf life of fruits and vegetables.. Particular practices and the sequence of operations will vary from crop to crop. Post harvest technology applied to horticultural crops produce after harvest for its protection, conservation, processing, packaging, distribution, marketing, and utilization to meet the food and nutritional requirements of the people in relation to their needs and adds value to the product. Post harvest losses in fruits and vegetables are very high and about 10-15% fresh fruits and vegetables shrivel and decay, lowering their market value and consumer acceptability. Minimizing these losses by adopting appropriate post harvest technology can increase their supply without bringing additional land under cultivation.

P-4.27

Influence of foliar application of zinc and copper on growth and post-harvest life of asiatic lily

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Lilium is a unique ornamental plant with many colourful flowers which occupies an important place in floriculture as cut flower, in flower pots and as garden plant and is very popular despite being the higher price. An experiment was carried out in the field and Post-harvest Laboratory of Department of Horticulture, Banaras Hindu University, Varanasi, India during 2013-2014 to see the effect of zinc and copper on growth characteristics and post-harvest life in lilium grown under polyhouse condition. The treatments used were Zn 0.2%, Zn 0.4%, Cu 0.2%, Cu 0.4%, Zn 0.2% + Cu 0.2%, Zn 0.2% + Cu 0.4%, Zn 0.4% + Cu 0.2%, Zn 0.4% + Cu 0.4% along with control (distilled water). Foliar application of zinc and copper was done at 30 days after planting. Spraying of nutrients was done to run-off stage and control plants were treated in the same manner with distilled water. Experiment was laid out in a Randomized Block Design (RBD) and replicated thrice. A significant result was observed in all the parameters studied. Among the growth parameter, treatment Zn 0.4% + Cu 0.4% showed significant increase in the leaf area

followed by Zn 0.2% + Cu 0.4% whereas, Zn 0.2% + Cu 0.2% recorded maximum chlorophyll content followed by Zn 0.4% + Cu 0.2%. Maximum fresh weight and dry weight of leaves were observed with Zn 0.2% + Cu 0.2%. Among post-harvest parameters maximum weight of cut stem at 2nd, 4th and 6th day was noticed in Zn 0.4% followed by Zn 0.2% + Cu 0.4%. Treatment Zn 0.2% + Cu 0.4% extended the days to opening of 1st and 2nd flower followed by Zn 0.4% + Cu 0.2% and Zn 0.2% + Cu 0.2% while, Zn 0.4% recorded maximum diameter of flower which was statistically at par with Zn 0.2% + Cu 0.4% whereas, longevity of 1st and 2nd flower was maximum with Zn 0.2% + Cu 0.4% followed by Zn 0.4% + Cu 0.2%. Maximum solution uptake and vase life was observed with Zn 0.4% + Cu 0.2% followed by Zn 0.2% + Cu 0.4%.

P-4.28

Effect of different packaging materials on shelf life of guava cultivars

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Different packaging materials affect the shelf life and postharvest quality of guava. The experiment was carried out to observe effect of different packaging material viz. black polythene, white polythene, tissue paper and control on shelf life of guava cultivars Allahabad safeda and Lalit at the room temperature. Observations of different physical and biochemical parameters were taken at interval of 4 days. It was reported that highest fruit length 5.47cm in fruits packed with black polythene after 16 day of packaging along with lowest shrinkage of fruits. Allahabad safeda found to best in term of fruits width 5.34cm compare to Lalit. Maximum fruit weight loss 11.85% was reported in fruits packed with tissue paper after 16days of storage. There was no significant difference recorded in specific gravity of fruits; however specific gravity 1.24 was observed in Lalit variety after 4 days of storage. Total soluble solids increase as storage period and highest observed 13.20^{0}Brix after 16 days of packaging with black polythene. Ascorbic acid content was found lowest 173.0 mg/100g fruit pulp in fruits of Allahabad safeda. So it was found that black polythene gives better results in increasing shelf life and overall acceptance of fruits of guava.

P-4.29

Development of protocols for successful production of tomato powder

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Tomato (*Lycopersicon esulantum* L.) is highly perishable in nature because of high moisture and poor storage stability. Investigations were under taken for production of tomato powder using different pre and post techniques. In the experiment pre treatment of the tomato with the food grade acid, slice sizes and different drying methods were standardized for production of tomato powder. Fully matured tomatoes were pretreated with and without KMS and sodium metabisulphite in which tomatoes treated with KMS indicated significant results compare with sodium metabisulphite. For the slicing of tomatoes different sizes viz. 3 mm, 6 mm and 9 mm were tried. Tomato slice size of 6 mm found excellent for acidity, non reducing, sugar and total sugar similar results were noticed for colour, textures taste and aroma during sensory evaluation of tomato powder. Maximum ascorbic acid and ratio of reducing to non-reducing sugar were recorded with 9 mm slice and maximum moisture loss and reducing sugar was recorded with 3 mm slice. Drying of tomatoes slices vis. Mechanical drying, solar drying and hybrid drying were

tried. Out of those hybrid drying method was found most successful for making qualitative tomato powder followed by mechanical drying with respect to maximum moisture loss, reducing sugar, total sugar and ratio reducing to non-reducing sugar as composed to other. It can be concluded that tomatoes treated with KMS having 6 mm of slice size and hybrid drying method indicated the excellent result for production of tomato powder.

P-4.30

Curing role of underutilized plants at household level

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The world is precariously dependent on a limited number of food crop species despite its wealth of traditional, locally-adapted underutilized species. In many cases, the underutilised species have a much higher nutrient content than globally known species or varieties, even though they may not be fully suited to conventional production systems. These plants have many advantages like easier to grow and hardy in nature, producing a crop even under adverse soil and climatic conditions. These neglected and underutilized species (NUS) play a crucial role in the food security, income generation and food culture of the rural poor. They are also often more resilient than staple crops, because they are better adapted to grow in marginal areas, with little need for irrigation, pesticides and fertilizers. Yet the lack of attention by mainstream research and development programs means their potential value is under-estimated and under-exploited, with many under threat of disappearance. The belief behind this mode of eating underutilized fruit crops is good for health and acts as a remedy for various ailments like relief of strain muscle, laxative, sedative, herbal hair lotion shampoo for antioxidant, dysentery, diarrhoea, jaundice, cough etc. This could be attributed due to the presence of phytochemical in these minor fruit crops that enhance the power of immunity of human body. The ample presence of these underutilized minor fruit crops and their adaptation in the local climate and thus their expansion in length and breadth of the state can be achieved without much hurdle. Once a systematic scientific intervention is achieved the fullest use of these crops can be launched through value addition.

P-4.31

Evaluation of sugar and stevia ratio and standardization of recipe for preparation of low calorie beverages

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Studies were undertaken to evaluate sugar and stevia ratio and standardization of recipe for preparation of low calorie beverages. The results revealed that in evaluation of sugar and stevia ratio, half of the sugar can be successfully substituted by stevia without impairing the quality of beverages. In case of recipe the low calorie RTS drink prepared with 25 per cent aonla pulp + 75 per cent mango pulp + 50 per cent sugar + 50 per cent stevia + 13 per cent total soluble solids and 0.3 per cent acidity, nectar drink prepared with 25 per cent aonla pulp + 75 per cent mango pulp + 50 per cent sugar + 50 per cent stevia + 15 per cent total soluble solids and 0.25 per cent acidity and squash prepared with 25 per cent aonla pulp + 75 per cent mango pulp + 50 per cent sugar + 50 per

cent stevia + 47 per cent total soluble solids and 1.1 per cent acidity was found to have the highest organoleptic scores with respect to colour and appearance, test, flavour and overall acceptability.

P-4.32

Principles and practices of preservation in relation to horticultural crops

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Food preservation can be defined as the science which deals with the method of preservation of decay or spoilage of food, thus allowing it to be stored in fit conditions without deterioration for future use.Preservation means protecting foods against spoilage, but scientifically it may be defined as a science which deals with the process for prevention of decay or spoilage of the food. Fruits and vegetables are highly perishable but constitute the most important commodity for human diet due to their high nutritional value and protective food supplied in fresh or processed or preserved from throughout the year for human consumption. Food needs to be preserved to increase shelf life and augment supplies. From a commercial perspective, it helps to stabilize the prices of the food in the market. Some method of preservation are by asepsis, high temperature (pasteurization, sterilization), low temperature (cellar storage, refrigeration, freezing), chemical (sulphur dioxide, benzoic acid), drying, filtration, carbonation, sugar, fermentation, salt, acid, oil & spices, antibiotics, irradiation etc. Food is preserved in order to make the seasonal fruit available throughout the year, increase the shelf life of food, for increasing the supply and to improve the health of the population.

P-4.33

Innovations in reducing wastage of agriculture produce post harvesting

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India's F&A sector is dynamically upgrading itself to achieve new levels of growth by strengthening the forward and backward linkages; however the sector has yet to realize its full potential in terms of yield, processing and exports. Compared to changes in global agricultural scenario, changes in Indian agriculture are meagre. Even we have changed the face of our traditional agriculture but we still lack behind on gaining the potential yield, technology adaptation and post-harvest practices. As per the report 'FDI in Retail - Advantage Farmer 2013' by ASSOCHAMhttp://www.assocham.org/"Post-harvest losses of farm produce of fruits, vegetables and other perishables, have been estimated to be over ? 1 trillion per annum, 57 per cent of which is due to avoidable wastages mainly. The post-harvest losses in fruits and vegetables have reached to an alarming level as indicated in the study conducted by Export Import Bank of India during 2011-12. The study reveals that only 2.4% of the fresh raw tomatoes produced in country go to consumers or export markets. The rest 97.6% of the tomatoes are either wasted or processed. According to a statement of Press Information Bureau of India, 2010, 'around 2.2% of fruits and vegetable produced in India goes for processing'. Considering with time, the level of processing for tomatoes may have reached to around 10%, even with such optimistic figure, the level of wastage is huge. However without creating additional and adequate infrastructure such as cold storage, reefer vans etc. this wastage cannot be reduced easily. An attempt is made here to highlight the use of waste material of tomato processing units. Tomato is used as a food throughout the world. The fruit can be consumed raw, processed into ketchup,

sauce or even juice. The crop is rich with ingredients such as lycopene content, which is a natural antioxidant (2573µg/100g), Vitamin C (14mg/100g), Vitamin A (42µg/100g) and other essential nutrients. The fresh fruits are taken into the market for direct consumption or as a raw material for food processing industries. The major processed products of tomato includes ketchup, sauce, puree, diced tomato and juice, which utilizes the red pulp of fully matured tomatoes and a large quantity of seeds, peel and pulp are left unutilized and are eventually wasted. The waste originating from tomato processing plants contains carotenoids, which has various health-promoting functions. Carotenoids contain 96% â carotene and Lycopene and 4% Lutein. Industries can be set up wherein tomato wastages can be procured from processing industries to extract carotenoids and lutein which in turn can be used in the pharmaceutical sector of the country. Irini and Vassiliki, found an extraction method to utilize the carotenoids wasted from tomato processing plants using organic solvents. It was proved that Hexane and Ethyl acetate in the ratio 45:55 is optimum for the extraction of carotenoids from the processed tomato wastes.

Lateral shoots are developed on tomato plants after the first flowers have opened (Logendra, 2004). These lateral shoots are pruned either following single stem or two stem pruning system in poly house cultivation. The pruned lateral shoots are burnt, when this can be used for further propagation through cuttings. Pro trays are filled with coco peat, vermiculite and perlite in the ratio 3:1:1 and the cuttings are planted for vegetative propagation. This method can not only reduce the post-harvest wastage but can also diminish the issues of high input costs. The pest infested and diseased fruits are left behind in the field to rot. The rotten tomato fruits that find no place in the market can be used for seed extraction through acid method. The fruits are mashed and placed in plastic containers and commercial Hydrochloric acid (10-20 ml/ kg of pulp) is added. Stirring is done for separation of pulp and the seeds. The seeds are allowed to sediment. Excess water has to beremoved and the seeds are sundried before sowing. This paper also includes various other methods that can be taken up to handle the post-harvest agricultural wastages. It comprises of the utilization of tomato plants that are left on field after harvesting for mulching, use of the leaves and stem for vermicomposting, and feeding of the tomato plants to livestock as fodder.

P-4.34

Effect of post harvest dip treatments on physico- chemical characteristics and shelf life of litchi fruits (*Litchi chinensis* Sonn.) cv. Rose Scented

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High perishability, post harvest pericarp browning, decay, poor shelf life and dessication are the major constraints in litchi cv. Rose Scented post harvest handling which restrict the expansion of litchi industry. The present investigation was carried out at Post Graduate Laboratory of Department of Horticulture, College of Agriculture, GovindBallabh Pant University of Agriculture and Technology during the year 2012- 2013. The main aim was to investigate the effects of different post harvest treatments namely Kinetin, Oxalic acid and Potassium metabisulphite at varying concentrations on physico- chemical characteristics and shelf life of litchi fruitThe trial consisted of seven treatments in three replications.The experiment was conducted in two factorial Completely Randomized Design. The two factors consisted of treatments and storage period. The trial was carried out at ambient temperature 25-28^0 C at 75 % R.H. Results of the present investigation revealed that oxalic acid 10 % treatment was most effective in reducing post harvest pericarp browning and decay. The physiological loss in weight was also recorded minimum with oxalic acid 10 %. Higher TSS, ascorbic acid and higher score of organoleptic evaluation was significantly noted in oxalic acid 10 % treatment.

P-4.35

Vitamin-a fortification of a dairy product using underutilized beetroot leaves

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Present study was carried out with the objective to fortify vanilla ice cream with vitamin A using beet root green pulp at different levels of fortification & to assess enhanced nutritional quality of the developed product. A control and four experimental treatments were prepared with varying proportions of beetroot green pulp- 3%, 6%, 9%, and 12%. Organoleptic evaluation of the ice cream was carried out using 9-Point Hedonic scale. The data obtained was analyzed statistically using analysis of variance and critical different techniques. Estimation of vitamin A content of sample showed high improvement in nutritional value of vanilla ice cream with maximum value of 181.72 µg. There was linear increase in calcium content of the product from 47mg- 59mg.

Technical Session 5:

Underexploited and Exotic Horticultural Crops

O-5.1

Underexploited and exotic horticultural crops

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India is one of the 17-mega diverse countries of the world. Though the land area of India is merely 2 % of the world, it represents 11 % of the known world flora. The country is endowed with rich diversity of horticultural crops, comprising fruits, vegetables, flowers and ornamental crops, plantation crops, etc in different agro-ecological zones. This offers unique scope of exploiting relatively less known but potentially high value horticultural crops in the years to come.

The present paper focuses on exploring possibilities of exploiting some of the hitherto underutilized indigenous and exotic horticultural crops. This also stresses on explorations for extent of variability in various potential underutilized fruit crops and identification of suitable promising types. Explorations were conducted in different hot spot areas of north India. Explorations were conducted and promising accessions were identified in aonla (*Emblica officinalis* Gertn), bael (*Aegle marmelos* Correa), jamun (*Syzygium cuminii* Skeels) wood apple (*Limonia acidissima* L.), khirni (*Manilkara hexandra*), chironji (*Buchanania lanzan*), tamarind (*Tamarindus indica* Linn), mulberry (*Morus spp*), kamarakh (*Averrhoa carambola*), lasora (*Cordia myxa*) barhal (*Artocarpus lakoocha*). As a result promising accessions were identified.

O-5.2

Study of indigenous leafy vegetables of cold desert- Ladakh (Jammu & Kashmir), India

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Naturally grown vegetables such as *Malva vertisilester* (scholik), *Chenopodium album* (neyu) *Atriplex hortensis* (Phaltora), *Fagopyrum tataricum* (tayat), *Rumex patientia* (Shoma), and *Amaranthus cruentus* (Khi snama) are consider as nutritious vegetable in cold desert of Ladakh. They grow very fast in a short period of time around 30-45 days and gives yield of .750-1.8 kg/m^2 even in less fertile soil, it matures and produce seeds in September-October. Medicinally, the leaves of these plants are used for different remedies as health tonic, treatment of various ailments like purgative, gout, tiredness, and lung diseases. Seeds of some plants are grounded into a meal and used in soups and can be mixed with flour while making bread.

The seeds of the Indigenous vegetables were collected from the wild and sown in cropping season of 2014-2015 at field of Defence Institute of High Altitude Research (DIHAR) Leh-Ladakh. Irrigation was done on the day of sowing and after 9-14 days. All the plants were analyse for their yield contributing characters in which *Atriplex hortensisi, Fagopyrum tataricum* and *Amaranthus cruentus* confer good yielding characters i.e., plant height (64-69 cm), number of leaves (29-35), number of branches (11-27), leaf length (5.36-12.39 cm), leaf width (2-6 cm), leaf area (4.41-41.03), leaf thickness (0.01-0.5 mm), petiole length (1.8-4 cm), chlorophyll content (46.8-53.53 SPAD unit), .750-1.800 yield/m^2, wet weight (g) and dry weight (g). Further Organoleptic test was conducted in which a total of 45 panels were recruited in which out of 5 vegetables *Atriplex hortens* stood first followed by *Fagopyrum tataricum*, *Chenopodium album*, *Amaranthus cruentus, Rumex patientia* and *Malva vertisilester*. From such facts, there is need to explore genetic variability, phytochemical analysis, antioxidant activities of these under exploited plants and bring such plants under mass cultivation practice for harnessing its full potential and to integrate the Ladakhi indigenous leafy vegetables into the health security of the troops deployed in elevated areas of Ladakh and local people of these regions.

O-5.3

Camelina sativa: An underutilized and unexploited brassica for renewable biofuel

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In the present world scenario bio-diesel has been accepted as a clean alternative fuel. India with its robust economic growth (8% annually) is likely to account for 15% of world's oil demand by 2040. To meet such a huge demand for fuel and to realize self-reliance in energy, India through its National Bio-fuel Policy aims to meet 20% blending of bio-fuels with petrol and diesel by the year 2017. Feasibility of camelina oil as biodiesel has been successfully demonstrated by Japan Airline and Dutch Airline (KLM) during 2009 and by US Navy during 2010 on Earth day by flying Super Sonic 'Green Hornet' F/A-18. Camelina [*Camelina sativa* (L.) Crtz.] belongs to the family Crucifereae (Brassicaceae) and is one of the oldest oil crops in the temperate regions. Camelina has been grown in Europe for centuries and was an important crop in Iron and Bronze ages. It is an under-exploited oilseed, low input crop and was used in oil lamps and edible purpose from the Roman Empire to the discovery of gas and electricity. Recent interest in this crop is mainly due to search of new crops with high oil content for industrial application. Although linolenic acid content of camelina is less than that of linseed (60-70%) but it places this oil crop in the category of drying oils and too high to penetrate the edible oil market.

Defence Institute of Bio- Energy Research (DIBER) is stepping steadily in this direction with successful introduction of *Camelina sativa* at its station Pithoragarh, Uttarakhand through NBPGR, New Delhi for its potential as biofuel. Two germplasm lines (Iwan and Calena) from BOKU- University of Natural Resources and Applied life Sciences, Vienna, Austria and four germplasm lines (PI 258366, PI 304270, PI 650152 and PI 652886) from Plant Introduction Station, Iowa State University, Iowa, USA were collected. DIBER has successfully multiplied the 5.0 g seed of camelina to hundreds of kg which will be utilized for extraction of oil for biodiesel purpose and its testing. Breeding work for increasing seed yield through hybridization has been initiated. Agro technology standardization of the crop has been done for mid hills of Himalaya. Adaptability trials have been completed at various stations of DIBER i.e. Ahmednagar, Mhow and Secunderabad to develop a complete package of practices for the crop to achieve nationally and internationally important goal i.e. clean and green energy. Being a short duration (80-100 days) crop with high oil content (40%), it can easily be fit in any crop rotation. As the crop is frost and drought tolerant, it can be a potential biofuel crop to be grown in the fallow lands of Uttarakhand for increasing the cropping intensity in the hills for additional income vis-à-vis meeting the national target of biofuel.

O-5.4

Are we paying enough attention to our indigenous crops?

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Indigenous biodiversity grows in obscurity in their niche areas and are considered traditional crops. Much emphasis has been laid on their use as alternative crops and nutraceuticals since they are a rich repository of bioactive compounds and have the capacity to perform even under conditions of biotic and abiotic stress.

However, the potential of this indigenous flora is still underexploited since technologies for their improvement and industrial utilisation are still not developed. Since the crops are growing as scattered plantations in the wild or rural areas hence, they would directly improve the socio-economic conditions and directly impact poverty alleviation. With the current governmental policies focussing on very fast urbanisation, ignoring the depletion of fertile arable lands, which would limit agricultural production significantly in the times to come. Issues of nutritional security using indigenous biodiversity, which is more versatile and hardy become important.

P-5.1

Morphological changes during different stages of fruit development in date palm cultivars

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The date palm (*Phoenix dactylifera* L,) is one of the most important and highly nutritive fruit crops which can be grown in hot arid regions of the world. The present investigation was undertaken with the view to assess the changes in fruit characters and TSS content during the development of fruits in 10 cultivars *viz.* Zahidi, Braim, Chip Chap, Khalas, Medjool, Shamran, Dayari, Khadrawy, Halawy and Khuneizi at four different fruit development stages *i.e.* chimri, pre *doka*, *doka* and pind stage. The results showed significant differences among the cultivars at different stages of fruit development. The increasing values were observed for the characters like fruit weight (2.81-11.0 g), fruit length (1.20- 4.11 cm) and fruit diameter (1.41-2.63 cm) from chimri stage to *doka* stage then slightly decreasing values were observed in pind stage. The pulp to stone ratio was varies from 4.55-18.38 in different cultivars at different stages. The maximum pulp to stone ratio was observed in pind stage. The total soluble solids were increased sharply from *doka* to pind stage and the maximum TSS was observed in cultivar Khadrawy (68.45 ^{0}B) followed by Medjool (63.95 ^{0}B) and minimum was in cultivar Khalas (44.25 ^{0}B) at pind stage.

P-5.2

Exploiting nutritional security from underutilized vegetables

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More than one-thirdof Indianpopulation are suffering from the hunger and malnutrition, whereas; food security is a major problem in front of Indians. We can say, nutritional security is exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life. In India there are a lot of underutilized vegetables which are rich in nutritional as well as medicinal components, but these are not utilized properly. Underutilized vegetables are the most affordable source of micronutrients and health-promoting phytochemicals,changing consumption practices is only one of several components of a food-based approach to combat micronutrient malnutrition; this can be advanced using nutritional education and mass communication technologies.Other components of such a strategy include a focus on improved production technologies for vegetables, as diversity in vegetable consumption increases when production of vegetables increases. India, being blessed with a variety of natural surroundings and varying climates and seasons, has a number of underutilized vegetables such as, Drumstick, Winged Bean, Amaranths, Spine Guard, Sweet Guard, Pointed Guard, Gherkin, Colocasia, Yam, Broccoli, Red Cabbage, Brussels Sprouts, Celery, Parsley, Chicory, Lettuce, Curry Leaf*etc*., are locally grown and utilized. These are rich sources of vitamins such as â-carotene, ascorbic acid, riboflavin and folic acid as well as minerals such as iron, calcium, phosphorous and antioxidants. These are also recognized for their characteristic color, flavor and therapeutic value.Significant research, breeding and development efforts are needed for a range of promising underutilized vegetable crops to convert existing local landraces into competitive varieties with wide adaptation and promising commercial potential.

P-5.3

Morphological characterization of jack bean – An under exploited vegetable

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Jack bean (*Canavalia ensiformis* (L.) DC.) is an important underexploited vegetable crop belongs to the family leguminaceae. The Genus *Canavalia* consisting of 48 species of which, four species are reported from India, *viz., C. ensiformis, C. gladiata, C. maritima* and *C. virosa*. Morphological characters are useful for characterization of germplasm against high heritability and stable traits. Further, association of any morphological character with desirable traits/yield components serves as phenotypic marker in the selection process. Hence, the present study was under taken to characterize fifteen genotypes of jack bean for further improvement. The experiment was conducted at NBPGR (National Bureau of Plant Genetic Resources) Regional Station, Rajendranagar, Hyderabad during Kharif, 2013 in a randomized block design with three replications. The morphological characterization was done as per minimal descriptors of NBPGR developed for Dolichos bean. The results revealed that there was lot of diversity among the genotypes for various characters studied. Growth habit was varied from pole type to bush type while leaf density was sparse, intermediate and dense. Stem colour was light green, purple and dark purple where as flower colour was white and purple only. Similarly pod beak size was short, medium and long while the pod curvature was highly curved and curved. However, pod surface was found smooth and wrinkled. Seed colour was varied from brown, white, reddish purple, grayish yellow and grayish orange. However, leaf vein colour (green), origin of inflorescence emergence (axillary) and pod suture colour (green) was same in all genotypes.

P-5.4

Effect of foliar application of different chemicals on yield and quality of pomegranate (*Punica granatum* L.) Cv. Bhagawa

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An experiment was conducted during 2013 to find out the effect of foliar application of different chemicals on yield and quality of pomegranate (*Punica granatum* L.) Cv. Bhagawa. The experiment was laid out in Randomized Block Design (RBD) with ten treatments replicated thrice in a well established of 7 years old orchard planted at 4.5 m x 3 m spacing having uniform growth and productivity at farmer's field in *Amdia bahar* crop. The investigation indicated that the foliar application of 19: 19: 19 @ 1% + $ZnSO_4$ @ 0.5% + $FeSO_4$ @ 0.5% + boric acid @ 0.3% (T_8) resulted in maximum number of fruits per tree (100.33), number of fruits per square metre tree (8.95), yield per tree (27.04 kg) and yield per hectare (20.01 t). However, application of calcium nitrate @ 1% (T_4) resulted maximum in weight of fruit (263.33g), volume of fruit (286.67 ml) and diameter of fruit (8.41cm). Whereas, other quality parameters like maximum weight of arils, aril %, aril: peel ratio with minimum weight of peel, peel %, TSS, reducing and total sugars with minimum acidity were observed with the application of 19: 19: 19 @ 1% + $ZnSO_4$ @ 0.5% + $FeSO_4$ @ 0.5% + boric acid @ 0.3% (T_8).

P-5.5

Morphological and physical changes associated with growth and development of pomegranate fruit (*Punica granatum* L.)

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Morphological and physical changes occurred during growth and development of three pomegranate cultivars were studied at AICRP on Arid Zone Fruits, Department of Horticulture, MPKV, Rahuri. Changes were determined at 30 days intervals from anthesis till harvest maturity. The pomegranate fruit in all cultivars showed single sigmoid pattern of growth. The size, weight and volume of the fruit of each cultivar increased while the specific gravity increased earlier and then decreased after 90 days in Cv. Bhagwa and after 120 days in Cv. Mridula and Sel-4 to less than one. The elongated oval shape of fruit at the early stage changed to round with prominent suppressions on sides at maturity stage. From those studies, it was revealed that the pomegranate fruits showed colour changes from initial green to orange red and high red at maturity stage and it can be harvested within 150 to180 days.

P-5.6

Effect of IBA concentrations on the rooting of pomegranate (*Punica granatum* L.) cv. ganesh hardwood cuttings under mist house condition

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The experiment site was conducted under mist chamber at Horticulture Research Center, HNB Garhwal Central University, Chauras Campus Srinagar (Garhwal), Uttarakhand, India, situated in the Alaknanda valley at 30^0 13' 25.26'' N and 78^0 48' 04.93'' E and 563 m above mean sea level. The average temperature and relative humidity inside the mist house during experiment was 30 ± 3 ^{0}C and 77 ± 5%, respectively. The soil temperature measured was around 25 ± 2 ^{0}C. The hardwood cuttings of *Punica granatum* L. cultivar Ganesh were collected from healthy vigorous shoots of 4-6 year old plants. For preparing rooting media one part sandy soil and one part of FYM Were mixed thoroughly. The stem cuttings of *Punica granatum* L. treated with IBA solutions of different concentrations i.e. 1, 2, 3, 4, 5g.L^{-1} and control by quick dip method. The experiment was replicated thrice with 10 cuttings in each treatment. A total of 180 cuttings were tested. Among all the treatments, maximum number of sprouted cuttings (7.33), average length of sprout (20.53 cm), average number of leaves (25.33), percentage of rooted cutting (73.33), number of primary roots (29.26), and average length of roots (24.88 cm) was noticed in 5g.L^{-1} concentration of IBA.

P-5.7

Promising *Annona* genotypes selection from Western Maharashtra

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*Annona*is one of the favourite dry land fruit of Maharashtra, because it is hardy in nature and drought tolerant. One of the important bottlenecks in process of area of expansion is unavailability of suitable and improved varieties. Among 101 genotypes collected from western Maharashtra;twenty two genotypes were found superior for physio-chemical characteristics.On the basis of two year data (2011-12 & 2012-13); the highest fruit pulp percentage was found in Island Gem (61.72) and SG-8 (60.46), but genotype SG-8 was superior for other fruit quantitative and qualitative characters. Dendogram using average linkage on the basis of physio-chemical characteristics revealed that genotype SG-8, Island Gem and Pink Mammoth formed distinct cluster from other genotypes. The *Annona* is highly perishable fruit, so shelf life is determined to find out promising genotypes. The genotype SG-8 showed highest (five days) shelf life among selected genotypes. Hence, genotypes collected from various regions can be evaluated morphologically and promising one can be selected for further improvement programme.

P-5.8

Salinity tolerance studies in ber (*Zizyphus mauritiana* Lamk.)

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Zizyphus mauritiana Lamk., the Indian jujube or ber belongs to the family Rhamnaceae. Jujube is considered to be minor fruit and, from a research and development point of view, has not received any major emphasis yet. However, the fruits are an integral part of the culture and way of life of millions of diverse peoples of India. Cultivated species of *Zizyphus* are tolerant to a degree of salinity and great interest for production and reclamation of the alkali soils of India which have high pH, low organic carbon, low fertility, excessive exchangeable sodium and indurated $CaCO_3$. The present investigation was carried out at Main Experiment Station, Department of Horticulture, Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during to the year 2011 to 13. The Experiment was laid out in a completely randomized block design (factorial) with three replications to evaluate the performance of six ber cultivars *viz.,* Banarsi Karaka, Narendra Ber Sel.-1, Narendra Ber Sel.-2, Narendra Ber Sel.-3, Ponda, and Gola against different levels of salinity viz., normal soil, 4, 8, 12 and 16 ECe on vegetative growth.

Plants Establishment and survival decreased significantly with higher electrical conductivity (ECe). The plant growth decreased with increase in level of salinity. The results indicate that cvs. Banarsi Karaka and Narendra Ber Sel.-2 proved highly tolerant to salinity and can be successfully grown in saline soil upto 12 ECe. Ponda proved to be tolerant and Narendra Ber Sel.-3 and Gola showed mordrate tolerance, hence it is not suitable for planting at higher level of salinity.

P-5.9

Diversity in ber varieties in irrigated eco-system of Northern India

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Ber occupies a significant position as a fruit crop in Indian subcontinent. Maximum number of ber varieties have been reported in China. But in India about 125 ber varieties are grown in different states which have been developed by selection. During the last three decades the cultivation of ber become very popular particularly in the arid and arid irrigated zones of Haryana, Punjab Rajasthan and Gujarat. There is lot of genetic diversity in the ber grown in different states. Thus, to optimize fruit yield and to improve income of the fruit growers a field gene bank was established at FRS Bahadurgarh in which more than 50 varieties were collected and out of which ten promising were evaluated for their fruit yield, quality and reaction to the powdery mildew disease. The internodal length was recorded maximum (7.25 cm) in Umran and minimum (3.75 cm) in Sanaur-2. Most of the varieties developed spreading habit of branching except in Wallaiti where the branches were erect. Least thorn length was noted in Umran and Selected Safeda. Different varieties develop variable fruit apex i.e. round in Umran, Sanaur-5, Illaichi, ZG2, Gola and Selected Safeda and slightly to medium pointed in Sanaur-2, Sanaur-3, Sanaur-4 and Wallaiti. In all varieties flowering commences from 1st September and completed utpo 25th September. Maximum average fruit weight (30.45 g/fruit) was recorded in Umran followed by Sanaur-2, whereas minimum fruit weight was recorded in Illaichi (4.60 g/fruit). Maximum fruit size in term of fruit length and breadth was recorded in Umran i.e. 5.11 x 3.49 cm followed by in Sanaur-2 i.e. 4.20 x 3.21 cm while among all the varieties it ranged from 2.17 x 1.01 cm to 5.11 x 3.49 cm respectively. The maximum fruit yield 195.9 kg/plant was recorded in Umran followed by in Sanaur-2. The picking of fruits starts from 10th February to 15th April. On the basis of picking of fruits these are classified as early (Gola, Selected Safeda), mid season (Sanaur-2, Sanaur-3, Sanaur-4, Sanaur-5, Wallaiti) and late (Umran, ZG-2 and Illaichi). The fruit colour was observed deep golden yellow in Umran which is more appealing to the consumers. Light golden yellow colour of fruits was noted in Sanaur-5 and Wallaiti. The fruits of Sanaur-2, Sanaur-3, Sanaur-4 and Gola attained light yellow colour at maturity. The total soluble solids ranged from 12.80 to 16.70 per cent among all the cultivars. The varieties were evaluated against the powdery mildew and it has been observed that Umran, Gola, Selected Safeda, Illaichi and Wallaiti were found highly susceptible whereas Sanaur-2, Sanaur-3, Sanaur-4, Sanaur-5 and ZG2 were found moderate to resistant to powdery mildew.

P-5.10

Underexploited vegetable biodiversity in India

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Plant biodiversity represents the primary source for food, feed, shelter, medicines and many other products and means that make life on Earth possible and enjoyable. India is very rich in underutilized vegetable crops in its different agro-ecological region which has not yet been explored. In the same way there are number of underutilized species of vegetables within the families also. Among solanaceous group; *Solanum macrocarpon* L., *S. xanthocarpum*, *Cyphomandra betacea, Lycopersicon pimpinellifolium.,* etc. cucurbitaceous crops like *Cylanthera pedata, Luffa acutangula*, *L. cylindrical*, *Cucumis hystrix, Luffa graveolens, Momordica macrophylla, Momordica subangulata, Trichosanthes cucumerina, M. cochinchinesis*, *M. Dioica*, *Sechium edule* etc. leafy vegetables; *Chenopodium album*, *Ipomea reptans*, *Amaranthus viridis*, *A. lividus, A. Spinosus*, *Basella rubra, B. Alba*, *Rumex rasicarius*, *Brassica juncea*, *Malva verticillata* etc. Similarly, there are number of diverse species of delicious

edible bamboo shoots *Arundinaria callosa*, *Cephalostacham capitatum*, *Bambusa balcona, Dendrocalamus giganteus*, *D. Hamiltonii* etc. cole group; Sprouting broccoli Romanesco broccoli. Purple cauliflower, Chinese broccoli (Alboglabra Group) are other underexploited species of *Brassica oleracea.* Colocasia also comprises a wide variability of different species *alata, bulbifera, brevipetiolata, esculanta, hamiltonii, hispida, kamaonensis, nummularia, pentaphylla, puber and quinata* etc. underexploited leguminous species are *Vigna radiate* var. *sublobata, V. umbellate* var. *radiate, Canavalia ensiforimis* L., *Psophocarpous tetragonolobus, Vicia faba, Atilosia geonsis, Canavalia gladiate, Mucuma monosperma, Mucuma nivea, Mucuma utilis, Dolichus biflorus, Bauhinia purpurea, Vigna vexillata etc.* Apart from the nutritional value, medicinal purposes, income generation and poverty alleviation many regional underutilized vegetable crops are used as a source important genetic resource for improvement of high yielding cultivated varieties of different vegetable crops. Today, unreliable and changing climate becomes a threat for the vegetable cultivation under normal growing period. To make it tolerant and resistant to a number of biotic and abiotic stresses, underexploited vegetables provides rich gene diversity for crop improvement. There are about more than thousands of vegetable crops are still unexplored, not only this, they are also required to be conserve because many of them are under threat of vulnerability, endangered and extinction due to previous unintentional skate over for one or another reasons. So, there is a need to link the potential of the bioresources to economic prosperity of the region which could be valuable for the society.

P-5.11

Nutritional qualities of lesser known GLV molokhia

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Half a world away here in Milwaukee, molokhia is a known quantity among Middle Eastern immigrants, but is unfamiliar to almost everyone else. Molokhia is only one name of dozens for this leafy plant of the Corchorus species, which is commonly utilized in Egyptian and Middle Eastern cuisine. The historical usage and the bitter taste may be the reason that molokhia is not too common around the world, but the taste and consistency is not much different than okra or various other cruciferous vegetable leaves. When boiled, molokhia makes a kind of broth, making it a common ingredient in soups. There are more than 30 vitamins, minerals, and trace minerals in molokhia, as well as certain organic compounds that significantly contribute to human health. It provides 45 kcal energy, 3.29 g protein, 9.84 g carbohydrate, 0.23 g fat, 4.8 g fibre, 12 mg sodium, 372 mg potassium per cup. The high potassium content in molokhia means that the blood vessels and arteries will be relaxed, because potassium is a vasodilator. This increases blood flow and oxygenation levels to the body and reduces the strain on the cardiovascular system. High iron levels means a reduced chance of developing anemia, while also ensuring that circulation in the body is at optimal levels, which can boost energy levels. The high fiber content also helps to balance cholesterol levels in the blood stream, as dietary fiber binds with “bad” cholesterol and removes it from the body. Despite the so many health benefits it is less familiar and underutilized in India and World. There is need of research which could enlighten the hidden facts and potential health benefits of this ancient GLV.

P-5.12

Combating micronutrients deficiencies through underutilized green leafy vegetables

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Underutilized green leafy vegetables (GLV) are found in numerous agricultural ecosystems and often survive mainly in marginal areas. Yet a large number of GLV that are now overlooked have the potential to play a much more important role in sustaining livelihoods and enhancing environmental health. India, being blessed with a variety of natural surroundings and varying climates and seasons, has a number of edible GLV some of which are locally grown and utilized. GLV are rich sources of micronutrients such as â-carotene, ascorbic acid, riboflavin and folic acid, iron, calcium and phosphorous. GLV are also recognized for their characteristic colour, flavor and therapeutic value. Some of the underutilized leafy vegetables are amaranth, drumstick, beet greens rich in micronutrients. Amaranth is a very nutritious leafy vegetable, both in raw and cooked form. The nutritional value of this crop is comparable to spinach, but much higher than cabbage and Chinese cabbage. Amaranth is increasingly gaining importance both for household consumption and commercial production in Africa and Asia. Drumstick has a high nutrient density and is rich in many essential micronutrients and vitamins as well as antioxidants and bioavailable iron. It excelled among 120 species of Asian traditional vegetables tested for their content of micronutrients and phytochemicals, antioxidant activity and traditional knowledge of their medicinal uses. Moreover, it is easy to grow, has excellent processing properties, and good palatability. Beet greens are simply the leafy portion of a beet plant. These tender greens are high in dietary fiber and are high in antioxidants A, C and E. Beet greens provide a good source of protein. The abundantly available inexpensive leaves of amaranth, drumstick and beet greens can serve as a pool house of nutrients and can be used in the developing countries to combat micronutrient deficiencies.

P-5.13

Biochemical and morphological characterization of some varieties of *Clitoria ternatea* (L.) a multipurpose legume collected from Achanakmar-Amarkantak Biosphere Reserve- Central Highland, India

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The medicinal plant *Clitoria ternatea* belongs to the family fabaceae commonly known as butterfly pea, their seeds are highly nutritive. This species is gradually depleting and listed as a rare species by International union for conservation of nature and natural resources (IUCNNR). In the present study characterization of seed proteins of its popularly growing varieties has been undertaken. A comparative study has been done in term of qualitative estimation of total seed protein among the six accessions of white and blue petal varieties simultaneously morphological studies of blue, white and double petaloid blue petal varieties are done. The present study confers the difference in polypeptide mosses as well as some important morphological parameters of above mentioned varieties of Achanakmar- Amarkantak Biospheere reserve of centeral highland, India. The results concludes the significant differences in protein composion and genetic differences revealed by SDS-PAGE and morphological and agronomical traits of above varieties.

Technical Session 6:

Horticulture for Environment and Society

O-6.1

Floriculture in peri-urban areas of India

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Floriculture in India is a dynamic and expanding industry recording impressive annual growth rate particularly in peri-urban areas due to increasing income and living standards of people. From a symbol of love, flowers have transformed into an industry, generating both income as well as employment. India is blessed with a diversity of agro-climatic conditions prevailing in the different regions in the country ensuring production of almost all the ornamental crops throughout the year. In peri-urban and surrounding areas cultivation of commercial flowers increased tremendously. These include loose flowers i.e. marigold, jasmine, annual chrysanthemum, crossandra, etc. and cut flowers i.e. rose, gerbera, gladiolus, tuberose, chrysanthemum, anthurium, etc. Among cut flowers carnation, lily, orchids, alstroemeria are also gaining popularity in some areas. Recently several cut greens are also in big demand in cities. These crops grown in open field and protected conditions and have been proved as profitable ventures in and around cities of India. The floriculture industry comprises chiefly four sectors in peri-urban areas are: The florist trade traditional and contemporary cut flowers and cut foliage, both fresh and dried and value-added products like bouquets, floral baskets, flower arrangements and garlands; The plant nursery for propagation and supply of plant material including tissue culture plants, seeds, bulbs, corms and other propagated material; Plant rental service for supply of house plants on annual rent for a specific period, now it is expanding very well and last flower perfume and oil industry. Production of foliage and introduction of new potential flowers in peri-urban areas of India would be a dynamic step to boost the floriculture sector.

O-6.2

Horticulture potential in Fiji Island

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Fiji consists of approximately 300 islands, the oldest of which dates back to 40 million years (Rodd 1993). The two largest islands in Fiji are Viti Levu (10,338 km^2) and Vanua Levu (5,535 km^2) characterized by a rugged mountainous interior and coastal plains. Precipitation patterns fluctuate between the wet months of December to April and dry months of May to October. Seasonal precipitation and a rain shadow caused by high mountains results in a dry side of Fiji that once contained large expanses of tropical dry forest. Large areas of tropical dry forest were converted to savannas due to burning and before European contact the tropical dry forest region was extremely degraded (Rolett & Diamond 2004). After European contact, the tropical dry forest region was further degraded by the introduction of non-native tree species and commercial agriculture (Keppel 2001). Lowlands on the dry side of Fiji were converted to sugarcane plantations in the 19th century and laborers from India were brought to Fiji by the English colonists to work these large plantations.

Agriculture/Horticulture being the mainstay of Fiji's economy, contributes around 28% to total employment in the formal sector and indirectly employing many more. This sector which was once a major stronghold of Fiji's economy is the third largest now, contributing $451 million (9%) annually to the nations GDP. More than three-quarters of all Fijian households used to engage in agricultural-related activities, but now many of those workers have switched over to the growing service industry. Indigenous Fijians own most farmland and local residents of Indian ancestry farm it and produce about 90% of all sugarcane, which is then processed into raw sugar and molasses and exported to the European Union which is the largest export market for Fiji's sugar.

Sugarcane which used to dominate the sector now only contributes (0.9%) and has been surpassed by other crops, horticulture, and livestock production and subsistence sector. Having a rich resource base and tropical climate, Fiji has an advantage in producing a wide variety of tropical fruits and vegetables given Fiji's fast expanding tourism sector, agricultural growth is necessary to supply high local hotel demand. This is a major development in the fresh food market worldwide and provides lucrative opportunities to investors and stakeholders. Potential horticultural commodities for value added processing include; papaya, tomatoes, pineapple, coconut, duruka, mango, chillies, banana, cassava, breadfruit, sweet potatoes, ginger, cocoa, yaqona, taro, cassava and other root crops. Horticulture is one of the largest growing sub-sectors of agriculture and holds potential for continued growth. It is the only sub-sector within agriculture with increasing exports of a large variety of products. Further growth potential lies in increasing access to new markets through new modes of transportation, processing and packing; increasing productivity, improving quality, developing year-round production and introducing new crops; and improving access to new production techniques, information and high quality production inputs. Thus, the potential for Fiji's horticulture sector is in production for local consumption and export of high value commodities. Numerous opportunities in Fiji lie in horticulture says AusAID representative for Market Development Facility (MDF) project (Beckers, 2011). Mr. Beckers said products such as fruits and vegetables had substantial unmet local demand, export opportunity and supplies into tourism sector. The Fiji Government is aware of this and announced number of scholarships to start certificate, trade diploma and B. Sc. (Ag.) programmes by the Fiji National University and incentives to start new business from 2009 onwards to national and foreign investors. This paper discusses different aspects of Horticulture and outlines the various prospects in the field of Fiji's horticulture for national and foreign investors and also the qualified human resource to find suitable employment.

O-6.3

Evaluation of newer fungicides and bio-agents for management of mango graft rot

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Grafting is a commercial method of propagation of mango (*Mangifera indica* L.) planting material. Under controlled conditions, it is done during April and May with great success. However, under natural conditions, it is also done during the months of July and August. In the process of grafting, scion sticks are covered with polythene cap (narrow envelop) up to the union of root stock and scion to maintain higher humidity for better success and avoiding drying. However, high moisture also favours graft rot by different pathogenic fungi viz. *Botryodiplodia theobromae*, *Rhizoctonia solani*, *Macrophomina phaseolina*, etc. or infection of root stock by *Sclerotium rolfsii* at ground level. Failure in perfect root stock-scion union is mainly due to presence of the pathogenic fungi. Scion sticks dip treatment in carbendazim or thiophanate methyl solution is generally suggested to protect grafts/union rot but this single treatment is partially effective and does not protect union rot up to the satisfactory level. Therefore, four fungicides (azoxistrobin, difenconazole, propiconazole and thiophanate methyl) at three different concentrations (0.05, 0.1 and 0.2%) and two bio-control agents i.e. *Trichoderma harzianum* and *T. viride* at two concentrations (500 and 1000 cfu/ml) were evaluated as soil drench 10 days before grafting followed by scion sticks treatment before grafting and single spray of the fungicides after removal of caps. *Trichoderma* spp. treated grafts were sprayed with thiophanate methyl @ 0.1%. At stage of cap removal, 12-28 per cent scion sticks were found rotten in various treatments. Isolation made from rotten grafts revealed the presence of *Botryodiplodia theobromae*, *Rhizoctonia solani* and *Macrophomina phaseolina*. Final data was recorded after five months of grafting. Maximum successful healthy grafts (52.0%) were obtained with complete package treatment (i.e. soil drenching, scion sticks treatment and one spray after cap removal) of thiophanate methyl (0.05%) followed by 48.0 per cent in propiconazole (0.1%), 46.0 per cent in *T. viride* (1000 cfu/ml), 40.0 per cent in difenconazole (0.05%) and 38.0 per cent in *T. harzianum* (1000 cfu/ml) and azoxistrobin (0.05%) as compared to 20.0 per cent

in untreated control. Results suggest that complete package with thiophanate methyl is the best treatment and is followed by propiconazole or *T. viride.* These results can be used to protect mango propagules against graft rot at nursery stage with higher success rate of grafting.

O-6.4

Evaluation of chrysanthemum (*Dendranthema grandiflora* Tzevlev.) varieties under sub-humid condition of Jhalawar, Rajasthan

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The present investigation was carried out to study the performance of 15 varieties of chrysanthemum (*Dendranthema grandiflora* Tzevlev) under open field conditions in sub- humid region of Rajasthan. The vegetative and flowering characters varied significantly among the varieties. The results revealed that the variety Mauve Sarha recorded maximum plant height (68.73 cm), number of primary branches (23.27) and leaf width (4.88 cm). The maximum plant spread recordrd in "Shyamal" (54.61 cm). The maximum no. of leaves at the time of bud initiation was recorded in Chandani (762.55), maximum leaf length in Flirt (9.30 cm) and leaf area in Jaya (2.00cm^2). The earliest flowering (77.60 days) and fresh weight (8.77 g) was recorded in White Bouquet while Anmol recorded longest duration of flowering (100.67 days), highest yield (1.34 kg) and number of flower per plant (610.33). The highest number of flower per stem (spray) found in Shyamal (48.00) and highest value for stalk length in Ravi kiran (19.90 cm). Longest vase life was recorded in variety Chandani. The maximum *insitu* life was recorded in Clovelea Star (14.67 days).

O-6.5

Effect and economic feasibility of plant growth regulators on yield of 'Nagpur Mandarin' (*Citrus reticulata* Blanco.)

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An experiment was carried out at Fruit Research Farm, Department of Fruit Science at College of Horticulture and Forestry, Jhalawar during July, 2012 to April, 2013 to study the effects and economic feasibility of plant growth regulators on yield of Nagpur mandarin (*Citrus reticulata* Blanco.). The maximum increase in yield attributing characters like weight, volume and diameter of fruit along with number of sacs per fruit was recorded with the spray of 100 ppm GA_3, which was closely followed by 30 ppm 2,4-D. The significantly higher number of fruits per tree, fruit retention per cent and yield with best economic feasibility were recorded with the spray of 30 ppm 2, 4-D.

P-6.1

Performance of chrysanthemum varieties in Saurashtra region of Gujarat

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An experiment was conducted to evaluate 15 chrysanthemum varieties under Saurashtra region of Gujarat in relation to growth, yield, yield attributes and vase life. Out of all the 15 varieties, Shyamal registered maximum flower yield per plant and per hector (247.63g and 107.16 q/ha, respectively) and was also at par with IIHR-6. Plant height was found highest in Puja, whereas, plant spread (E-W) was recorded highest in Baggi and plant spread (N-S) was noted highest in Yellow Button. The variety Sharad Mala was earliest for flowering as well as longest flowering span. On the other hand, Shanti recorded biggest flower diameter. However, the smallest flower diameter, lowest weight of 10 flowers and highest number of flowers par plant were noted in Yellow Button. Significantly the flower weight was observed in IIHR-6 followed by Shyamal which was exhibited significantly the longest vase life (11.27 days). Highest monitory return was noted in IIHR-6 followed by Shyamal.

P-6.2

Response of Carnation (*Dianthus caryophyllus* L.) varieties to foliar spray of nutrients (NPK) under protected condition

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Carnation (*Dianthus caryophyllus* L.) is one of the most beautiful commercially important cut flower in florist trade. It occupies prime position in international cut flower trade. The growth and development is greatly influenced by the different concentrations of foliar spray. Foliar spray is the technique of feeding plants by applying liquid fertilizer directly through their leaves. For this study fifteen treatment combinations comprising of three varieties *viz*., V_1 (Don Pedro Rapido), V_2 (Becarat) and V_3 (Madame Colette) and five levels of nutrients viz., F_1 (0 N : 0 P_2O_5 :0 K_2O ppm as a Control), F_2 (1000 N: 600 P_2O_5:300 K_2O), F_3 (2000 N : 1200 P_2O_5 :600 K_2O), F_4 (4000 N : 2400 P_2O_5 :1200 K_2O) and F_5 (6000 N : 4000 P_2O_5 :2000 K_2O) were allocated in Completely Randomized Design with Factorial concept in three replications. The comparison of results show that variety V_1 (Don Pedro Rapido) exhibit significantly increased vegetative growth, flowering, yield and quality parameters. Plant analysis results implies maximum Nitrogen content in leaves and plants in variety V_1 (Don Pedro Rapido) and maximum Phosphorus and Potassium content in leaves as well as highest Potassium content in plants observed in variety V_2 (Becarat). The treatment F_5 (6000 N : 4000 P_2O_5 :2000 K_2O) has significant effect on vegetative growth, flowering, yield and quality parameters. Highest net return was recorded in variety V_1 (Don Pedro Rapido) and treatment F_5 (6000 N : 4000 P_2O_5 :2000 K_2O). This study reveals that the variety V_1 (Don Pedro Rapido) was found best with F_5 (6000 N : 4000 P_2O_5 :2000 K_2O) for obtaining a better crop of carnation under greenhouse with better growth and yield as well as maximum net returns when which were subjected to five sprays at an interval of 25 days during the growth period which started after five days after first pinching the plants.

P-6.3

Effect of chemical solutions on vase life, quality parameters and biochemical parameters of Gerbera (*Gerbera jamesonii* Bolus ex. Hooker F.) cv. Pink and Red Star

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The present investigation entitled "Effect of Chemical Solutions on Vase life of Gerbera (*Gerbera jamesonii* Bolus ex. Hooker F.) cv. Pink and Red Star" was conducted during September 2011 to April 2012 at Department of Floriculture and Landscaping, K.N.K. College of Horticulture, Mandsaur (M.P.) Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior. Twenty two treatment combinations consisting of two cultivars (Pink and Red Star) and 11 preservatives *viz.* C_0 (Control (only DW), C_1 (10 ppm $AgNO_3$), C_2 (20 ppm $AgNO_3$), C_3 (2% Sucrose), C_4 (4% Sucrose), C_5 (2% Sucrose + 10 ppm $AgNO_3$), C_6 (4% Sucrose + 10 ppm $AgNO_3$), C_7 (2% Ascorbic acid), C_8 (3% Ascorbic acid), C_9 (300 ppm KMS) and C_{10} (600 ppm KMS) were replicated 3 times in factorial completely randomized design. The observations on vase life, quality parameters and bio-Chemical parameters were recorded.

The effect ofvarieties, chemical solutions and interaction effect of varieties and chemical solutions on various characters has been summarized below:

The vase life of flowers was significantly influenced by the varieties and chemical solutions while the interaction effect of varieties and chemical solutions was non significant. The cv. Red Star recorded a longer vase life than the cv. Pink. The chemical solution C_5 (2% Sucrose + 10ppm $AgNO_3$) recorded the longest mean vase life while the shortest mean vase life was recorded in C_0 (Only DW). The treatment combination C_5V_2 (cv. Red Star with 2% Sucrose + 10ppm $AgNO_3$)recorded the longest vase life while the shortest vase life was recorded by treatment combination C_0V_1 (cv. Pink with Only DW).

The fresh weight offlowers increased from harvest to 3rd day in vase in both cultivars with all the treatments. The mean increase in fresh weight offlowers from harvest to 3rd day was more in cv. Red Star in comparison to cv. Pink. The maximum increase in fresh weight of flowers from harvest to 3rd day was observed in chemical solution C_5 (2% Sucrose + 10ppm $AgNO_3$). The treatment combination C_5V_2 (cv. Red Star with 2% Sucrose + 10ppm $AgNO_3$) recorded the maximum increase in fresh weight of flowers from harvest to 3rd day.

A decrease in fresh weight (g) of cut flowers from 3rd day to 6th day in vase was observed in both cv. Red Star and cv. Pink. The mean decrease in fresh weight offlowers from 3rd day to 6th day in vase was more in cv. Red Star than cv. Pink. Among the chemical solutions the maximum decrease in fresh weight of flowers from 3rd day to 6th day was in C_1 (10ppm $AgNO_3$). The maximum decrease in fresh weight of flowers from 3rd day to 6th day was recorded in treatment combination C_1V_2 (cv. Red Star with 10ppm $AgNO_3$).

A decrease in fresh weight (g) of cut flowers from 6th day to senescence in vase was also observed in both cv. Red Star and cv. Pink. The decrease mean fresh weight offlowers flower from 6th day to senescence was more in cv. Red Star than cv. Pink. The maximum decrease in fresh weight of flowers from 6th day to senescence was recorded in chemical solution C_3 (2% Sucrose). The treatment combination C_3V_2 (cv. Red Star with 2% Sucrose) recorded the maximum decrease in fresh weight of flowers from 6th day to senescence.

The effect of varieties and chemical solutions on dry weight of flowers at senescence was statistically significant, while the interaction effect of varieties and chemical solutions was non significant. The mean dry weight offlowers at senescence was more in cv. Red Star in comparison to cv. Pink. The maximum dry weight of flowers at senescence was recorded in chemical solution C_5 (2% Sucrose + 10ppm $AgNO_3$). The treatment combination C_5V_2 (cv. Red Star with 2% Sucrose + 10ppm $AgNO_3$) recorded the maximum dry weight of flowers at senescence.

The mean solutionuptake by the flowers on 3rd day, 6th day and total solution uptake was more in cv. Red Star in comparison to cv. Pink. Among the chemical solutions the maximum solutionuptake by the flowers on 3rd day, 6th day and total solution uptake was recorded in C_5 (2% Sucrose + 10ppm $AgNO_3$). The treatment combination

C_5V_2 (cv. Red Star with10ppm $AgNO_3$ + 2% Sucrose)recorded the maximum solutionuptake by the flowers on 3rd day, 6th day and total uptake of solution/water.

The effect of chemical solutions on anthocyanin content, soluble sugar content and starch content was statistically significant, while the varieties and interaction effects of varieties and chemical solutions were non significant. The reducing sugar content in petals were significantly influenced by the varieties and chemical solutions while the interaction effect of varieties and chemical solutions was non significant.

The mean anthocyanin content, soluble sugar content, reducing sugar content and starch content in petals were more in cv. Red Star in comparison to cv. Pink. Among the chemical solutions the maximum anthocyanin content, soluble sugar content, reducing sugar and starch content in petals was recorded in C_6 (4% Sucrose + 10ppm $AgNO_3$).

The treatment combination C_6V_2 (cv. Red Star with 4% Sucrose + 10ppm $AgNO_3$) recorded the maximum anthocyanin content, soluble sugar content, reducing sugar content and starch content in petals while minimum anthocyanin content, soluble sugar content and reducing sugar content were recorded in the treatment combination C_0V_1 (cv. Pink with Only DW). The minimum starch content in petals was recorded in the treatment combination C_0V_1 (cv. Pink with Only DW) and C_0V_2 (cv. Red Star with Only DW).

P-6.4

Effect of organic manures and inorganic fertilizers on growth and flowering in gladiolus cv. Tiger Flame

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The experiment was conducted in Randomized Block Design (RBD) with three replications. Afield experiment was conducted to assess the effect of vermi compost 5t/ha, 10t/ha 15t/ha, and F.Y.M. 10t/ha, 20t/ha, 30t/ha, Nadep compost 10t/ha, 20t/ha, 30t/ha and NPK 120:60:120kg/ha on Vegetative and Flowering Growth in Gladilous Cv. Tiger Flame. Application of 15t/ha Vermi compost increasing flowering character like spike length, no. of florets / spike, no. of spike / plant , size of florets and height of plants and vegetative characters like – number of leaves per plant, number of corm per plant.N.P.K. 120 : 60 :120 Kg/ ha was showed highest plant height.

P-6.5

Evaluation of warm season turfgrasses under Delhi agro-climatic conditions

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Turfgrasses adorn our homes, public places and sports fields. Turfgrass endows many benefits to our environment besides improving the aesthetic of a landscape and providing a platform for various sports and host of activities. Turfgrass absorbs rain water thereby reducing run-off. It also decreases erosion, purifies air and neutralizes pollutants. There is a need to identify turfgrass which can grow throughout the year in Delhi. Therefore, a field experiment on evaluation of turfgrasses was carried out during 2013-14 at research farm of the Division of Floriculture and Landscaping, IARI, New Delhi. The planting material utilized for the study consisted of six varieties of Bermuda grass (*Cynodon dactylon*) namely Bargusto, Palma, Panama, Panam, Selection 1 and Tif dwarf 419 and another species *Paspalum notatum*. The various observations on morphological traits were recorded monthly for a period

of a year. Colour and density are two of the most important traits to be considered for selecting a grass for turf and 'Tif dwarf 419' showed the most favourable dark green colour on visual basis throughout the year except during winter season. However, the leaves of *Paspalum notatum* exhibited shades of green and yellow colours and thus it was found inconsistent and unfavourable for turf. Density of the shoots was highest in Selection 1 followed by Tif Dwarf 419 of Bermuda grass. Systematic research and scientific documentations specifically for Indian conditions are still lacking in turfgrasses, hence present study was done to evaluate the varieties and species available at the institute for their suitability to be used as turfgrass throughout the year under Delhi climatic conditions.

P-6.6

Effect of NPK on growth and flower yield of ratoon spider lily (*Hymenocallislittoralis* L.) cv. Local

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The investigation was carried out to study the effect of various levels of N, P and K on ratoon spider lily. All the growth parameters were significantly influenced due to different levels of nitrogen. Application of nitrogen at 400 Kg N ha^{-1} with three equal split doses recorded significantly the highest plant height, number of leaves per plant, leaf area, total chlorophyll content at flowering stage, number of flower stalk per plant, length of flower stalk, number of flower buds per stalk, number of flower buds per plant, flowering duration of single stalk, number of flower buds per net plot as well as flower yield per hectare. Phosphorus also plays a significant role in improving growth parameters at higher level except, number of leaves per plant. Phosphorus at 200 Kg P_2O_5 was recorded maximum number of flower stalks per plant, number of flower buds per stalk,length of flower stalk, maximum flowering duration, number of flower buds per plant, number of flower buds harvested per net plot and flower yield per hectare. The optimum growth and flowering yield was obtained with application of 400 Kg N ha^{-1} and 200 Kg P_2O_5 ha^{-1}.

P-6.7

Exotic Heliconias a speciality cut-flower and ornamental for landscaping

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Since their introduction to India, Heliconias have been well adapted to major agroclimatic regions of our country especially to Kerala. Heliconias belonging to the family Heliconiaceae, are among the most provocative of all exotic tropical flowering plants. Common names for the genus include lobster-claws, wild plantains or falsebird-of-paradise. The family comprises of 250-300 species distributed mainly in Neotropical areas. Heliconia are known for their beautiful, brilliant colourful flowering bracts. Breathtaking and unusual flowerheads (bracts) rise from clumps of banana like leaves, sometimes very large or slender. Apart from highly valued flowers (both erect and pendent types), the large variation exists in plant height, leaf shape and colour, leaf sheath colour, clump spread. This variation awaits its exploitation for landscaping. Heliconias are classified as speciality cut-flowers because of their uniqueness in size, shape and colour. Demand for Heliconias in international flower market is ever increasing and prices are also high. Heliconias can also be utilized for beautification of public places, private gardens, institutional gardens, residential complexes, factory gardens, courtyard and road side as well as road divider plantation. Other potential areas being foundation planting, flanking pathways, porches, patio, fences and even a

tall varieties with large leaves for screening purpose. Choosing an exotic Heliconia variety with good floral attributes can provide substantial monetary returns to Indian Farmers.

P-6.8

Impact of climate change in indian horticulture

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Global warming and climate change is the greatest concern of mankind in 21st century. The crop productivity is subjected to number of stresses and potential yields are seldom achieved with stress. The present challenges like global climate change, water and soil pollution, less water availability, urbanization etc adds up to the situation. These lead to growing interests among scientists on abiotic stress research. Abiotic stress includes drought, heat, flood, salinity, mineral deficiency, toxicity, and chilling or freezing stress. Due to high temperature physiological disorder of horticultural crops will be more pronounced eg. Spongy tissue of mango, fruit cracking of litchi, flower and fruit abscission in solanaceous fruit vegetables, etc. Breeding a new variety takes long time and ability to breed new varieties is undermined by the rapid loss of horticultural biodiversity, which is in turn accelerated by climate changes. Hence there is a need to protect these valuable crops for sustainability against the climate change scenario. The most effective way is to adopt conservation agriculture, using renewable energy, forest and water conservation, reforestation etc. To sustain the productivity, modification of present horticultural practices and greater use of greenhouse technology are some of the solutions to minimize the effect of climate change. Development of new cultivars of horticultural crops tolerant to high temperature, resistant to pests and diseases, short duration and producing good yield under stress conditions, as well as adoption of hi-tech horticulture and judicious management of natural resources will be the main strategies to meet this challenge.

P-6.9

Water chestnut: A potential crop for management of wetlands and food security

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Water logging is one of the major problems of land degradation in India and may be a result of natural or man made factors arising from unscientific management of soil, water and crops in irrigated lands. In India, the waterlogged area is 2.46 M ha (Source: MOWR working group, 1996.) and it is increasing every year due to excessive rainfall, floods and glacier melts. With the decreasing arable land due to urbanization and the increasing waterlogged areas it becomes mandatory to manage the so-called waterlogged wastelands for providing nutrition solutions through cultivation of aquatic crops like water chestnut (*Trapa natans* var. *bispinosa* Roxb.), *Euryle ferox*, *Nelumbo nucifera* etc.

With the above in view, a preliminary survey was conducted by the Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, Lucknow from 2009-2011, to study water chestnut as a potential crop for the cultivation in waterlogged areas. The collection and evaluation of different cultivars of water chestnut for their physical and biochemical parameters was done in order to explore the possibility of genetic variability in water chestnut. The studies showed that considerable variation was found in the physical and biochemical characters. Variability was observed in physical and biochemical parameters viz., fruit length (3.88-

4.68cm), fruit width (4.13-4.74 cm), fruit weight (20.25-26.72g), peel weight (7.93-11.95), kernel weight (12.09-15.80), TSS (6.34-7.20 ^{0}Brix), Ascorbic acid (8.24-9.30 mg/100g), Vitamin-A (17.63-18.81 I.U./100g), Acidity (0.09-0.10 %), pH (5.63-6.03), reducing sugar (1.56-2.01 %), non-reducing sugar (1.99-2.56 %) and total sugars (3.72-4.58 %) etc. The importance of these findings in the exploitation of this aquatic crop to meet the demand of food perspectives is massive and needs to be standardized and promoted for agriculture in waterlogged areas highlighted.

P-6.10

Effect of temperature, physical and chemical treatments on dormancy breaking, germination and vigour of gloriasa superba

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The experiment was conducted at Department of Seed Science and Technology H.N.B.G. University. Srinagar-Garhwal 246174 (Uttarakhand) India. Freshly harvested seeds of *Gloriasa superba*, after sun drying failed to germinate in laboratory at 20ºC and 25ºC in light or in dark. Seeds, prior to germination were subjected to the following treatments: T_1- untreated (control); T_2 cold water (24 h); T_3 sulfuric acid (SA; 5 min); T_4 SA (10 min); T_5 SA (15 min); T_6 gibberellic acid (GA) (50 ppm for 24 h); T_7 GA (100 ppm for 24 h); T_8 GA (200 ppm). T_8 recorded the highest number of seedlings, germination percentage and seedling vigor index, and the tallest seedlings. The 25ºC temperature give the best results.

P-6.11

Plant architecture management for scheduling flowering in *Tagetes erecta* cv. Pusa Narangi Gainda

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African marigold (*Tagetes erecta* L.) belongs to the family Asteraceae and is one of the most important ornamental plants and it occupies significant position in loose flower production. The area under commercial cultivation of marigold is increasing at a faster rate due to its multipurpose usage in social and religious functions and pigment extraction. Pinching is one of the important agronomical operation which influences plant growth, branching, flower size, flower yield and time of flowering. Timing of flowering in marigold is very important due to very high volatility in market prices due to varying demand. In marigold, growers are trying to schedule the crop to get remunerative prices. Keeping these facts in view, a systematic experiment was laid out in randomized block design at the research farm of the Division of Floriculture and Landscaping, IARI, New Delhi during 2013-14. The experiment was with six treatments and formulated with single and double pinching combinations comprising T_{0-} Control, T_1- 20 days after transplanting(DAT), T_{2-}30 DAT, T_{3-}(20 &30 DAT), T_4- (30 &40 DAT), T_{5-}40DAT. Pinching at 20 and 30 days after transplanting (T_3) resulted in minimum plant height(52.89 cm), highest plant spread (41.44 cm) and delayed bud initiation (82.22 days) and flowering (94.11). T_3 resulted in favourable flower diameter. The number of flowers per plant was recorded highest in T_3 but the flower yield was highest in T_2. Pinching may be used as one of the tools for crop regulation to get flowering at a desired time for higher profitability.

P-6.12

Weed manangement in *Tagetes patula* cv. Pusa Arpita

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French marigold (*Tagetes patula* L.) of family Asteraceae is one of the most important ornamental plants and it may occupy significant position in loose flower production in near future due to easy adaptability to various climatic and soil conditions and there is no need to carry out pinching. The area under commercial cultivation of marigold is increasing at a faster rate due to its multipurpose usage in social and religious functions and pigment extraction. Early infestation of field with heavy weed population reduces vegetative growth and flower yield drastically. Keeping these facts in view, a systematic experiment was laid out in randomized block design at the research farm of the Division of Floriculture and Landscaping, IARI, New Delhi during 2013-14.

In the experiment ten treatments (T_1 Pendimethalin1.0 Kg/hectare + Metribuzin 0.3Kg/hectare (Before transplanting),T_2 -Pendimethalin@1.0Kg/hectare+ Metribuzin 0.3Kg/hectare (Aftertransplanting), $T_3 – T_1$ + Residue, T_4- Metribuzin 0.5Kg/hectare (Before transplanting),T_5 - T_4+ handweeding at 30 days,T_6- Pendimethalin@1.0 Kg/ hectare (Aftertransplanting),T_7- T_6 + Hand weeding at 30 days ,T_8- Pendimethalin@1.0 Kg/hectare (Before transplanting) + Clodinafop- propargyl@ 60 g/hectare(Aftertransplanting),T_9 – Weed free check andT_{10}- Weedy check) were taken. Among the treatments taken, T_6 gave best results. T_6 (Pendimethalin@1.0 Kg/hectare (Aftertransplanting) registered less fresh weight and dry weight of weeds. The vegetative parameters like number of secondary branches (44.22) were high under T_6. The number of flowers per plant were higher in T_3 (204.56) and T_6(200.89) whereas flower yield per plant was highest in T_6 (686.89 g). The flower yield per plant was drastically reduced in weedy check T_{10}(331.99). Pendimethalin 1.0 kg/ha (after transplanting) was found to be best in controlling weeds without affecting vegetative growth.

P-6.13

Impact of global warming on production and quality of fruits

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Global warming is the increase in the earth's temperature as a result of the green house effect. Certain gases such as Co_2, Nitrous Oxide, and Methane act as the additional blanket around the earth. They allow sun's heat to reach the earth surface and warm up the earth's temperature. Most of the fruits are the very sensitive to the temperature. As the increase in the temperature the less flower bud induction, higher fruit drop, faster volume growth of fruit, earlier maturation, earlier loss of juice, faster decline in acidity, usually less total soluble solids. The basic ingredients of photosynthesis are carbon dioxide and water. For instance, increase in CO_2 concretion; increase in temperature and variable distribution of rainfall caused earlier leaf production by trees, earlier greening of vegetation which show a mixed projection of yields of various crops across regions.

Secondary impact of changed pest and disease scenario can further complicate the crop yield situation. Many species of fruit fly lack the ability to adapt effectively to predicted increases in global temperatures and may face extinction in the near future, which acts as the main source of pollinator. In the absence of these, cross pollination become difficult, which is also caused the poor fruit set. Studies indicate that increased temperature can substantially reduce yields of fruits apart from affecting their quality.

P-6.14

Response of nitrogen, phosphorus and spacing on growth, flowering and bulb production of hemerocallis (*Hemerocallis fulva*)

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An investigation was carried out of find the effect of different spacing (30x15 cm and 30x30 cm) and nitrogen levels (0,20,40 and 60 g/m^2) on growth, flowering and yield characters of hemerocallis (*Hemerocallis fulva*). Among the different treatments the spacing 30x30 cm and application of (40 g/m^2) recorded the minimum time taken to sprouting of bulb, maximum plant height, minimum number of days taken for bud initiation, maximum diameter of flower, duration of flower, vase life and flower and bulb yield.

P-6.15

Effect of staggered planting on round the year production of gladiolus under deccan plateau

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Gladiolus *(Gladiolus hybridus*) is a perennial bulbous flowering plant in the family Iridiaceae. It is an important cut flower crop grown under open conditions and ranks next to carnation and gerberas in importance.There is round the year demand for gladiolus spikes in the flower market. In view of the increasing demand for cut flowers, there is a good scope for year- round production of Gladiolus in peri- urban areas of Hyderabad. Keeping in view of changing climatic conditions and increasing demand, a field experiment was conducted at the Floricultural Research Station, Rajendranagar, Hyderabad to study the effect of staggered planting for extended flower availability and to study the effect of planting time on growth, quality, yield of flower spikes and corm production.

Planting was staggered at fortnightly interval from 15th June onwards till 30th December. The spike emergence and flowering was observed to be early in September planting while planting in December took more time for flowering (75.5 days) while all the growth parameters such as number of leaves, tillers per plant and leaf width were maximum in July 15th and August 15thplanting. Maximum spike length, rachis length with more number of florets (17.5) was observed with June 30th planting. Maximum floret size (9.8cms) was noticed with October planting. The rate of production of corms and cormels were high in August, September and October planting. Based upon the results of two years study, planting of gladiolus in June 2nd fortnight, August, September and October plantings were best in respect to growth, flowering and corm production which, can fetch higher returns to the growers besides ensuring best quality spike throughout the year to the market. However for early flowering and longest duration of flowering September planting was the best. The spike length decreased and flower size is of inferior quality in November and December plantings.

P-6.16

Influence of nitrogen and potassium on growth and yield of gladiolus corms

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A field experiment on "influence of nitrogen and potassium on growth and yield of gladiolus corm" was conducted at Horticulture Section, College of Agriculture, Nagpur (M.S.) during 2012-2013 with sixteen treatment combinations in factorial randomized block design. The treatment comprised of four levels of nitrogen (0, 150, 300 and 450 kg ha^{-1}) and four levels of potassium 90, 75, 150 and 225 kg ha^{-1}). The results of the experiment revealed that, plant height, shoots $plant^{-1}$, number of cormels $plant^{-1}$ and ha^{-1}, diameter of corm, weight of corms $plant^{-1}$ and weight of cormels $plant^{-1}$ were recorded significantly higher with 450 kg nitrogen ha^{-1} and 225 kg potassium ha^{-1}. However, in respect of corm yield, the treatment combination of 300 kg ha^{-1} of nitrogen with 225 kg ha^{-1} of potassium produced significantly maximum number of corms $plant^{-1}$ and ha^{-1}.

P-6.17

Effect of plant growth retardants on growth, flowering and yield of chrysanthemum (*Chrysanthemum morifolium* Ramat.) cv. IIHR-6

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The present experiment was conducted on chrysanthemum (*Chrysanthemum morifolium* Ramat.) cv. IIHR-6 at Jambu Vadi Farm, College of Agriculture, JAU, Junagadh during winter season of 2013-14 under South Saurashtraagro climatic condition. The experiment was laid out in Randomized Block Design with Factorial concept with two time of spray viz., spray at 30 days after transplanting (S_1) and spray at 60 days after transplanting (S_2) and six treatment of plant growth retardants *viz.,* MH 500 @ mg l^{-1} (P_1), MH 700 @ mg l^{-1} (P_2), CCC @ 2000 mg l^{-1} (P_3), CCC @ 2500mg l^{-1} (P_4), PCB @ 0.4 ml l^{-1} (P_5), PCB @ 0.5 ml l^{-1} (P_6) were sprayed including control (P_7). The effect of different time of sprays and plant growth retardants on growth, flowering and yield of chrysanthemum cv. 'IIHR-6' were found significant. The vigorous growth in terms of plant heightat 90 DAT (52.65 cm) and at the time of final harvest (63.34 cm) was noticed the highest in control (P_7) treatment while, the number of branches per plantat 90 DAT (28.80) and at the time of final harvest34.89), plant spread in N- S (52.15 cm and 60.78 cm) and E-W direction (53.25 and 62.45 cm) at 90 DAT and at time of final harvest, respectively; fresh weight of plant (317.55 g) and dry weight of plant (35.87 g) recorded maximum under plant receiving MH @ 700 mg l^{-1} (P_2). Consequently, these plants produced early flowers (70.94 days), took minimum days for 50 per cent flowering (101.16 days) with maximum flowering span(46.36 days), flower diameter (6.33 cm), shelf life (5.00 days) of flower as well as vase life (9.05 days) of flower. The yield of flowers (13.43 t ha^{-1}) also produced maximum in these treatment.Interaction between different time of spray and plant growth retardants was found to be non significant in case of growth, flowering and yield of flowers, except diameters of flower. Economics of chrysanthemum indicated that the plant sprayed at 30 days after transplanting (S_1) and treated with MH @ 700 mg l^{-1} (P_2) found most remunerative as they gave highest net returns (Rs. 208980) with maximum BenefitCost Ratio (1:4.50). It can be concluded that the foliar application of MH @ 700 mg l^{-1} at 30 days after transplanting proved superior in terms of growth, flowering, flower yield andmore economical as compared to all other growth retardants treatments.

P-6.18

Effect of planting distance and pinching on flowering and yield in Cina aster (*Callistephus chinensis* L. Nees) cv. Kamini

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An investigation was carried out at College of Horticulture, Rajendranagar, Hyderabad during rabi, 2013-14 to assess the effect of planting distance and pinching on flowering and yield in China aster cv. Kamini. The experiment was laid out in Randomized Block Design with factorial concept and replicated thrice. The study consisted of 12 treatment combinations with three spacings (30 cm x 15 cm, 30 cm x 30 cm and 45 cm x 30 cm) and four levels of pinching (pinching at 20 DAT, 30 DAT and 40 DAT and no pinching). The results revealed that closer spacing of 30 x 15 cm (S_1) recorded significantly minimum days to first flowering (82.30) and 50% flowering (100.42), maximum flower stalk length (37.18 cm), number of flowers per plot (3684.37), flower yield per plot (4.66 kg), flower yield per hectare (14.38 t), seed yield per plot (649.12 g) and seed yield per hectare (2003.46 kg). While wider spacing of 45 x 30 cm (S_3) recorded maximum flower diameter (6.20 cm), number of flowers per plant (65.88), flower yield per plant (70.56 g), seed yield per plant (12.40 g) and thousand seed weight (1.77 g). Plants pinched at 20 DAT recorded significantly maximum flower stalk length (36.83 cm), number of flowers per plant (70.47), number of flowers per plot (3760.86), flower yield per plant (73.46 g), flower yied per plot (4.01 kg), flower yield per hectare (12.38 t), seed yield per plant (13.07 g), seed yield per plot (684.02 g) and seed yield per ha (2161.58 kg) and thousand seed weight (1.78 g) when compared to other pinching treatments. It was concluded that for obtaining higher flower and seed yield per hectare in China aster cv. Kamini planting at a closer spcacing of 30 cm x 15 cm and pinching at 20 DAT could be recommended.

P-6.19

Maintenance, conservation and morphological characterization of elite bougainvillea germplasm

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Bougainvillea belongs to the family Nyctaginaceae are the most popular ornamental shrubs and trees. The wider adaptability to adverse soil and climatic conditions and its modified brightly colourful bracts has made bougainvilleas as most ideal and admired garden plant in tropical and sub tropical regions of the world. It has diverse use as a shrub, climber, pot plant, specimen plant, topiary, hedge, hanging baskets, cascade, bonsai, arches, pergolas and group planting. Owing its performance and significance it is necessary to conserve the germplasm and access the diversity among the species and cultivars. Systematic characterization of varieties will be useful in maintaining purity of the varieties and also avoid duplications. In the light of significant work done by the division of floriculture and landscaping in bougainvillea improvement programs, it has been appointed as the International Crop Registration Authority for Bougainvillea by International Society for Horticultural Science, Belgium for registration of cultivars. An attempt was made to characterize hundred cultivars available at the repository through morphological traits. Morphological descriptors as per the UPOV guidelines including qualitative/pseudo-qualitative and quantitative traits were used to group and distinguish the cultivars. The dendrogram based on

morphological characters separated all the bougainvillea cultivars into 12 major clusters and several sub-clusters. Out of twelve major clusters, the cluster-I exhibited as largest cluster compared to all other major clusters comprising of 49 cultivars. However, cluster II with 14 cultivars, Cluster III with 12 cultivars, cluster XII with 7, cluster X with 6, cluster VII with 5 and clusters no V, VI, VIII, IX, XI having only one cultivar in each case. It clearly grouped the cultivars of single and double type of bracts and also grouping based on pattern of variegation in leaves. This quantification of existing genetic variation and identification of cultivar for each economic character and grouping the popular cultivars based on genetic divergence will help in efficient and effective use of germplasm for bougainvillea improvement. Further, this characterization could be utilized for maintaining the genetic purity of a genotype as well as DUS testing becomes easy in a well characterized genotype.

P-6.20

Effect of pre-harvest foliar sprays, packaging and storage temperatures on storability of marigold loose flowers (*Tagetes erecta* L.) cv. pusa narangi gainda

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African marigold (*Tagetes erecta* L.) is the extensively grown traditional flower crop in India. Besides its use as loose flower, marigold is valued for xanthophylls extraction that are used in food and poultry industry. Normally marigold flowers last for 3-4 days after harvest depending upon the season. With proper pre and post harvest technology, the shelf life of marigold loose flowers can further be increased. Keeping in view of this objective, a study was conducted at Floricultural Research Station, Rajendranagar, Hyderabad, during 2012-13, to know the influence of packaging and storage temperatures on shelf life with loose flowers of cv.Pusa Narangi Gainda. The flowers were harvested from the plots sprayed (pre-harvest) with salicylic acid @ 200 ppm, Calcium nitrate($Ca(NO_3)_2$) @ 2% and Calcium Chloride($CaCl_2$)@ 2% and compared with control (water spray) for storage studies.

The study involved the packaging of flowers in Onion mesh bags and Polyethylene (PE) bags of 200 gauge thickness with 0, 1, 2 & 3% ventilation and storage at ambient conditions and at 10^0C. The results revealed that packaging of the flowers in PE bags with 0% ventilation resulted in minimum physiological loss in weight (PLW) of flowers with extended shelf life at both storage conditions. The flowers packaged in 0% ventilated PE bags were stored for 4.63 days under ambient conditions and for 14.04 days in cold storage at 10^0C. In this study packaging influenced the post harvest storage life of flowers rather than pre-harvest foliar sprays. However, among all treatments, pre-harvest spray with Ca $(NO_3)_2$ @ 2% was the best, affecting the shelf life of flowers.

P-6.21

Response of pinching and nitrogen to growth, flowering and seed yield in African marigold

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Marigold is leading loose flower of India (1). Besides being an ideal bedding plant, now African marigolds are economically used as loose flower for decoration and landscaping purposes. Work on pinching has been done on marigold and it responded well for flower production but limited information is available on effect of double pinching

in marigold. Spraying of nitrogen on carnation plant has been found beneficial. But combination of nitrogen with single and double pinching is yet to be standardized. A field experiment was conducted to find out effect of pinching and application of nitrogen in marigold. Uniform and vigorous seedlings of marigold cv. Pusa Narangi Gainda were transplanted in 2.4 × 3.0 m plots. There were eight treatments i.e. single pinching (SP), double pinching (DP), SP + 1% nitrogen, SP + 2% nitrogen, SP + 3% nitrogen, DP + 1% nitrogen, DP + 2% nitrogen and DP + 3% nitrogen. Experiment was laid out in a randomized block design with three replications. Double pinching + 2% nitrogen as foliar application significantly increased number of secondary branches and leaves/plant, plant spread, plant height, number and weight of flowers/plant, flower yield/m^2, number and weight of seeds/plant and seed yield/m^2. Single pinching + 3% nitrogen treatment significantly increased number of primary branches/plant, whereas early flowering was recorded with single pinching + 1% nitrogen treatment. All the treatments failed to exert any striking effect on diameter of flower and 100-seed weight.

P-6.22

Response of foliar application of iron and zinc to growth, corm and cormel yield in gladiolus cv. American Beauty

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Floral spike is the characteristic feature of gladiolus which adds aesthetic beauty to decorations. It is an important cut flower for national and international trade. The inflorescence of gladiolus is a magnificent spike blooming in vibrant colours. Adequate amount of fertilizers are necessary for optimum growth and quality flowers. Both macro- and micronutrients have respective roles in the development of bulbous flowering plants. They also influence several metabolic activities and synthesis processes. Iron is an important component of enzymes and catalyzes several reactions *viz*., chlorophyll synthesis, photosynthesis, respiration, reduction of nitrates and phosphates. Zinc deficiency is global and in Uttar Pradesh, iron deficiency was recorded to be 15% whereas zinc deficiency was much higher i.e. 46% in Varanasi district. Therefore an experiment was conducted to study the response of gladiolus to foliar application of iron and zinc. Iron sulphate and zinc sulphate at the concentration of 0.2% and 0.4% were taken for foliar spray. The spraying was done at 3 and 5 leaf stage. Experiment was laid out in randomized block and the results obtained revealed that $ZnSO_4$ at 0.2% increased dry weight of leaf and $ZnSO_4$ at 0.4% foliar dose increased length of longest leaf, width of longest leaf and also improved weight of corms/hill, weight of cormels/hill and diameter of corm. Foliar spray of combination of $FeSO_4$ 0.2% + $ZnSO_4$ 0.4% and $FeSO_4$ 0.4% + $ZnSO_4$ 0.4% increased number of corms/hill and number of leaves/plant, respectively.

P-6.23

Dwarfing bougainvillea for pot purpose

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Bougainvillea (*Bougainvillea spp.*) is a member of family Nyctaginaceae is an evergreen landscape plant of tropical and subtropical areas. It is becoming popular in urban and peri urban areas as it is very hardy and requires

minimum care, except pruning. In urban areas land is shrinking and people are staying in multistory houses and want to enjoy the beauty of plants such plants in their corridors and balconies. Therefore, they use this plant either as pot plant or in hanging baskets, but due to vigorous growth habit it needs to be pruned regularly by skilled person. Hence, plant growth retardants could be alternatives to reduce frequent pruning as well as labour costs. Since, little research has been carried out on the use of plant growth retardants (PGRs) for controlling the growth and flowering, the present investigations were carried out at the Division of Floriculture and Landscaping, IARI, New Delhi to study the effects of growth retardants mainly; paclobutrazol, CCC, ethephone, TIBA and maleic hydrazide to induce dwarfing in bougainvillea cv. Partha. The experiment was laid out in completely Randomized Block Design with 13 treatments and four replications. The plants of bougainvillea cv. Partha were planted in pots of 15 cm diameter and were pruned to a uniform height of 20±2 cm. The growth regulators were applied in the form of foliar spray or drench and data was recorded at 1, 2, 3, 4, 5 and 6 months intervals. After 5 months, it was observed that drenching of plants with 30 ppm paclobutrazol resulted in average minimum plant height (21.88cm), percent increase in plant height over initial height (13.58%), internode distance (0.38 cm), growth index (19.20). Application of 40 ppm paclobutrazol in the form of drench resulted in minimum plant spread (15.27 cm) and maximum chlorophyll content (40.41 spad). Six months after treatment, maximum flower index (3.50) and was, observed when plants were sprayed with 2000ppm cycocel. It was also observed that application paclobutrazol resulted in minimum disease severity. with From the present studies, it is concluded that the application of paclobutrazol is best for inducing dwarfism as compared to CCC, ethephone, TIBA and maleic hydrazide, as paclobutrazol restricted the vegetative growth but promoted flowering as compared to control.

P-6.24

Effect of integrated nutrient management on growth behaviour of tuberose (*Polianthes tuberosa* Linn) cv. Hyderabad Double.

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The present investigation on integrated nutrient management on growth behaviour of tuberose (*Polianthes tuberosa* L.) cv. Hyderabad Double was carried out at Main Experiment Station, Department of Horticulture, Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad, (U.P.) during the year 2009-10 to 2010-11.The experiment was laid out in randomized block design with thirteen treatments comprising of PSB, *Azotobacter* and FYM alone or in combination with each other and variable doses of N, P and K in three replications.

The treatment combination of PSB + *Azotobacter* + 50% N+50% P + K during 2009-10 and the same combination along with FYM during 2010-11 revealed the earliest initiation of spikes in tuberose cv. Hyderabad Double. However, the higher dose of inorganic fertilizers along with PSB, *Azotobacter* and FYM delays the initiation of spikes during both the years of study. The earliest opening of first floret, longest duration of flowering, maximum spike length and number of floret per spike was observed in the plants feeded with PSB + *Azotobacter* + 50% N + 50% P + K + FYM during 2009-10 and 2010-11.The highest average weight of florets per spike was obtained with the treatment PSB + *Azotobacter* + 50% N + 50% P + K + FYM in both the years. The treatment combination of PSB + *Azotobacter*+50% N+50% P + K + FYM produced the maximum number of spikes per unit area (hectare) during 2009-10 and 2010-11.The plants nourished with PSB+*Azotobacter*+50% N+ 50% P+K+FYM yielded the maximum flowers during 2009-10 and also in successive year of experimentation.

P-6.25

Nutrient management practices for cultivating Tuberose (*Polianthes tuberosa L.*) in partially degraded sodic land

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Tuberose is a leading commercial crop because of its multipurpose uses as cut flower, loose flower as well as its potential in perfume industry. The growing period of tuberose is normally 2-3 years or more, and, therefore, high amount of fertilizers are needed to maintain sustainable growth and flowering over a long period. As tuberose is a gross feeder and requires a large quantity of NPK, both in organic and inorganic forms, there is utmost need of integration of plant nutrients and their efficient managements. Continuous and adequate use of organic fertilizers with proper management can also increase soil organic carbon, soil water retention and improvement of physical properties of soil. Keeping these facts in mind, a field experiment was conducted at Banthra Research Station of CSIR-National Botanical Research Institute, Lucknow, to examine the response of organic manures supplemented with bio fertilizer on growth and floral characteristics of tuberose (*Polianthes tuberosa L.*) crop on sodic soil of Uttar Pradesh. The results revealed good performance of the crop with application of vermicompost and FYM, supplemented by seed treatment with *Trichoderma*. The improved vegetative growth and flowering behavior was achieved by a proper nutrition provided by these organic manures, resulting in greater plant height, leaf area, number of spikes and spike length of both main and ratoon crops. Application of vermicompost and FYM, supplemented by seed treatment with *Trichoderma* not only improved the flower and soil quality but also protected the plant from insect pest and disease infestation.

P-6.26

Green clod chain solution

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Refrigerated transport is necessary for maintaining the quality and prolonging the shell life of fresh, frozen and perishable products during transportation. In the present paper, development and performance evaluation of a refrigeration truck with phase change material is conducted. It will replace the predominant technology used in refrigerated road transport i.e. mechanical compression refrigeration driven by a diesel engine. Phase change material will be charged for the storage of coolness using off-vehicle refrigeration unit powered by electricity and stored coolness has been used to maintain the truck temperature.

P-6.27

Water use efficiency in Turfgrasses using superabsorbent polymers

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Turf grasses are considered as vital component of landscape Industry which provides aesthetic value. These are narrow-leaved grass species that form a uniform, long-lived ground cover that can tolerate traffic and low mowing heights. Irrigation water plays an important role in maintaining turf grass quality. The adequate quality and quantity of water supply is crucial for obtaining maximum growth because it maintains normal physiological activity and turgidity in turfgrasses. Balanced irrigation often decreases weed invasion, allows lawn grasses to tolerate insect and disease pressure and maintains its appearance. However, improper either more or less irrigation can lead to poor turf grass health and increase weed, insect, and disease problems. Excessive watering causes shallow root system and rapid turf growth which results in extra mowing and clippings, whereas a reduced watering makes turf open and sparse, poor appearance and allows weed invasion.

Superabsorbent polymers are largely cross-linked poly acrylates also called hydrogels. In general, they play an important role in conserving water, reducing irrigation frequency and releasing sufficient moisture to roots of growing plants. An indigenous superabsorbent hydrogel technology "Pusa Hydrogel" has been developed for improving water-use efficiency in agricultural and horticultural crops. Its potential in this context has been recently validated in an important indoor plant, *Coleus blumei* Benth.; commonly known as coleus or painted nettle. The turf grass namely, Bermuda grass (*Cynodon dactylon* var. Selection-1) is widely used for developing home and institutional lawns, playing surfaces, pathways, etc and require high amount of water for their maintenance. Therefore, keeping these points in view, the present investigations were carried out to study the performance of Pusa Hydrogel w.r.t. water use efficiency and growth related traits in Bermuda grass. Pusa Hydrogel@ 0g/4m^2(T_0), 1.2g/4m^2(T_1), 2.0g/4m^2 (T_2), 4.0g/4m^2(T_3), 5.0g/4m^2 (T_4), 6.0g/4m^2(T_5) on dry weight basis was applied throughout the field and in furrows (precise application). Bermuda grass showed increased irrigation interval and better growth related traits when Pusa hydrogel was applied in furrows as compared to throughout the field. Preliminary observations of six months old established turf grass exhibited that irrigation interval was increased by 4.36 days in T_5 followed by 3.47 days in T_4 when Hydrogel was applied in furrows. In control (T_0), irrigation was, however, at 1.51 days interval. The amount of water used in irrigating Bermuda grass was significantly lesser as compared to control. Various growth related traits viz., shoot length, root length, fresh weight of shoots, fresh weight of roots, dry weight of shoots, dry weight of roots, dry root/shoot ratio, shoot density /25cm^2, root density /25cm^2 increased with increased application of hydrogel and growth was maximum with 6.0g/4m^2 (T_5) . Leaf colouration measured in terms of chlorophyll content was more intense in plants grown in media amended with Pusa Hydrogel. In view of the growing input and turf grass management costs, use of Pusa Hydrogel technology will surely help the end users in saving water and reducing irrigation frequency, additionally maintaining superior quality turf grass.

P-6.28

A case study on the flower market of Lucknow

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A case study on the flower markets of Lucknowwas done in order to understand the functioning and the effectiveness of the Lucknow flower market. A survey of the flower market of Lucknow District was conducted during the last week of December 2010 through a questionnaire where information was collected from the local flower growers coming to the market regarding the crops being cultivated, scale of cultivation, technical expertise and awareness, returns on cultivation etc. Perusal of the information collected revealed that major flower growing development blocks of Lucknow district include Kakori, Malihabad, BakshiKaTalab, and the major villages are Amethiya, Salempur, Kanausi, Tompur, Muyabganj, etc. The cut flower industry include Gladiolus (White), Red Rose (Super), Tuberose (Harbrett), Chrysanthemum (mainly white), Gerbera and Carnation. Few farmers also grow Orchids and Anthurium which are priced high in the market. While the loose flower industry includesDesi Rose, Marigold, Kund, Chrysanthemum, etc.The pattern of cultivation in the area is as follows (0-.25hac-80 %,)(0.25-1hac- 16 %) (, > 1 hac- 4%). The educational qualification of 90% of farmers is below class 12th, 6% farmers are graduate and only 4% farmers were found post graduates. Majority of the farmers have started floriculture after seeing the success of neighboring farmers and they do not have any technical training,their produce is marketed in local Lucknow market i.e. chowkmandi. The flower market is not an organized market with any control over the prices of the flowers. It is run by a private society named"NawabAsafuddaula Fool VyapariKalyanSamiti' and the growers arefully dependant on this society for the selling of their produce. The society plays the role of "Arhatias" and they take 10% as a commission on the sale price of the flowers. The demand of flowers in Lucknow is totally dependent on marriages. The highest and the lowest prices of major flowers in Lucknow market are as follows (Marigold Rs.5-40per Kg, Gladiolus Rs.1-5 per stick, Rose cut- Rs.60-120per bundle of 20pcs.). Flowers are transported to market by cycle, motorcycle and public conveyance (taxi or buses). No farmer is involved in processing of flowers they are also not getting any storage facility and government assistance.

It is thus, obvious that the flower market of Lucknow is at a very premature stage and it needs proper governmental intervention and support for its proper development. Awareness about technical inputs related with commercial flower cultivation among the growers is poor and the market is unregulated which discourages farmers from shifting towards floriculture from traditional farming. Governmental policies, thus, should be aimed at upgrading the present knowledge level of the farmers through trainings and demonstrations, ensuring easy availability of quality planting material of indigenous and exotic flowers, regulating the floriculture marketas well as providing basic infrastructure, etc., in order to encourage them to take up floricultural activities.

Technical Session 7:

Horticultural Crops as Nutraceuticals and Pharmaceuticals

O-7.1

Fruits of Russian olive (*Elaeagnus angustifolia*), an underexploited multipurpose tree from Kargil: A pack house of phytochemicals

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Russian olive (*Elaeagnus angustifolia* L.), a small Eurasian tree, is distributed from Spain in the west to China in the east through western and central Asia. Though the species grows throughout Ladakh, it thrives well in relatively warmer climate of District Kargil within an altitudinal range of 2650-2900 m above mean sea level. Villages where the species grows naturally are Shillikchey, Hardass, Poyen, Mingi, Goma Kargil, Chikten and some parts of Kargil city. Locally, this species is known as *sersing*. It produces sweetly scented flowers and edible fruits. Fruits and flowers of Russian Olive have been the essential ingredients of many ethno-medicinal preperation of local communities. Different parts of the plants are being used in the Amchi system of medicines in Ladakh.

Many reports of presence of bio-active chemicals of neurtaceutical and pharmaceutical importance have also been published in scientific journals from all over the world. Bioactive phenolic compounds (flavonoids, phenolic acids and tannins) have been extracted from flower, young branch and fruit of this species. Besides that, bark has been reported to contain alkaloids of â-carboline group. Among bioactive lipids, â-sitosterol from fruit, seed, leaves and flowers of *E angustifolia* have also been isolated. In recent studies, fruits collected from Kargil have been found to contain other bioactive phytochemicals- stigmasterol and anthocyanin, reported for the first time in this species. Further, antioxidant activities of these fruits- as revealed by total polyphenols content, FRAP assay, DPPH radical scavenging activity and inhibition of lipid peroxidation- has been found to be high and hence these can be utilized in development of functional foods and nutraceuticals.

O-7.2

Genetic improvement and agro-techniques for nutritionally rich underutilized vegetables of Andaman and Nicobar Islands

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The underutilized vegetables are very important contributor in dietary microelements and biofunctional compounds for tribal and rural communities. Among them, the leafy vegetables constitute a significant portion because they are highly perishable, region and season specific and cultivated in very small clusters for home consumption or selling in adjacent markets only. Though, the ICMR prescribed 125 g leafy vegetables per person per day but breeder has neglected these crops except few varieties with higher yield potential. Though, these crops have potential traits for breeding for nutritional and uniformity traits, abiotic and biotic tolerance, climate resiliency, increasing shelf-life and transportable attributes and reducing anti-nutrients. In present study, systematic improvement on underutilized vegetables of Andaman and Nicobar Islands was started in 2008 by documenting documented 57 indigenous vegetables including 30 leafy vegetables. Most of them (60%) were local and abundant in forest or farmstead while 40 % are brought in from mainland India, Bengladesh, Burma and other regions by the settler communities along with immigration to islands during British settlement plans and post-independent settlements. Nutritional analysis revealed richness of indigenous vegetable plants in Ca (32.0 - 830.0 mg/100g DW), Fe (1.5 - 268.8 mg/100g DW), polyphenol (215.3 - 1151.0 mg/100g FW), carotenoids (109.7 - 1946.0µg/100g

FW), vitamin C (226.6 - 314.3 mg/100g FW) and chlorophyll (45.6 - 267.0mg/100g FW). Indigenous vegetables also contain nitrate (27.5 - 113.8 mg/100g), phytate (8.9 - 41.4 mg/100g), oxalate (2.8 - 41.4 mg/100g) and saponin (6.0 - 285.0 mg/100g). The five most common vegetables were identified as *Eryngium fotidum* L., *Basella alba* L.*, Amaranthus* spp., *Hibiscus sabdariffa* L., *Ipomea aquatic* Forsk. The germplasm purification was done and mass selection programme was started which resulted in one variety of *Eryngium foetidum* L. (CARI Broad Dhaniya), one of *Basella alba* L. (CARI Poi Selection) and two of *Ipomea batata* (CARI SP-1 and CARI -2). Besides, superior genotypes developed in amranthus (CARI AMA Green and CARI AMA Red), *Hibiscus sabdariffa* (CARI BH-1), *Ipomea aquatica* (CARI-Nallibhaji) and *Basella rubra* L. (CARI Poi Red) for island conditions. These varieties are gaining tremendous acceptance among the farmers and consumers for their uniformity, tolerance to diseases, higher yield and better nutritional profiles. The study suggests for similar efforts in different regions where indigenous vegetables are important source of regular dietary pattern particularly in tribal and remote rural area.

O-7.3

Phytates: Chemistry, advantages and disadvantages for human health and nutrition

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"The hardest thing to see is what is in front of your eyes."

Phytates: the inorganic salts of polymerized Phytic acid are the primary storage of phosphate and inositol in edible plant parts. Phytic acid (*myo*-inositol 1,2,3,4,5,6-hexakisdihydrogenphosphate) & mixed cation salts of phytic acid. The unique structure of phytic acid offers it the ability to strongly chelate with cations such as calcium, magnesium, zinc, copper, iron and potassium to form insoluble salts which are mostly present as salts of the mono- and divalent cations K+, Mg2+ and Ca2+.

The main sources of phytate in the daily diet are cereals and legumes, including oil seeds and nuts. They are important for human nutrition and represent l40 and l60% of total caloric intake for humans in developed and in developing countries, respectively.

Advantages: In industrialised countries where various civilisation diseases are prevalent, the beneficial properties of phytic acid, such as its anti-cancer, anti-oxidative and anti-calcification activities, are of great importance. The chelation capacity of phytic acid enables it to perform these effects. Due to the enormous problems of civilisation diseases, any contribution to prevent these diseases is highly significant.

Disadvantages: Due to its molecular structure, phytic acid shows a high affinity to polyvalent cations, such as minerals and trace elements, and interferes in their intestinal absorption. With unbalanced nutrition or undernourishment this may lead to serious deficiencies and is of particularly great significance for developing countries.

The presentation is focused on the fundamentals and essentials of phytic acid presence in daily food. How developing countries may be benefited by reducing dietary phytate levels to come out of malnutrition problems and how developed countries may improve their health by reducing occurrence of lifestyle disorders by increasing the levels of phytate in daily diet.

O-7.4

Marigold: A potential flower crop for nutraceutical and pharmaceutical industry

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Marigold (*Tagetes erecta* L.) is one of the most important species grown commercially for loose flower production in different parts of India. Marigold is one of the richestsource of carotenoid pigment and nowadays,it is being commercially grown in countries like Mexico, Peru and India for pigment production. Carotenoids extracted from *Tageteserecta*L.is being utilized in poultry feed so as to enhance the colouration of egg yolk as well as chicken flesh. Natural carotenoids are eco friendly and safe for human use and are being commercially exploited invariousfood, cosmetic and pharmaceutical industries. There is a need to develop variety/ hybrid rich in carotenoids which will meet the future demands of nutraceutical and pharmaceuticalindustries.Hence, the present investigation on exploitation of heterosis for higher carotenoid content in marigold was carried out at research farm of the Division of Floriculture and Landscaping, IARI, New Delhi. A line × tester set of 15 parents involving three male sterile lines (MS-5, MS-7 and MS-8) and 12 diverse pollinators of African marigold (*Tagetes erecta*L.) which included 10 selections numbered as African Selection1 (Af.Sel.1), Af.Sel.4, Af.Sel.5, Af.Sel.6, Af Sel.8, Af Sel.10, Af.Sel.11, Af.Sel.12, Af.Sel.14 and Af.Sel.16 and two varieties namely Pusa NarangiGainda and Pusa BasantiGainda and their 36 hybrids were analyzed for heterosis for total carotenoids. It was concluded from the study that hybrids showed heterosis over the parents for carotenoid content and the best three hybrids namely MS-8 x Af.Sel.6, MS-8 x Af.Sel.6 and MS-8 x Af.Sel.1reported maximum heterosis for total carotenoids over better, mid and commercial check, respectively. The correlation of total carotenoids with molecular markers has also been worked out. Nowadays, hybrids from private sector are grown in India for commercial extraction of carotenoids so the present study is an effort by public sector to develop carotenoid rich germplasm by utilizing the indigenous germplasm of marigold.

O-7.5

Nutraceuticals: Pharmacokinetics and pharmacodynamics

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Nutraceuticals are substances which are considered to be a part of food, but also have health benefits. These can prevent disease and promote good health. Awareness is required amongst the people to maximise health benefits of the food they consume. Probiotics, prebiotics, antioxidants, PUFA, dietary fibres, phytosterols are some of the common ingredients which are best absorbed when given with lipids eg lycopene. Some nutraceuticals must be heated/ cooked to be best absorbed while others are thermo labile. This awareness must come early so that a healthy eating habit is inculcated and the diseases that can be prevented must be!

Pomegaranate, orange rind, and all coloured fruits and vegetables have a high antioxidant value. Suitable portions of such nutraceuticals when taken, can prevent diseases caused by free radical generation since they are able to scavenge these free radicals. Various oils are rich in PUFA, which belong to the linoleic group. Probiotics are living microrganisms which are taken with food, and improve the gut flora. They not only improve the gut flora but also prevent pathogenic bacteria from attaching to gut walls. Prebiotics are food for the probiotic microbes, which are the friendly microbes of the gut. Inulin is one such prebiotic which is obtained from chicory. Oats are a

good source of dietary fibre. Even the tea we drink can be taken in a manner that health benefits are maximised. Eskimoes are known to have a high fat intake in their diet but they rarely display symptoms of atheroscelorsis because they mainly consume fish oils which are rich in PUFA. The chinese too, have been utilising the health benefits of soyabean in the form of tofu in their diet. Designing food in such a manner such that the health benefits are maximised is a priority which has been taken up seriously in developed countries. In a country like India where we are yet struggling with malnutrition, nutraceuticals , their identification and proper usage, should be taken up on priority.

The various metabolites of the nutraceuticals have not only been identified but also the fascinating mechanisms by which they act. Thus, the nutraceuticals promise to become an integral part of healthcare sooner than we expect.

P-7.1

Sea vegetables; nori (laver) - new health and functional ingredient: the inside happening- taurine factor

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Sea vegetables have been part of human diet of oriental people since ancient time. The recorded evidences reveals as old as in Joman-Pattern era (BC 300-6000) however it is Yamato dynasty in Japan, during the 4th century; started to collect it as tax. The word Nori is Japanese term which is also called Laver in English literature. Nori is also associated with redigious rituals and offered to the spirits of ancestors. The original Nori was formed as a paste. Currently it is generally in sheet (paper) form which was invented in Kido period. Traditionally it is a part of diet of Chinese, Korean, Japanese and other oriental countries with believe that it protects them to stay away from various alignments and is vital of longevity and good health. Its food benefits are so high that today it has crossed mountains and sea to reach all the continents; from European Union, America, Oceania and to Arab world. Taxonomically it belongs to genera porphyra with about 50 species of which half of them found in Japan itself. Through biology of porphyra is complicated but now it is well understood. The wide acceptability of Nori is due to its taste and health benefits. Nori contains almost all essential molecules for sound health, from minerals to protein, fatty acid to amino acids. It also contains vitamins A, B1, B2, B3, B6, B12, C, E and the fighting nucleotides to valuable fibres.

The use of this weed as component of food is consequence of its valuable health benefits and literature has ample supporting evidences; for lowering of blood cholesterol levels, anti coagulant, anti cancer with lowering rate of breast cancer, prevention of the occurrence of gallstone, prevention of gastric shay ulcer, intestinal carcinogenesis, anti-inflammatory, anti oxidant, fat liver infiltration, anti allergy, reducing arsenic toxicity as well as promoter of hair growth, eye sight to increase life span. The increasing health benefits have increased the number of consumers several fold. Today; besides its utility in making sushi and rice balls; it is boiled as vegetable, drinks as part of soup stocks. Seasoning for rice dishes, part of snakes , it is also used as raw making for jam and wine and sold as norijam, noriwine It is also used to wrap up all kinds of raw pate's, sprouts, fermenting food (like sauerkraut) or any vegetable sushi combination, mixing with salad, meso soup . For vegetarian, sushi roll are used having nuts and seeds as a alternative to fishes or seeds and cheeses wrapped up a cooked avocado and cucumber. Kids love it in a great way for them; to get such mineral rich nutrient from a wonderful ocean vegetable is a mixture of taste and health. All these beneficial actions of Nori is seems to be because of the molecules present in it; while going through its various chemical component, besides others, the presence of large number of bound and free amino acids are surprising events and is believe to be responsible for taste, texture and flavour. The presence of very high amount of sulphur amino acid; taurine, the highest among the free amino acid found, is a matter of thought, as such a huge amount must have marked utility. In fact, what's ever the nori showed its functionality, taurine also has; and it is quite possible that nori beneficial activities many be monitor through taurine.

Taurine, chemically; 2- Amino ethane sulfonic acid is endogenous substance in human body with about 0.1% but its concentration decline with ageing hence external supplementation is essential. Taurine is now regarded as functional agent and has been patented; for various disease prevention, for brain to heart, eye to lever, and diabetic to bone loss. It is also promoter of well being, hair growth and is part of longevity agents like Nori. Thus it seems that Nori beneficial properties are because of presence of high amount of taurine. Current era is health conscience ere, where consumers needs every food item in substantial form and like to depends more on functional foods, nutraceutical, for well being, designed/special food for chorionic diseases. Taurine is a part of several such diet/ food. As nori is natural and it contains significant amount of taurine thus it is also part of such functional ingredients. Nori sheet and its products for food, snake, and other preparation are getting big momentum which is now becoming billion dollar business and becoming global, are now inviting special attention towards its production, invention of its therapeutic potential with functional molecular linkage with taurine for better understanding of its action mechanism and superiority.

P-7.2

Cultivation of medicinal plant- ashwagandha (*Withania Somnifera*)

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The present investigation was carried out by Krishi Vigyan Kendra, Banavasi, Yemmiganur mandal at farmers' field in western mandals of Kurnool district, A.P during Kharif, 2011. Medicinal plant Ashwagandha (*Withania somnifera*) is also known as Indian ginseng is cultivated under rainfed conditions instead of regular field crops. Results revealed that, in Ashwagandha dry root yield is 6.25 q/ha, seed yield is 2.5 q/ha, stem yield is 4.5 q/ha and leaf yield is 1.75 q/ha recorded. As per the farmers opinion all the parts of Ashwagandha plant are useful and they are getting profits when compared to field crops. The cost of cultivation was Rs.30,700/ha resulting in Gross returns of Rs.1,71,170/ha and Net returns of Rs.1,40,470/ha.

P-7.3

Nutraceutical properties of pineapple guava (*Feijoa sellowiana* berg.)

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*Feijoa sellowiana (*Pineapple guava*)* is an evergreen bush belongs to the myrtaceae family native to South America and is closely related to the *Psidium guajava* L. The fresh fruit is appreciated for its characteristic flavour and aroma, which are similar to pineapple, for this reason it is also called pineapple guava. Feijoa fruit is a good source of vitamin C, low in calories and high in minerals and fibre. A feijoa essential oil showed wide spectrum anti-microbial activity, especially against fungal strains. The major components were limonene, b-caryophyllene, a-pinene, b-pinene and estragole. The ellagitannins have been identified in the leaves of the feijoa which is useful in anti-cancer activity. The fruits have anti-inflammatory and immunity stimulating properties. The antioxidant activity of feijoa fruits is found to be superior to that of kiwi fruits. The oils are exceptionally fragrant and have the potential to be used as food flavour essences, but the yields of the feijoa oils are low. The three fruit provide around 4 g of dietary fibre and one unique characteristic of feijoa fruit is its high content of iodine. Thus these multifaceted properties of feijoa fruit will develop as a commercial health product in future nutraceutical markets. Commercialisation would be facilitated by large scale cultivation, which would be advantageous to the country's agricultural sector.

P-7.4

Observation on horticultural plants as neutraceuticals and pharmaceuticals of district Hamirpur – A sub Himalayan Tropical Region of Himachal Pradesh (India)

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Himachal Pradesh is endowed with four agroclimatic zones with district Hamirpur located in subtropical climatic zone. The wisdom of the curative properties of neutraceutical and medicinal of horticultural plants is acknowledged since time immemorial.There are nearly about 15000 species of phanerogams, out of which only 17 present are recognized as having potential nutraceutical properties. Forest areas of district Hamirpur are endowed

with horticultural plants having useful medicinal properties which are well recognized by village people and even now cure their ailments by such plants. With the advancement of time and bio- technology, various pharmaceutical companies have extend their efforts to recognize and develop the worth of such horticultural plants but still more efforts are required in this dirction. However, there exist numerous horticultural plants with nutraceutical and pharmaceutical properties whose potential is yet to be recognized and utilize for the benefit of mankind.

P-7.5

Post harvest management in stevia for obtaining high percentage of steviol glycoside content

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Stevia is harvested just prior to flowering when steviol glycoside content in the is at its maximum. Following harvest the whole plant is dried and the leaves separated from the stems for further processing. The stems have very low concentration of sweet glycosides and are removed to minimize processing costs. Drying *stevia* under artificial condition is affected by a number of factors including loading rate, temperature and ambient air conditions. The usual procedure is to harvest the whole crop green and transport it to drying sites through facilities: sun drying or (artificial) kilns drying. With low humidity, sun drying of a thin layer of cut plants can be quite rapid (9-10 hours) to reduce plant moisture from approximately 80% to 10%. Kiln drying take two days. Fast drying is likely to give 'better quality' dried leaves. If cut plant material is not dried quickly leaf quality can deteriorate by oxidation, losing up to one third of stevioside content after three days. High temperature during artificial drying can also lead to loss of content. A green dried leaf colour is desirable and represents good quality of produce. After drying, leaves are stripped from the stems by hand or a mechanical thrasher/ separator and are packed for transport to processing units for powdering and storage. Stems of *stevia* plants contain little or no sweeteners, although it is suggested that they may contain some flavor enhancers, odourisers and other agents of potential use for improving food stuffs or alcoholic beverages. In colder climate (with severe winter) only one harvest per planting is possible. Under these circumstances the harvest is done when yield is greatest. It can be at onset of cold weather; early harvesting will reduce total yield. By covering the harvest crowns of the plants (with polythene etc.) plants can survive in winter and production for a second can be possible. In warmer climates where some plants growth is possible for most of the year (and plant do not die over winter) more than one harvest per year is normal. In Paraguay / Brazil three harvests a year are normal, often with a cleaning harvest after winter used for vegetative propagation purposes. In mid summer harvest interval can be less than two months. In India four or five harvests a year are possible and in Indonesia up to seven harvests have been possible per year. Under the autumn harvest conditions harvesting is affected by cutting the whole plant 5-10 cm above the ground. Artificial drying is generally required to reduce plant moisture content to less than 10%.

P-7.6

Health benefit of cowpea

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Cowpea tones the spleen, stomach and pancreas; it helps induce urination and relieves damp conditions like leucorrhea. The soluble fiber found in these beans have a low glycemic index and provide low risk for diabetes. The high fiber content also plays an important role in improving diabetes. They are rich in lignans, which may play a

role in preventing osteoporosis, heart disease, and certain cancers. The flavonoids in beans may help reduce heart disease and cancer risk. Phytosterols present in the beans help reduce blood cholesterol.

Report on Flatulence and Abdominal Discomfort on Ingestion: 1989 report on abdominal discomfort associated with ingestion of cowpea and the decreased incidence of side effects with pressure cooking and dehulling.

- **Antifungal / Antiviral**: Study presents evidence of multiple proteins with antifungal and antiviral potency in cowpea seeds. The two proteins, designated alpha-antifungal and beta-antifungal, were capable of inhibiting HIV reverse transcriptase and one glycohydrolisis associated with HIV infection. The proteins also retarted the mycelial growth of a variety of fungi, with the alpha-protein more potent in most cases.
- **Protein Source/ Anti-Nutrient Factors:** Study suggests cowpea as a valuable protein source with the predicted protein deficit in Southern Africa. Unlike other legumes, VU contain anti nutritional factors (ANF) as trypsin inhibitors, tannins and phytates.
- **Anti-Inflammatory**: Study on the anti – inflammatory activity of *Vigna unguiculata* seed extract.
- **Anti-Bleeding**: Rats on boild white rice dite developed symptoms of severe vitamin K deficiency and the addition of autoclaved beans of *V. unguiculata* in the diet prevented the bleeding syndrome.
- **Antifungal / Antibacterial**: Results have indicated antifungal and some antibacterial activity by cowpea leaf extracts.
- **Lipids / Constituents**: Dried edible seeds of *V. unguiculata* and *P. vulgaris* grown in Northern Nigeria were studied for its chemical constituents. Iodine values were higher in *vigna*. Overall, potassium was the most abundant element in the seeds.16 amino acids were identified. Study highlights the safety and high nutritive values of the studied varieties.

P-7.7

Effect of different row ratio on yield and economics in intercrops (Maize) with citronella (*Cymbopogon winterianus*)

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The present experiment entitled “Effect of different row ratio on yield and economics in intercropping with citronella (*Cymbopogon winterianus*)”was conducted during *kharif* and *rabi* season, 2011-12 at students Instructional Farm (SIF), C.S. Azad University of Agriculture and Technology, Kanpur with an object to find out suitable and economical combination of *kharif* and *rabi* intercrops with citronella (*Cymbopogon winterianus*).The experiment was laid out in randomized block design with 13 cropping systems with different combination [sole citronella, sole Pigeonpea, sole maize, sole Mustard, citronella + Pigeonpea (1:1), citronella + Pigeonpea (2:1), citronella + Pigeonpea (2:2), citronella + maize (1:1), citronella + maize (2:1), citronella + maize (2:2), citronella + Mustard (1:2), citronella + Mustard (2:2) and citronella + Mustard (2:4)], each replicated thrice.

The soil of experimental field was slightly alkaline with 8.12 pH and 0.21 EC. The soil is low in organic carbon (0.43 %) and low in available nitrogen (256 kg/ha), medium in available phosphorus (17.75 kg/ha) and medium in potash (178 kg/ha).The effect on intercropping on the soil row ratio wise better increase in soil organic matter deposit in soil it highest organic matter in increasing sole pigeonpea.and also increase in availability of nitrogen. And decreasing soil P_2O_5, K_2O and soil pH.

The Citronella sole cropping system gave significantly the highest Citronella equivalent oil yield than other cropping systems. in the study of *Kharif* season crop all the row ratio 1:1, 2:1 and 2:2 of Citronella + Pigeonpea treatment proved significantly better over Citronella +Maize cropping systems. Among the Citronella + Pigeonpea row ratio combination 2:1row ratio found significantly better that the 1:1and 2:2 row ratio. Among the Citronella +Maize treatments, 2:1 row ratio proved significant better than 1:1 and 2:2row ratio Citronella +Maize cropping

systems. In Rabi season, 2:2 row ratios were significantly better over1:2 and 2:4 row ratio Citronella + Mustard cropping systems. Citronella sole brought about 49.29 (225.61%), 72.42 (42.77%), 75.36 (45.29%), 117.21 (94.12%), .18 (129.0%), 136.69 (130.11%), 160.66(198.14%) 1162.70 (205.84%), 166.16 (219.84%), 167.18 (224.22%), 180.57 (295.19%) and 194.32 (49.78%) kg/ha higher Citronella equivalent oil yield than Citronella + Pigeonpea (2:1), Citronella + pigeonpea (1:1), Citronella + pigeonpea (2:2), Citronella + Maize (2:1), Citronella + Maize (1:1), Citronella + Maize (2:2), pigeonpea sole, Citronella + Mustard (2:2), Citronella + Mustard (1:2), Citronella + Mustard (2:4), Mustard sole and Maize sole, respectively.'

Cultivation of citronella sole crop was superior over sole Pigeonpea, maize Mustard as well as their intercropping system adopting in different row pattern. In relation to growth yield contributing characters and yield citronella sole cropping system with significant the highest citronella equivalent oil yield than other copping system and after the citronella sole. When intercrop *kharif* (Pigeonpea and maize) with C: P, 2:1 treatment rank next in order of merit providing significantly better than other cropping system.Next C: M (2:1) ranked in next in order of statistically at par with C: Mu (2:2) providing significantly superior over other cropping system.From economic point of view the highest net return was found in sole citronella system. But intercropping system, intercropping of C: P with 2:2 row ratios as next highest benefit treatment followed by C: M, 2:1 row ratio and C: Mu, 2:2 row ratios.

P-7.8

Secoisolariciresinol diglucoside (SDG) - A cardioprotective component of flaxseed

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Cardiovascular diseases (CVD), constituting coronary heart (CHD) diseases, are currently the leading cause of death globally. Nowadays, with the growing interest towards natural foods, plant lignans are becoming important. The history and the evidences explain the fascinating story of flaxseed's use. The studies have shown that flaxseed have the capacity of reducing the blood sugar and is found to be beneficial in preventing cardiovascular diseases. Flaxseed is a very good source of Secoisolariciresinol diglucoside (SDG) and its concentration in flaxseed is about 1000 times as high as found in other food sources. SDG is a plant lignan, which has been found to have anticarcinogenic, antidiabetic and miraculous cardioprotective capacity. SDG has antioxidant activities and is a potent angiogenic and antiapoptotic agent that may have a role in cardioprotection and ischemic heart disease. SDG have also been found to be beneficial in preventing the hyperlipidemia and lowering of plasma lipids.

P-7.9

Linseed- a nutritional punch (Omega–3, Omega–6 fatty acids and SDG)

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Omega-3 fatty acids (also known as n-3 fatty acids) are polyunsaturated fatty acids (PUFA) that are essential nutrients for health. We need omega-3 fatty acids for numerous normal body functions, such as controlling blood clotting and building cell membranes in the brain, and since our bodies cannot make omega-3 fats, we must get them through food. Omega-3 fatty acids are also associated with many health benefits, including protection against heart disease and possibly stroke. New studies are identifying potential benefits for a wide range of conditions including cancer, inflammatory bowel disease, and other autoimmune diseases such as lupus and

rheumatoid arthritis. There are two major types of omega-3 fatty acids in our diets: One type is alpha-linolenic acid (ALA), which can be found in smaller quantities in fruits: Raspberries (126 mg/100g), Common guava (112mg), Avocados (110mg), Black berries (94mg), Elderberries (85mg), Strawberry guava (65mg), Blueberries (58mg), kumquats (47mg), Gooseberries (46mg), Red cherries (44mg), Kiwifruit (42mg) and mangoes (37mg). ALA is also found in some green vegetables, such as Brussels sprouts (13g per 100g), kale (121mg per 100g), spinach (816mg per 100g), and salad greens. The other type, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), is found in fatty fish. The body partially converts ALA to EPA and DHA. We do not know whether vegetable or fish omega-3 fatty acids are equally beneficial, although both seem to be beneficial. Unfortunately, most Indians do not get enough of either type. For good health, should aim to get at least one rich source of omega-3 fatty acids in diet every day. Omega-6 fatty acids (also known as n-6 fatty acids) are also polyunsaturated fatty acids (PUFA) that are essential nutrients, meaning that our bodies cannot make them and we must obtain them from food. They are abundant in the Western and central diet; common sources include safflower, corn, cottonseed, and soybean oils. Omega-6 fatty acids lower LDL cholesterol (the “bad” cholesterol) and reduce inflammation, and they are protective against heart disease. So both omega-6 and omega-3 fatty acids are healthy. While there is a theory that omega-3 fatty acids are better for our health than omega-6 fatty acids, this is not supported by the latest evidence. Thus the omega-3 to omega-6 ratio is basically the “good divided by the good,” so it is of no value in evaluating diet quality or predicting disease. More concentrated sources can be found in oils such as canola, soybean, walnut, and wheat germ. The best sources of alpha–linolenic acid are flaxseeds and flaxseed oil. The objective of present investigation was to select the linseed varieties with high omega-3, omega-6 and Secoisolariciresinol digluscside (SDG).

A collection of 51 genotypes of linseed was grown in augmented design at AICRP on linseed, Department of Genetics and Plant Breeding, College of Agriculture, Nagpur during *rabi* 2010-11. Based on the finding of the study, the different linseed varieties evaluated had significant effects on omega-3, omega-6 and SDG. Character wise study showed that out of 51 genotypes Subhra (15.50g per 100g) and Jawahar7 (14.04g per 100g) showed highest omega-6 fatty acid, whereas, highest SDG was exhibited by Pusa-2 (19.82g per 100g) and Jawahar1 (18.13g per 100g). The mean percentage of omega-3 content was found to be highest for RLC-92 (57.80g per 100g), Garima (57.82g per 100g). The wide availability of linseed and its products is an added advantage as a nutritional supplements omega-3, omega-6 and SDG could be regularly incorporated in the diet to prevent the risk of diseases.

P-7.10

Neutraceutical phytochemicals of fruit crops

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Increasing health awareness among consumers about antioxidant properties of phytochemicals and phenolic compounds from plant source gaining importance worldwide, because such chemicals can prevent the spread of free radical species, and protect the human health from various diseases. Free radicals and other reactive oxygen species (ROS), such as, hydroxyl radicals, hydrogen peroxide and superoxide anions are highly reactive species produced in the human body from the normal metabolism of oxygen or from other exogenous sources. These molecules cause oxidative damage to cellular parts and supposed to be a possible reason in the etiology of several human diseases such as, cancer, cardiovascular diseases and aging. Antioxidants play many important roles in maintaining human health because of their free radical scavenging properties, donation of hydrogen atoms or electrons, or chelating with metal cations. Vitamins C and E possess strong antioxidant properties as both are capable of neutralizing the free radicals, responsible for degenerative diseases. Vitamin C also reduces the level of hydrogen peroxide (H_2O_2), which prevent cells against reactive oxygen species. The oxidation of lipids present in foods is responsible for development of off flavour and rancidity during storage and distribution makes it unfit for human consumption. Therefore, antioxidant is also used in foods rich in lipids in order to delay or prevent rancidity.

P-7.11

Nutraceutical values of coriander

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Coriander (*Coriandrunsativum*) is an herb that is widely used in recipes to give an appetizing aroma to the dishes. It is also known by the name of cilantro, especially in North American countries. It also has the health benefits, mainly because of its high nutritional value having vitaminA-6748 IU, vitaminB6-0.149mg, vitamin-27mg, vitaminE-2.5mg, vitaminK-310 mg, dietary fiber, Water - 92.21 gm., Carbohydrate - 3.67 gm., Fats - 0.52 gm., Calcium - 67 mg, Copper - 0.225 mg, Iron - 1.77 mg, Manganese - 0.426 mg, Magnesium - 26 mg, Phosphorus - 48 mg, Potassium - 521 mg, Selenium - 0.9 mg, Sodium - 46 mg, Zinc - 0.5 mg, Energy - 23 Kcal. Coriander leaves act as stimulants and tonics for the stomach, strengthening its functions as well as promoting digestion. Coriander seeds have been associated with offering a feeling of coolness and also reducing fever. Coriander has been found to provide effective protection against urinary tract infections. Coriander seeds can be boiled in water to make coriander tea and mixed with honey to soothe the acidity, which helps to ease constipation, clear toxins from the body. Coriander is also an effective antiseptic as it contains citronellal, which helps in healing mouth ulcers and coriander seed also some side effective but excessive use of coriander seeds can cause liver problems. Pregnant women can use coriander seeds but in lesser amounts.Chutney is made of cilantro and mint with onions and garlic is very popular in India. Also, split coriander seeds are roasted to make a great chewable mouth freshener. It is used in pickles, chutneys, curries, marinates apart from being used in garnishing food. In India, since ancient time's coriander has been used in food and in medicine. Coriander contains many compounds which have anti-oxidant properties. The flavor of coriander and cilantro is due to the fatty acids and volatile oils the, dietary fiber found in coriander helps in lowering the LDL cholesterol as it binds to the bile salts. Coriander contains very good amounts of minerals like iron, copper, calcium, potassium, manganese, magnesium and zinc. It also has high levels of vitamin C. Coriander is also a storehouse of the B-complex vitamins, thiamine, niacin and riboflavin. Coriander oil is extracted from the seeds and contains anti-bacterial properties and is rich in phytonutrients, flavonoids and active phenolic compounds. Coriander oil is a sweet and spicy, warm oil with almost colorless to pale yellow colored and of watery consistency. It helps in reducing brain fag, tension, migraine and nervous weakness. Also relieves gas and stomachache controls rheumatic and arthritic pains, muscle spasms, benefits in colds and flu. It removes toxins and wastes. One can use it in hot water used for taking steam and the vapors of this oil use for massage it for pain relief.

P-7.12

A medicinal and neutraceutical potency of genus momordica

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During the last few decades, there has been an increase in the study of medicinal plants and their traditional use in different parts of the world. Herbal remedies are considered as the oldest forms of health care known to mankind on this earth. Prior to the development of modern medicine, the traditional systems of medicine that have evolved over the centuries within various communities are still maintained as a great traditional knowledge base in herbal medicines. Many researchers have paid attention towards the cucurbitaceae family because the fruits, seeds and vegetables are traditionally consumed. Important genera belonging to the family are *Trichosanthes,*

Lagenaria, Luffa, Benincasa,Cucumis, *Cucurbita*and *Momordica*etc.The genus Momordica comprises 47 species in Africa and 12 in Asia and Australia.Recently it has been found that seven closely related species (*Momordicacharantia, M.balsamina,M.dioca, M. cochinchinensis, M. cymbalaria,M.sahyadrica*,*M. subangulata*)to bitter gourd are found in Indian sub-continent. *Momordicacharantia*have potential as an antioxidant, anti-microbial, anti-HIV, anti-dengue, anticarcinogenic, healing of open wounds,antifertility, hypoglycemic, antioxidant,hepatoprotective, anti-tumor, antibacterial, antifertility, antispermatogenic, androgenic, insecticide activities andinhibits breast cancer cell.*M. balsamina*have anti-inflammatory, analgesic,anti-plasmodial,anti-diarrheal and shigellocidal properties**.***M. dioca* have antifeeedant, antiulcer,antisteatotic, antiallergic, analgesic, hepatoprotective, anti-lipid peroxidative and hypoglycemicactivities.*M. cochinchinensis*have antioxidant activity and *M. cymbalaria*haveantimicrobial and antidiabetic effect. The genus *Momordica*is a hidden gift of nature which is proving itself as a potent miracle herb for biopharmaceutical and neutraceutical attention for human welfare.

P-7.13

Effect of fym and spacing on herbage yield and oil quality of ocimum (*Ocimum Basilicum* L.)

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The Tulsi (Ocimum basilicum) is one of the important indigenous medicinal annual herb used in Indian system of medicine. The present investigation has been carried out at Main experiment Station, Department of Horticulture, N.D. University of Agriculture & Technology Kumarganj, Faizabad. (U.P.), to find out the effect of FYM and spacing on herbage yield and of quality of Tulsi, which designed in Factorial Randomized Block Design with three level of FYM and three spacing is 9 treatment combination replicated thrice. Observation on various parameter *viz*- plant height (92.50 cm), Plant spread (92.90 cm) no. of branches (11.89), late days taken to 50 % flowering (90.33), fresh herbage yield (97.18q.ha), dry herbage yield (27.65q/ha) oil yield (74.54 L/ha), carotene, protein, carbohydrates, mineral matter and vitamin 'c' content in tulsi oil were noted maximum due to application of 10 t FYM ha^{-1}. In case of spacing, plant spread, no. of branches, late days taken to 50 % flowering were obtained from wider spacing (60 × 60 cm) and fresh herbage yield (107.95 q/ha), dry herbage yield (29.63 q/ha) and oil yield (76.901/ha) have been obtained from closer spacing (60×45 cm) and oil quality content was obtained maximum from wide spacing (60×60 cm). From the experimental findings, it is concluded that higher economic return was obtained from fresh herbage (115.43q/ha) dry herbage (33.67 q/ha) and oil yield (87.80 1/ha). with the application of 10 ton FYM/ ha at wider spacing (60×60 cm) which would be very helpful to the farmers for economic importance and subsequently pharmaceutical industry for getting raw material to eradicate disease and increase vitality.

P-7.14

Edible flowers a potential source of mineral elements in human nutrition

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For centuries edible flowers have been an integral part of human nutrition. The information concerning the composition and nutritional value of edible flowers is important and represents a sufficient reason for their consumption. The important edible flowers of ornamentals such as chrysanthemum, antirrhinum, dianthus, fuchsia, impatiens,

rose, nausturtium, viola, bigonia, marigold, calendula, hibiscus, etc are predetermined by many chemical compounds but the contents of carotenoids, flavonoids and phenolics are most important. The total contents of phenolic, flavanoids and antioxidant capacity of these edible flowers is comparable with those found in common fruits and even higher than those normally occurring in common vegetables. The content of mineral elements is one of the most essential aspects that influence the use of edible flowers in human nutrition. The mineral elements in edible flowers are interesting with an excellent source of minerals, especially phosphorus and potassium along with other important macro and micro elements (calcium, magnesium, sodium, iron, manganese, zinc, copper, Molybdenum) which is comparable and even higher than that of other common fruits and vegetables. Generally, macroelements and microelements are the fundamental part of enzyme systems which involve in major functions in human body and serve as the prevention of many diseases and strengthen the human immune system. Edible flowers are also associated with anti-inflammatory, antibacterial, antifungal and antiviral effects, and mineral elements may be one of the causes of these effects. Food insecurity is both a global and national problem today, however high nutritional value of these edible flowers shows to be a new and promising source for a wider use in human nutrition. However, unfortunately there is scarce data available in literature about the composition and nutritional value of each botanical species of edible flowers which are quite unique. In this context, it is necessary to conduct research in this area for efficient exploitation of potential edible flowers in human nutrition.

P-7.15

Bitter gourd and its nutraceutical importance

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Bitter gourd (*Momordica charantia* L.) or Karela has long been used as a food and medicine. Depending on the variety, the immature fruit is white or green with a different size or shape. As a medicinal plant, it possesses antilipolytic, analgesic, antiviral, cytotoxic, hypoglycemic and antimutagenic properties. The main constituents of bitter gourd which are responsible for these effects are triterpene, protein, steroid, alkaloid, inorganic lipid and phenolic compounds. The protein in bitter gourd including alpha-momorcharin and beta-momorcharin were known to have the ability for fighting against HIV. The phenolic compounds from bitter melon extracted by solvent extraction have the antioxidant activities. Fresh fruit is an excellent source of vitamin-C (100 g of raw fruit provides 33-88 mg) and possess potent anti-oxidant and free radical scavenging activities which prevents cancer development. Bitter gourd is a crop which contains highest ascorbic acid than other cucurbits. Decoction of its leaves and fruits is drunk as preventative for treatment of stomach-ache, toothache, liver diseases, diabetes, hypertension and cancer. The Cucurbitacin-bitter glucoside helps in preventing spoilage of cooked vegetable of bitter gourd. In addition, the bitter gourd is an also good source of niacin (vitamin B-3), pantothenic acid (vitamin B-5), pyridoxine (vitamin B-6) and minerals such as iron, zinc, potassium, manganese and magnesium.

P-7.16

Antibacterial activity of methanolic and diethylether extracts of *Piper betle* and *Zanthoxylumkhasianum*

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Traditional medicinal plants are important sources of potentially useful natural products in treating common infectious bacteria. A wide range of medicinal plant parts like roots, stems, flowers, fruits, leaves, twigs exudates and modified plant organs are being used for extract as raw drug and they possess varied medicinal properties.The antimicrobial activities shown by both methanol and diethylether extracts of *Piper betle* leaf and *Zanthoxylumkhasianum* seeds would likely be due to the presence of bioactive compounds in these plant extracts such as fatty acids (stearic acid and palmitic acid), hydroxy fatty acid esters (hydroxy esters of stearic, palmitic and myristic acids), phenolic compounds such as cavicol, cavibetol, carvacrol, eugenol, allilpyrocatechol and hydroxychavicol (the main component) in case of *Piper betle* leaves and essential oils (Linalool), steroids, alkaloids, flavonoids, triterpenoids and phenolic compounds or free hydroxyl group in case of *Zanthoxylumkhasianum*seeds. All these are a special class of compounds which have antimicrobial characteristics against bacterial species isolated from local beer includes, *Staphylococcus* species, *Escherichiacoli*, *Citrobacter* species, *Micrococcus agilis*, *Citrobacterfreundii*, *Pseudomonas cepacia*,*Piper betle*leaves (Tympew) and *Zanthoxylumkhasianum* (Jaiur) seeds have long been used and extensively applied by people of Meghalaya as traditional medicines to heal many bacterial diseases, including infectious one. From the overall results of the antibacterial activity assays studied, one can be concluded that both the plants species have the potential applications as natural medicines and to treat diseases as well as the microbiological safety of the human health and, thus, form a good basis for further investigation in order to develop new natural bioactive compounds. Once extracted, and before being used in new therapeutic treatments, they should have their toxicity tested *in vivo*. But, the problem of microbial resistance is increasing and the future use of antimicrobial drugs is still undecided, thus, actions must be taken in order to reduce this problem by continuing research studies so that new drugs could be developed naturally.

P-7.17

Natural essential oils: A commercial potential

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The world production and consumption of essential oils and perfumes is increasing very fast. Production technology is an essential element for improving the overall yield and quality of essential oil. Essential oils are generally derived from one or more plant parts, such as flowers (e.g. rose, jasmine, carnation, clove, mimosa, rosemary, lavander), leaves (e.g. mint, *Ocimum* spp., lemongrass, jamrosa), leaves and stems (e.g. geranium, patchouli, petitgrain, verbena, cinnamon), bark (e.g. cinnamon, cassia, canella), wood (e.g. cedar, sandal, pine), roots (e.g. angelica, sassafras, vetiver, saussurea, valerian), seeds (e.g fennel, coriander, caraway, dill, nutmeg)

and fruits (bergamot, orange, lemon, juniper). Traditional methods of extraction of essential oils such as water distillation, water and steam distillation, steam distillation, cohobation, maceration and enfleurage are the methods most widely used on commercial scale. However, with technological advancement, new techniques viz., super critical fluid extraction, solid phase-micro extraction, controlled instantaneous decomposition etc, have been developed which may be widely used for commercial production of essential oils and are considered valuable for the production of costly essential oils. Commercial cultivation of aromatic and medicinal plants and efficient extraction of superior quality essential oil could thus, be developed in India to meet the worldwide demand for raw materials, intermediary chemicals and end-products in time to come.

P-7.18

Uses of pomegranates

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The word pomegranate is derived from the Latin words pommus (apple) and granatus (seeded). Frequent intake of pomegranate juice can maintain good flow of the blood in the body. it decreases the risk of heart attack and heart strokes.

Pomegranates peel, bark and leaves are used to calm the stomach disorder or diarrhea triggered due to any kind of digestive problems. Drinking tea made from the leaves of this fruit helps in curing digestive problems. Pomegranate juice is also used for handling problems of dysentery and cholera. The best benefit of pomegranate is that its juice, along with its antibacterial and antiviral properties, helps to reduce the effects of dental plaque. Pomegranates consist of advanced level of antioxidants called flavenoids. These flavenoids are thought to be effective in counteracting various cancer radials. The individuals that face high risk of prostate and breast cancer should start drinking the juice of this fruit, as this will help them to reduce further risk of developing cancer. Regular consumption of pomegranates can reduce the PSA levels in the body and helps to fight the existing cancer cells in the body. Pomegranate minimizes the illness triggered in various forms, like atherosclerosis and osteoarthritis. The loss that is triggered due to the thickening and solidifying of the arterial walls and in cartilage and joints can be cured by consuming this fruit. Also, pomegranate is capable of preventing the creation of minerals that are liable for breaking down the connective tissues. Consuming of pomegranate fruit juice by a diabetic patient can prevent coronary illnesses. Along with this, there is a slowdown in solidifying of the bloodstream, which can fuel non-occurrence of various heart diseases.

P-7.19

Medicinal properties & spice value of ginger (*Zingiber officinalis*)

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Ginger (*Zingiber officinalis*) is an important spice crop of family Zingiberaceae. It is grown in tropical to temperate areas. In India, it is grown popularly as spice crop and accounts 70 % of world production. It is used as common ingredient in various foods and beverages. A part from spice crop, ginger has along time use of medicinal type back 3000 years. Ginger is mainly use medicinal and spice. Dry ginger is used for the manufacture oil,

oleoresin essence, soft drinks, non-alcoholic beverages and vitamins. It has medicinal properties like stimulant, carminative, flavouring agent. It is used in treatment of dyspepsia, flatulent, colic, pulmonary and catarrhal diseases, dropsy neuralgia, headache and toothache or cancer. Ginger also exhibits cancer preventive activity in experimental carcinogenesis. The anticancer properties of ginger are attributed to the presence of certain pungent vallinoids, gingerol and paradol, constituents like shogaols, zingerone and ginger use in antibacterial patent. The ginger oil extract were obtained by using solvents n-hexane, ethyl acetate, eathanolic soxhlet and water. It is beneficial and used indigenously against common cold, cough and also as refreshing drink. Ginger contains 5.19 % of fibre. Ginger is widely used throughout the world for treating loss of appetite, nausea and vomiting after surgery, nausea resulting from cancer treatment, flatulence, stomach upset, colic, morning sickness and motion sickness. In some parts of the world, ginger juice is applied to the skin to treat burns. Ginger is extremely safe, some people have trouble tolerating its spiciness, but most tend to adapt if they keep taking it.

P-7.20

Medicinal properties & spice value of cumin (*Cuminum cyminum*)

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Cumin (*Cuminum cyminum*) is an important spice crop of family Umballiferae It is grown in Gujarat Rajasthan Madhya pardesh In India,The chief constituent and important aromatic compound in cumin is cuminaldehyde (4-isopropylbenzaldehyde). Cumin seeds contain numerous phyto-chemicals that are known to have antioxidant, carminative and anti-flatulent properties. The seeds are an excellent source of dietary fiber.Its seeds contain certain health-benefiting essential oils such as cuminaldehyde (4-isopropylbenzaldehyde), pyrazines, 2-methoxy-3-sec-butylpyrazine, 2-ethoxy-3-isopropylpyrazine, and 2-methoxy-3-methylpyrazine.The active principles in the cumin may improve gut motility and help in digestion by augmenting gastro-intestinal enzyme secretions.This spice is an excellent source of minerals like iron, copper,calcium, potassium, manganese, selenium, zinc and magnesium. Copper is required in the production of red blood cells. Iron is required for red blood cell formation. Zinc is a co-factor in many enzymes that regulate growth and development, sperm generation, digestion and nucleic acid synthesis. Potassium is an important component of cell and body fluids that helps controlling heart rate and blood pressure. Manganese is used by the body as a co-factor for the powerful anti-oxidant enzyme, superoxide dismutase.The spice also contains very good amounts of B-complex vitamins such as thiamin, vitamin B-6, niacin, riboflavin, and other vital anti-oxidant vitamins like vitamin E, vitamin A, and vitamin C. The seeds are also rich source of many flavonoid phenolic anti-oxidants such as carotenes, zea-xanthin, and lutein. Its seeds are used to prepare decoction, which sometimes used in treating flatulence and indigestion in traditional medicines.

Technical Session 8:

Entrepreneurship for Farmers, Self Employment and IPR

O-8.1

Integrated nutrient management for enhancing yield and quality of fruits in banana cultivar G-9

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Banana (*Musa paradisiaca L.*) is an important fruit crop cultivated throughout the country, particularly in sub-tropical climate of eastern region. It contributes 32 percent to the total fruit production, and provides source of income and livelihood security for millions of people particularly for women. It is also important from the nutritional point of view due to high carbohydrate content, vitamins and minerals. Presently it is also gaining popularity in kitchen gardens because of high returns. India has emerged as the largest producer of banana at global level by producing 10.41 million tonnes but still there is a wide gap between current production and availability. Participation of women is less in banana cultivation but there is enough scope to enhance women's participation in banana orchard. With this objective, a field experiment was conducted at Directorate of Research on Women in Agriculture, Bhubaneswar during two years to find out the effect of integrated nutrient management on yield and quality of banana variety G-9. Seven treatments viz.T_1- fresh cow dung @ 500g/ plant; T_2- fresh cow dung @ 250g/ plant + pond soil@ 250 g; T_3-fresh cow dung @ 500g /plant + 5g urea; T_4 - 500g fresh cow dung +5 g ammonium sulphate, T_5- 500g fresh cow dung + 10g sulphate of potash, T_6-fresh cow dung @ 500g/ plant + 5g ammonium sulphate and 10g sulphate of potash T_7- removal of male bud after completion of female phase (control) were applied to the selected plants. Number of fruits/ bunch was significantly higher (92.26) with application of 500 g fresh cow dung + 5g urea. Size of fruits in terms of length and breadth and weight of fruits were significantly increased under 500g/ plant of fresh cow dung + 5g ammonium sulphate and 10g sulphate of potash as compared to control. It has been observed that 500g/ plant of fresh cow dung + 5g ammonium sulphate and 10g sulphate of potash dose was significantly reducing maturity period (104.45 days) as compared to control (122.76 days). Maximum fruit yield (24.10 kg/ bunch) and quality in terms of TSS (22.74%) were recorded with 500g/ plant of fresh cow dung + 5g ammonium sulphate + 10g sulphate of potash. The study concluded that adoption of integrated nutrient management in banana can increase the yield and quality which could fetch higher price and improve the livelihood of farmwomen.

O-8.2

Intellectual property right and trade related issues in vegetable: An overview

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Vegetable are important constituents of Indian agriculture and nutritional security. Our country is blessed with diverse agro-climates and distinct season, making it possible to grow a wide range of vegetable crops. In India between 1999 and 2012 per capita consumption of vegetables has doubled (120 g to 230g/day), while cereal consumption has declined by 10 %. But based on projections to 2030, further increases in vegetable production will be needed to meet the demand for fresh, export and processing under changing food scenario. The growth in vegetable sector is driven by consumer demand, and the need for farmers to enhance incomes through high value crops. The neutraceutical industry also searching different compound for medicinal and health benefits i.e.; bitter gourd as a potential health capsule. To improve the quality and horticultural traits breeders are making significant improvement through innovation that are benefiting farmer's returns and increasing demand due to health consciousness. Creation of hybrids is a key means towards modern sustainable vegetable production. Development

of transgenic and production technologies is a cost intensive venture. Well organized institution with good scientific manpower and well equipped research facilities can develop these technologies. Due to increased complexity and reduce time for development of new varieties/product, further escalating the cost. The short span of life of a variety/ product/technology in the environment is resulting in shorter earn back period. This double impact is bound to put more pressure on investors to recover their investment through protection of intellectual property, and consequently royalties. Protection of intellectual property in plant breeding is not the primary driver to develop new, innovative varieties but, it is an adequate tool to protect the new varieties in the market against illegal reproduction and sales. Intellectual property (IP) refers to creations of the mind, such as inventions; literary and artistic works; designs; and symbols, names and images used in commerce and have expanded to cover even resources that were previously deemed to be part of the public domain. IP is protected in law by, for example, patents, copyright and trademarks, which enable people to earn recognition or financial benefit from what they invent or create. By striking the right balance between the interests of innovators and the wider public interest, the IP system aims to foster an environment in which creativity and innovation can flourish. Intellectual property rights are the rights given to persons over the creations of their minds. They usually give the creator an exclusive right over the use of his/her creation for a certain period of time. In India, "Protection of plant variety and Farmer's Rights Act, 2001 was adopted to meet the obligation under Article 27(3) (b) of TRIPS Agreement, to protect rights of farmers and plant breeders and to encourage the development of new plant varieties. Any person or group of persons or any organization can also claim for benefit sharing if the plant genetic material belonging to them is shared in the development of a registered variety. The researchers are conferred the right to use any registered variety for conducting experiment or research and the use of a variety by any person as an initial source of variety for the purpose of creating the other varieties. The strong protection granted to a plant breeder over his/her variety is present in the section dealing with infringement of breeders' right where punishment in the form of substantial fines and jail term has been prescribed for those infringe the rights of the registered breeder. Intellectual property rights are i) copyright and rights related to copyright and ii) Industrial property. In Industrial property right, one area can be characterized as the protection of distinctive signs, in particular trademarks and geographical indications. Other types of industrial property are protected primarily to stimulate innovation, design and the creation of technology. In this category inventions (protected by patents), industrial designs and trade secrets are included. The social purpose is to provide protection for the results of investment in the development of new technology, thus giving the incentive and means to finance research and development activities. A functioning intellectual property regime should also facilitate the transfer of technology in the form of foreign direct investment, joint ventures and licensing. The protection is usually given for a finite term (typically 20 years in the case of patents). While the basic social objectives of intellectual property protection are as outlined above, it should also be noted that the exclusive rights given are generally subject to a number of limitations and exceptions, aimed at fine-tuning the balance that has to be found between the legitimate interests of right holders and of users.

O-8.3

Value addition of vegetables - A way towards entrepreneurship development

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Vegetables play a major role in Indian agriculture by providing food, nutritional and economic security and more importantly, producing higher returns per unit area and time. In addition, vegetables have higher productivity, shorter maturity cycle, high value and provide greater income leading to improved livelihoods. Due to the development in production technology in Horticulture, vegetable production in India has now reached to the level of 162.18 million tonnes from 9.205 million hectares during 2012-13 witnessing a growth rate of 3.72 per cent in total

production over the last two decades. However, being highly perishable, about 25-30% of the total production of vegetables goes waste from the time of harvesting till they reach the consumers while a large number of vegetables are not available throughout the year because of their seasonal nature of production, warranting the need of their preservation through storage and processing in order to ensure their availability in off season. It is, therefore, necessary to make them available for consumption throughout the year in processed or preserved form and to save the sizeable amount of losses. At present, about 2% of the total produce is processed in India mainly for domestic consumption.

The food processing industry ranks fifth in its contribution to value addition but tops the list in terms of employment opportunities with approximately 1.5 million employed consisting of 19 percent of the total investment in the industrial sector but contributes 18 percent to the GDP. Employment potential in post-harvest and value addition sector is considered to be very high. Every Rs. 1 billion invested in fruits and vegetable processing in the organized sector generates 140 persons per year of employment. The same level of investment in Small Scale Investment (SSI) units creates 1050 person day of employment per year. The SSI unit in food industry employs 4,80,000 persons, which accounts for 13% of all SSI units employed. Thus, vegetables have great potential for value addition and diversification to give a boost to food industry, create employment opportunities and give better returns to the farmers. In this paper, attempts have been made to throw some lights on the status, prospect and constraints on value addition of vegetables towards entrepreneurship development.

O-8.4

Income, employment & export pattern of traditional *Phulkari* embriodery in rural Punjab

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Phulkari, an embroidery technique from Punjab means flower crafts. It is cultural heritage of Punjab. *Phulkari* and *Baghs* were worn by women all over Punjab during marriage, festivals and other joyous occasions. They were embroidered by the women for their own use and were not for sale in the market. Thus, it was a true folk art which not only satisfied their inner urge for creation but brought colour into their day to day life. With passage of time, the beautiful pieces of *Phulkari* were sold across Europe. Partition of India and Pakistan in 1947 had a dramatic impact on this beautiful craft. Both sides of Punjab used this craft for the economic survival of displaced women across the Indian continent. Although, business of *Phulkari* selling prospered, but it hid a tale of exploitation. Women artisans lived in penury denied their share by greedy middle men. Krishi Vigyan Kendra improved skills of rural women in *Phulkari* embroidery by introducing innovations in design, motifs and background material through demonstrations and trainings. They were also provided financial and marketing assistance. Many new garments and articles like stoles, purses, pen stands, shawls, bed linen and mobile kits were designed to popularize them outside Punjab. A number of exhibitions on contemporary uses of *Phulkari* craft were organized at State and National level. All these efforts transformed rural women artisans into self assured entrepreneurs who did brisk business using their traditional skills with new found confidence.

O-8.5

Self-employmentthrough drying and dehydration of flowers and foliages

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Flowers have aesthetic value, novelty and always remained an integral part of man's life. Flowersare always has a property of cool to see, create beautyand happiness in the life. Fresh flowers create quite attraction to human kind but it is expensive, short lived and available only during a particular season. On the other hand dried flower and ornamental products offer a wide range of qualities like novelty, longevity,aesthetic properties, flexibility and year round availability. But objective is not only for round the year availability but to generate employmentfor small, marginal as well as large family since it has good export potentiality. Dry flowers constitute more than two-thirds of the total floriculture exports. The demand for dry flowers is increasing at an impressive rate of 8-10 per cent annually thus, offering a lot of opportunities for generate employment, entrepreneurship development and global trade. Rural and hilly areas are covered with different types of colourful flowers and foliage at different seasons round the year and all these are wasted under natural process. So, the raw materials are available in abundant. The entire seasonal colourful vegetation can be converted into value added products by using drying and dehydration techniques. Rural women and unemployed youth fetch good income through this industry since, the initial establishment cost as well as operational cost is not so much high. By making different flower products they churn out dry flower based fancy and utility based items like greeting cards, bookmarks, wall hangings, tablemats, garlands and dry flowers etc. mainly near metropolitan cities. Normally a piece cost is 30-40 rupees if it sold at domestic market while at tourist shopping centers it can fetch 100 rupees or more. Unemployed youth and rural women even the retired or old aged personscan take this opportunity. They can get training from a government's institutions, marginal loans from banks and start their own business to support their family and utilize their time also.

P-8.1

Vegetable growing in Kashmir: A profitable enterprise

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Presently India is poised to attain golden revolution with an overall development of horticulture. Indian horticulture achieved a significant increase in vegetable production with a total of more than 94.0 million tones and stands as the second largest producer next only to China. Although, vegetable production has been increased manifold in the last few decades but being highly perishable, needs to be preserved and processed in various value added products. In Kashmir valley by and large farmers possess small land holding ,hence the improved technologies and cash crops of high remunerative prices is of utmost priority. Krishi Vigyan Kendra Kupwara made an attempt by adopting some progressive farmers in vegetable processing for entrepreneur development and improve their livelihood. A farmer namely Mohammad Shafi Bhat was adopted by KVK Kupwara as a progressive farmer to take up processing of vegetables. The farmer grows vegetables over one acre of land. In addition to his own domestic use during the growing season , he preserves and processes surplus vegetables for use during long chilling winter season .The farmer earns Rs. 75000/= per annum from sale of early season vegetable seedlings cum fresh vegetables. He draws premium prices (Rs. 50000/=) of dried vegetables in off- season during winter when there is scarcity of fresh vegetables particularly during road blockade by heavy snow fall. He also processes vegetable products like tomato puree, mix vegetable pickle and gets a remuneration of Rs.30000/=. From the past two years many farmers from the adjoining areas of said progressive farmer got encouraged by this endeavour and approached KVK Kupwara for technological backstopping.

P-8.2

Strengthening farmwomen's role in quality seed production of vegetables

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Involvement of farmwomen in seed production and management was studied in four villages of Odisha, representing both rainfed and irrigated situations. Methodology was worked out for enabling maximum participation of farmwomen in seed production and quality improvement. It comprised seed production in homestead garden in rain fed villages and in the main field in irrigated villages, based on, access to good quality source seed, seed requirement, resource availability, skill and scope for marketing the seeds. The major constraints identified were less access of farmwomen to source seed, farmland, skill of seed production and storage, lack of marketing facility in the village for farm saved seed and lack of motivation. Skill training was imparted to farm women on different activities like planting, rouging, seed collection, planting material production, time of harvest, seed extraction, seed processing, labelling, packing and storage to enable them to take up seed production of vegetables. Vegetable seed production was planned in four villages, involving forty farmwomen. Seed production of brinjal, chilli, tomato, ridge gourd, french bean, cowpea, amaranths, okra and pumpkin was started in participation with the farmwomen in their own land. Average amount of seed produced per village was 20.76 Kg in homestead nutrition garden cum seed production units, out of which maximum seed was produced of amaranths (78.5%) followed by french bean (6.6%) and okra (5.4%). Farmer wise total seed production was ranged from 0.49 to 5.89 Kg. However, it was observed that all the farmwomen contributed to total seed production. Quality of produced seed before intervention of the project was tested for appearance and germination potential. Average of 77% seed samples collected from

village were below seed certification standards out of which more than 10% had less than 50% germination. In first season of guided seed production, 64% of seed samples were above seed certification standard. In second season, 95% seed samples met seed certification standard. Identification of constraints, motivation, hand holding and skill enhancement of farm women not only increased seed production, but also improved the seed quality.

P-8.3

Popularizing vegetable hybrids: A challenging scenario for public sector

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Hybrid varieties of vegetables have potential to give much enhanced yield compared to their open pollinated cultivars. In recent past, there has been a revolution in the hybrid technology in vegetable crops. Hybrids offer some of the unique advantages like higher yield, earliness, uniform and superior produce quality, and resistance to biotic/abiotic stresses. The first vegetable hybrid in India was developed in bottle gourd in 1971, and thereafter, a paradigm shift has been noted with a larger participation of public sector research institutes and SAUs in the development of vegetable hybrids. Indian institute of vegetable research, Varanasi has played a major role in development, testing and release of vegetable hybrids of vegetable under all India co-ordinate research project on vegetable crops (AICRP-VC). During the period 1975 to 2010, 96 hybrids were identified through AICRP-VC spanning 22 vegetable crops. According to NSAI (2005), during the 1998-2005 only 27 new vegetable hybrids developed by public sector whereas, private sector developed 598 hybrids in various vegetable crops. Public sector has been front runner in hybrids of brinjal, capsicum, Okra, bottle gourd and muskmelon, while private sector has been leading in crops like chilli, tomato and cabbage. Although, a large number of public sector hybrids were developed and released, the adoption of such hybrids has been low due to many reasons. Such low adoption may be attributed to insufficient supply of quality seeds, lack of market driven quality requirement, and lack of marketing strategies. Seed companies are profit making organizations and they have to keep the seed prices at a profitable level over and above meeting their establishment and production cost. Corporate seed firms are not trading with those crops where hybrids do not have feasibility, *e.g.*, legumes, potato, sweet potato and other tuber and bulb crops. Liberalization of seed trade, inability to generate huge fund for research and development (R&D), lack of proper advertisement and market for public sector bred varieties and hybrids are some of the contrasts compared to mega seed giants, which employ paramount technical personnel with opulence and extravagance. Under these circumstances, the role public sector organizations become very important to meet the supply good quality seeds at a cheaper price to the farmers. The popularization of public sector bred open-pollinated and hybrid seeds of vegetables also holds equally important for the benefit of the small and marginal vegetable growers. The hybrid seed business is expected to have huge scope and will play an important role in Indian economy.

P-8.4

Yield performance of onion var. nasik red multilocation demonstration under narayanpur district of Chhattisgarh

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Onion is important bulb vegetable and has tremendous export potential. Onions are rich source of calories, vitamin C and minerals especially iron, phosphorus and calcium and posses several medicinal properties. Successful onion production depends on the selection of varieties that are adapted to different conditions imposed by specific environment. In a tribal district like Narayanpur of Chhattisgarh farmers are not aware about improved varieties suitable for the region. Hence it was felt imperative to find out suitable varieties for its successful cultivation under Narayanpur district of Chhattisgarh as a basic step towards getting higher production. Hence, the present experiment was conducted to study the response of Nasik Red an improved variety of onion at Narayanpur district in Rabi 2013-14 in RBD in five replication with spacing 45 x 15 cm. Transplanting has been done in the first week of December. The mean performance of variety was having plant height 40.40cm, No. of leaves per plant 10.20, neck thickness 0.90cm, diameter of bulb 4.60cm, weight of bulb 60.50gm and bulb yield obtained 386 q per hectare. Hence, Nasik Red with medium bulb, better storage quality and good yield is advocated for cultivation in large scale at Narayanpur district of Chhattisgarh and it gives good opportunity for increasing the income of many tribal farmers.

P-8.5

A well-knitted agro supply chain management as a precursor to growth and development of horticulture

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India loses a huge amount of horticulture produce every year specially fruits and vegetables. Around 40% of produce goes to natural dustbin which is world's highest spoilage rate.India lacks coldstorage, effective food packaging as well as safe and efficient rural transportation system. On agricultural research and development (R&D), India spends only 1% of agricultural GDP, thereby ranking amongst the bottom of 26 lower middle-income countries in the index.[3] India is also facinginadequate and inefficient rural credit supply.This phenomenon poses great challenges before the implementation of National Food Security Act, rural economy and growth and development of horticulture. This research paper is a careful study of supply chain management of potato and onion which throws astonishing result that a well-knitted supply chain management is the key to growth and development of horticulture.

P-8.6

Urban farming though horticulture needed an urgent attention

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To feed more than 7.0 billion mouth including 1.26 billion Indian people, agriculture exerts a tremendous toll on the planet, from water draws to pollution and energy use to habitat loss. In India, agriculture is considered as backbone of the country and prime occupation of the country men since ancient; and it supposed to be the business of the rural populace, where as urban people are considered as a paracital entity. More than 50% of the populations are residing in urban areas in the worlds, whereas in India, it is about 33 % of the total india's population. Hence, it is the time to bring urban unproductive areas under productive one by culturing plants like seasonal vegetables, spices, flowers, small fruit in and around the cities, backyard of houses, rooftops, terraces, balcony, pots including hanging pots, containers, etc. Besides, the urban populace can rear small animals/birds and aquarium fishes. They can also set up the vermicomposting units, hydroponic, polyhouses, plant nurseries, community gardens, roadside urban fringe agriculture, field-to-direct sale farmers' and market; and livestock grazing parks and feedlots. The urban argi-horticulture is needed urgent attention to make city green and clean, to reduce harmful run off, decrease water lodging condition, increase shading and counter the unpleasant heat island effect. Urban agriculture means, "To establish and perform the agricultural practices in unproductive urban areas without hampering any urban function and at the same time contributing towards the improvement of agro-ecology in general and urban environment in particular". Urban farming helps in promoting fresh food, air and nutritional security, improving health and quality of life and creating dynamic, aesthetically pleasing city scape. Moreover, rooftops, balcony and patio create peaceful places for relaxation or contemplation. To promote urban farming in Goa, KVK- ICAR Research complex for Goa has created awareness though organizing various extension programmes like seminar, workshops, exposure visits, etc. The Kendra has also conducted hands on trainings at its own campus as well as schools, societies to impart skill and motivate them. A conceptual framework to expand urban farming is needed predominantly in urban areas for sustainable food chain. Considering the necessity and international scope of urban farming and desire to establish sustainable food production system for the future, we all should look forward to an improvement in the lives of urban as well as rural dwellers.

P-8.7

Strawberry cultivation – A boon to the home garden and urban development

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Strawberries (*Fragaria x ananassa*) are a welcome addition to any home garden. It is a delicious soft fruit and widely accepted for its characteristics aroma, attractive colour and refreshing quality. It has commanded a premier position in the world fruit market due to its attractive colour and distinctive flavour. It has adapted well to highly varying climatic conditions. It is cultivated commercially under extreme temperate conditions, sub-tropical and high altitudes of tropical regions and even in the desert-like areas of Israel. A number of large fruited, high yielding varieties viz., Chandler, Pajaro, Etna, Sweet Charlie, Selva, Douglas, Confictura, Dana, Belrubi, Gorella, Ophra and Addie are now available at IARI Regional Station, Shimla. Some of the day-neutral cultivars are Selva, Majestic, Phenomenal, Brighton, Etna, Fern, Sweet Charlie and Ophra are very promising. Farmers in the vicinity of Delhi, Haryana, Punjab and Uttar Pradesh a sub-tropical area have been profitably cultivating strawberries during the winter months obtaining their planting materials from the hills of Himachal Pradesh / Uttarakhand. Besides, the

income from strawberry fruits, growers in the hills thus can also earn by producing planting material for winter plantings in the plains. Being a shallow rooted & herbaceous fruit crop, it can also be grown easily in kitchen garden, roof garden, pots etc. which can be fitted well in home garden. The weight of a single fruit recorded 75gm in pot culture. But the average weight of fruit varied from 2gm to 18gm depending on the variety under field conditions. It is regarded as a valuable food in the diet of millions of people around the globe and is in special demand by the fruit processing industries for preparing the jams, ice cream, candy, toffee and other products. It is also prone to extremes of weather and to damage by birds, rodents and mammals because of its too attractive fruits. Investigations were also conducted to the newly planted strawberry plants and improving their productivity. It is highly commercialized fruit crop being sold at a premium price of Rs 200 to Rs 300 per Kg as an early crop and Rs 80 to Rs 100 as a late crop. Being a shallow rooted annual crop, it can be fitted anywhere in home garden and urban horticulture development with little but frequent irrigation facility.

P-8.8

Preference of farmers for flower cultivation

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The importance of floriculture has been realized throughout the world and today flower cultivation has developed into an intensive form of agriculture. The cultivation of flowers on commercial scale in our valley is still in infancy and is gradually developing its roots with improved transport facilities, introduction of improved varieties and increase in local demand. Commercial floriculture is increasingly being regarded as a viable diversification from the traditional field crops like food grains because of higher returns per unit area and growing demand for flowers in the domestic and export markets. According to latest figures, this activity covered an area of 0.25 million hectares in 2011-2012, with a production of 1.74 million tonnes of loose flowers and 7505 million number of cut flowers in India. However, unawareness about cultivation of important cut flowers on commercial scale among growers has been observed as a big constraint in development of commercial floriculture in the district Kupwara.

The present study was carried out in three villages of district Kupwara during 2013 to evaluate the adoption level of floriculture crops (marigold, gladiolus, gerbera and carnation). In each village two farmers were selected on pilot basis to take up the cultivation of these crops as they were unaware regarding cultivation of flowers. Among these, marigold has shown better adoption level (89%) among farmers while rest of the crops show poor adoption rate. On observation it was revealed that the reason for poor adoption of gladiolus, gerbera and carnation was mainly due to poor/costly transport facilities and lack of cold chain. The better adoption of marigold was attributed to its easy cultivation and high demand in market as it is transported to Jammu the temple city. The flowers are sold at premium prices as there is offseason in the city during June to September and are largely used in temples for worshiping the deities.

P-8.9

Strengthening farmwomen's role in quality seed production of vegetables

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Involvement of farmwomen in seed production and management was studied in four villages of Odisha, representing both rainfed and irrigated situations. Methodology was worked out for enabling maximum participation

of farmwomen in seed production and quality improvement. It comprised seed production in homestead garden in rain fed villages and in the main field in irrigated villages, based on, access to good quality source seed, seed requirement, resource availability, skill and scope for marketing the seeds. The major constraints identified were less access of farmwomen to source seed, farmland, skill of seed production and storage, lack of marketing facility in the village for farm saved seed and lack of motivation. Skill training was imparted to farm women on different activities like planting, rouging, seed collection, planting material production, time of harvest, seed extraction, seed processing, labelling, packing and storage to enable them to take up seed production of vegetables. Vegetable seed production was planned in four villages, involving forty farmwomen. Seed production of brinjal, chilli, tomato, ridge gourd, french bean, cowpea, amaranths, okra and pumpkin was started in participation with the farmwomen in their own land. Average amount of seed produced per village was 20.76 Kg in homestead nutrition garden cum seed production units, out of which maximum seed was produced of amaranths (78.5%) followed by french bean (6.6%) and okra (5.4%). Farmer wise total seed production was ranged from 0.49 to 5.89 Kg. However, it was observed that all the farmwomen contributed to total seed production. Quality of produced seed before intervention of the project was tested for appearance and germination potential. Average of 77% seed samples collected from village were below seed certification standards out of which more than 10% had less than 50% germination. In first season of guided seed production, 64% of seed samples were above seed certification standard. In second season, 95% seed samples met seed certification standard. Identification of constraints, motivation, hand holding and skill enhancement of farm women not only increased seed production, but also improved the seed quality.

P-8.10

Foliar feeding of different levels of boron and zinc on fruiting, yield, economics and quality parameter of winter season guava

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The investigation entitled "foliar feeding of different levels of boron and zinc on fruiting, yield, economics and quality parameter of winter season guava (*Psidium guajava* L.) Cv. L-49" was carried out in Fruit Research Farm, Horticulture Unit, B.H.U., Varanasi (U.P.) during the year 2012-2013. The experiment has different levels of zinc and boron at 0.2 % and 0.4 % respectively that was sprayed in guava plant cultivar Sardar (L-49). The fruit setting, fruit retention, number of fruits per tree, fruit yield (kg/tree) and physio-chemical composition of fruits, average fruit weight, fruit volume, specific gravity, polar diameter of fruit at harvest, radial diameter of fruit at harvest, pulp thickness, pulp weight, pulp percentage, seed weight were recorded maximum with foliar spray of $ZnSO_4$ 0.8% + Borax 0.4%, minimum fruit drop, Seed/Pulp ratio, time taken for first flowering (days), no. of seeds per fruit, acidity was in treatment T_8. The quality parameters Total soluble solids (TSS), TSS: acid ratio, ascorbic acid content was maximum with foliar spray of $ZnSO_4$ 0.8% + Borax 0.4%. It is revealed that highest yield with maximum gross return and benefit cost ratio (B: C) was found with treatment T_8 regarding economic viability.

Technical Session 9:

Innovative Technologies in Horticulture and Farmers Interaction Session

O-9.1

Fruit based cropping system for nutritional security in arid region

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The economic importance of horticultural crops has been increasing over the years due to increasing domestic and international demand. Area, production, productivity, availability and export have increased manifolds. This has provided ample opportunities for utilization of waste/marginal lands, employment generation and effective land use strategies particularly in the arid regions which occupy 12 per cent of the of the country's geographical area. To achieve sufficient and regular supply of food for subsistence is the primary goal of most human population living in these areas. Subsistence farmers who face famine would consider a technology to be one that produces at least some yield in the worst year. Traditionally, efforts have been made by the native people, obviously to achieve sustainable production ensuring ecological stability and nutritional security by growing several species together, e.g. pearl millet, moth bean, cluster bean and gram between the natural stands of khejri (*Prosopis cineraria*), bordi (*Ziziphus mauritiana* var. *rotundifolia*), lasoda (*Cordia myxa*), pilu (*Salvadora oleoides*), and ker (*Capparis decidua*). The perennial species also provide fodder for sheep, goats and during scarcity periods even for cattle and buffaloes. With arable land contracting in the face of land degradation and urban expansion, a movement towards intensification of existing cropping system, shortening of food chains and reduction of cash cropping in its many forms, seems to be the only way by which the growing population of arid and semi-arid regions can be fed. Under such situation fruit based cropping approach seeks to increase production, nutritional security and income in a sustainable manner by efficient utilization of both natural resources (land, solar radiation, water) and inputs (labour, credit, power, market infrastructure), meeting the diverse need of the farmers (4Fs, i.e food, fruit, fuel and fodder), economizing productivity, generating employment opportunities, improving economic conditions of the farmers and entrepreneurs, increasing export and nutritional security to the people. This paper deals with the research findings of fruit based cropping system developed for the arid region considering suitable over and under storey crops, economics of the system, allelopathic influence and management aspects.

O-9.2

Advances in nursery raising: present scenario

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Nursery raising under open field conditions suffers a lot due to a number of problems like biotic and abiotic factors (continuous rains, too low and too high temperatures, humidity, disease and insect-pest etc.). For the early establishment in the field and to reduce the cost of production now-a-day's vegetable seedlings are being raised in plug treys under controlled conditions round the year because, healthy vegetable seedlings up to a large extent determines the productivity and profitability from vegetable cultivation. Under plug tray system, each transplant grows in an individual cell to reduce the competition among transplants and maintain the uniformity resulting transplants establish better in the field due to less root damage. After independence, a lot of advances has been made and a number machine has been developed to make the nursery raising easy and convenient like media sterilizer, media mixer, media sever, plug treys filling, automatic plug trey seed sowing etc. by which the raising of seedlings under controlled environment now a day's become easier and labour intensive. The growth chambers

are usually an insulated room where temperature and relative humidity can be maintained which ease to germinate the seedlings very early. Air circulation is important to ensure uniform temperature and humidity throughout the chamber. Grafting in vegetables is a recent practice to overcome the soil borne diseases and nematodes, for both field and greenhouse grown crops. In addition, grafted vegetables can produce higher yields and have improved tolerance to environmental stresses, soil salinity and low soil temperatures which is only possible under protected conditions. Thus under present scenario raising of seedlings under controlled environment offers opportunity to go for the commercial nursery. Recently, growers have made the transition to greenhouse-grown transplants using various types of containers, primarily plug trays which. help in rapid growth and complete plant survival . Different plant species require differing amounts of space, nutrients and water. Certain cell sizes are more suitable for some plant species than others. Larger cells hold a greater volume of media, which enables them to retain more water and nutrients. Therefore, transplants growing in larger cells require less frequent watering and fertilizing. This helps reduce the likelihood of moisture or nutrient stress. Plastic and polystyrene containers most often come in straight row arrangements. Polystyrene containers normally have inverted pyramid-shaped cells that taper toward the bottom. They may have cell sizes as small as 0.8 inch square or as large as 6 inches square. The number of cells in a container depends on the cell size. So, there are a series of advancement made in span of time in the field of nursery raising where one can raise healthy seedlings in any part of the year successfully.

O-9.3

Physiological and yield response of tomato plant grafted onto eggplant rootstock under water-logging condition

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Due to the high market demand, tomato crops are frequently cultivated under unfavourable environmental conditions. These stresses include thermal, drought, flooding and salinity. It has been observed that in northern Indian plains, the young tomato plants faces water-logging situation due to heavy rainfall during September and early October. Tomato plants exposed to water-logging situation for more than 24 h, particularly during early growth stage causes leaf yellowing, stunted growth and wilting of the plant. Problems caused by flooding in tomato may be solved by growing flood-tolerant varieties or grafting superior tomato cultivars onto tolerant eggplant rootstocks. Grafting is nowadays regarded as a rapid alternative tool to the relatively slow breeding methodology aimed at increasing environmental stress tolerance of fruit vegetables. Keeping in view the above points, an attempt has been made during 2013-14 for grafting hybrid tomatoes (Arka Samrat and Arka Rakshak) onto selected eggplant rootstock (IC-354557) to alleviate the harmful effect of water-logging stress.

In this study, the tomato plants (grafted and un-grafted) were exposed to water-logging conditions for 96 h (4 days) both at early growth and reproductive stages. Various physiological parameters such as, leaf yellowing, wilting, chlorophyll content index (CCI), chlorophyll fluorescence (Fv/Fm), etc were measured at various intervals of post stress stage. Experimental findings revealed that when Arka Samrat and Arka Rakshak were grafted on eggplant rootstock (IC-354557) exhibited high CCI (30 to 42) and Fv/Fm (0.667 to 0.700) values, whereas self-rooted plants could not record these physiological traits 3-4 days after post stress. Similarly, the grafted plants did not show any yellowing or wilting during stress or post stress stage. In contrast to above the self-rooted plants showed 30-50% yellowing and 50-74% wilting. Thus, it may conclude from this study that grafting tomato on brinjal rootstock may alleviate the harmful effect of flooding or water-logging in tomato without significant reduction in yield.

P-9.1

Effect of foliar sprays of plant growth regulators on corm production and vase life in gladiolus

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Influence of plant growth regulator sprays on corm production and post harvest life of two gladiolus cultivars Darshan and Dhiraj was investigated for two consecutive years, 2008-09 and 2009-10. Growth regulators viz., GA_3, TIBA, CPPU and BR were sprayed at different concentrations at 3 rd and 6th leaf stage. The cultivar Darshan recorded maximum number of big cormels per plant and cormel weight. Cv. Dhiraj recorded maximum number of small cormels per plant. Foliar sprays of BR 10 ppm and GA_3 150 ppm significantly increased number of corms produced per plant, corm size, corm weight and propagation coefficient. Number of big cormels and total number of cormels per plant were recorded significantly higher with BR 10 ppm followed by TIBA 100 ppm. BR 10 ppm and TIBA 100 ppm produced maximum number of small cormels per plant. Weight of cormels per plant was recorded maximum with BR 10 ppm and GA_3 150 ppm. Post harvest studies revealed that the cultivar Darshan recorded maximum diameter of the second fully opened floret and higher vase life than cv. Dhiraj due to pre-harvest foliar sprays of plant growth regulators. Pre harvest foliar sprays of GA_3 150 ppm, BR 10 ppm and CPPU 5 ppm induced earliest first floret opening and recorded maximum values for number of florets opened at a time per spike, diameter of second fully opened floret and vase life.

P-9.2

Bio-priming of horticultural crop seeds through biocontrol agents (BCAs)

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Bio-priming is a novel technique of seed treatment through biocontrol agent (BCAs) like *Trichoderma viride, T. harzianum, Bacillus subtilis* and *Pseudomonas fluorescens* for disease control. It is recently used as an alternative method for controlling many seed and soil borne pathogens. It is an eco-friendly approach using selected fungal antagonists against the soil and seed borne pathogens. Biological seed treatments may provide an alternative to chemical control. Seed priming, were used commercially in many horticultural crops such as tomato, chilli, brinjal *etc*. as a tool to increase germination and improve vigour index of seeds. However, if seeds are infected or contaminated with pathogens, fungal or bacterial growth can be enhanced during priming, thus resulting in undesirable effects on plants. Therefore, seed priming alone or in combination with low dosage of fungicides and/ or biocontrol agents has been used to improve the rate and uniformity emergence of seed and reduce the soil and seed borne diseases. Use of bio-primed seeds might be considered as a safe, cheap and easily applied biocontrol method against these soil borne plant pathogens.

P-9.3

Advantages of micro-propagation technology in fruit crops

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In vitro multiplication of plants from small tissue (Explants) is known as Micro-propagation. It has several advantages in fruit crops such as: Micro-propagation offers rapid multiplication of desired plant species. Small pieces of plant (explants)/tissue can be used to produce a large number of plants in a relatively small space. Micro-propagation provides a high degree of phenotypic/physical uniformity. Since the production cycle takes place under controlled conditions, proper planning and scheduling based on the market demand is possible. The resulting product has very high degree of uniformity compared with traditionally propagated plants. Plants can be stored *in vitro* in a small space and less labour is required for maintenance of stock plants. Plantlets produced by tissue culture are usually disease free. With proper diagnosis and treatments, elimination of fungus, bacteria and virus prior to large scale propagation is possible. With the help of serological and molecular technique it is possible to index virus of mother plant/explants which is to be used for mass multiplication. Nutrient levels, light, temperature and other factors can be more effectively controlled to manipulate the growth, multiplication and regeneration. Micro-propagation is independent of season. As micro - propagation could be carried out throughout the year; production cycle can be scheduled to meet peak demands. For species that have long generation time, low levels of seed production, or seeds that do not readily germinate, rapid propagation is possible through tissue culture. The time required is much shortened, no need to wait for the whole life cycle of seed development.

P-9.4

Role of endophytes as antioxidant and its used in the crop production

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An endophyte is an endosymbiont, habitually a bacterium or fungus, that lives within a plant for at least part of its life without causing apparent disease. Endophytes basically transmitted maternally via vertical or horizontally in passively or through vectors. Endophytes are beneficial for the host plants by preventing pathogenic organisms from colonizing them. Plant growth and development are inhibited by the free radicals and ROS (reactive oxygen species) due the bioaccumulation of oxygen free radical and several ROS molecules (such as O^{-}_{2}, H_2O_2, OH^{-}) in cells. Which leads to plant cells death and DNA damaged thus caused several diseases result of this plant crop production very much exaggerated. Methods are used for visualization of endophytes are generally FISH, isolation and inoculation of endophytes etc. Benefit of endophytes producing several antioxidant enzymes and colonization, that reduced the cell death and DNA damaged as well as reduced the photosynthesis water transport which help to the crop production. The present review includes a brief knowledge about role endophyte and its bioactive compounds which act as antioxidant and help in crop production.

P-9.5

Solar box: An innovation in safe drying of fresh vegetables through low cost solar box

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Several methods of mechanical drying have been developed which have been used commercially for dehydration of vegetables. These methods include poly-house drying (solar drying), tray cabinet drying, tunnel drying, fluidized bed drying, spray drying, vacuum drying and microwave drying. Each has its own advantages and limitations. Moreover these process are highly energy intensive and expensive which ultimately increase the product cost. In many countries of the world, the use of solar thermal systems to conserve vegetables and fruits has shown to be practical and a responsible approach environmentally. However, the availability of low cost technology is lacking in many of the countries where solar food processing systems are most needed.

Low cost solar box was developed under the technical guidance from College of Agricultural Engineering, CCSHAU, Hisar. Experiments on drying of vegetables were conducted in the open space in the Department of Family Resource Management, College of Home Science, CCS Haryana Agricultural University, Hisar. Procedure for drying of vegetables was standardized. Objectives: 1-Development of Low Cost Solar Box. 2-Testing the drying performance of fresh vegetables. Existing low cost solar bed technology used for storage of grams, was modified and developed into a solar box. On the basis of results obtained from the preliminary survey, available literature and according to the availability of vegetables at the time of conducting experiments, 2 vegetables were selected viz. round gourd and cluster beans. Results showed that vegetables dried inside solar box were dried faster than open sun drying.

P-9.6

Effects of agro-forestry systems in improving soil health

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Underlying all consideration of the role of agro-forestry in maintenance of soil fertility is the fundamental proposition that trees improve soils. It is well structured, has good moisture-holding capacity, is resistant to erosion and possesses a store of fertility in the nutrients bound up in organic molecules. Further evidence for the effects of trees on soils comes from comparing soil properties under the canopy of individual trees with those in the surrounds without a tree cover. The land use systems comprising of tree, crops and pastures play an important role in improving soil fertility and its quality by several ways. the influence of agro-forestry systems, one must look for whether agro-forestry systems control soil erosion, maintain soil organic matter, maintain soil physical properties, augment nitrogen fixation, augment soil nutrient inputs, promote efficient nutrient cycling, reduce soil toxicities, promote desirable soil faunal activity, augment soil water availability to crops, and the role of root systems in agro-forestry. The agro-forestry, agri-horticultural and agri-pastoral systems have the potential to reduce erosion and runoff, and to maintain soil organic matter, improve soil physical properties and augment nitrogen fixation and

promote efficient nutrient cycling. The importance of alley cropping, agri-horticultural and agro- forestry practices under such use of trees has helped in improving nutrients status in soil and enhanced the growth of the trees. Out of the several benefits accrued from agro-forestry systems in terms of soil quality, nutrient cycling is the most predominant. In a soil-plant system, plant nutrients are in a state of continuous, dynamic transfer. Plants take up nutrients from the soil and use them for metabolic activities. In-turn, these nutrients are returned back to the soil either naturally as litter fall in unmanaged systems, deliberately as pruning in some agro-forestry systems or through root senescence in both managed and unmanaged systems. These plant parts are decomposed as a result of microbial activities and release the nutrients held in them into the soil.

P-9.7

Effect of genotypes and planting date on the yield and quality of onion bulb produced through sets at high altitude

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The present study was conducted to observe the effect of different genotypes and planting date on vegetative growth, bulb yield and quality. The experimentwas conducted with four genotypesi.e. Brown Spanish (BS) , Red Pinoy (RP), AgrifoundDark Red (AFDR) and Early Grano (EG) -50 and three planting dates i.e. 15 March, 15 April and 15 May. Two field experiments were conducted at Defence Institute of High Altitude Research in 2011 and 2012 in Randomized Block Design with three replications. The results showed that the genotypes and planting dates have significant effect on all most all studied parameters. Significantly higher bulb yield 83.40 t/ha with genotype EG-50 and 64.68 t/ha with 15th March DOP have been recorded.Maximum bulb yield 98.94 t/ha has been obtained with the interaction of genotype EG-50 and planting date 15th March. Pearson correlation analysis revealed that bulb yield has positive significant correlation with bulb diameter(r =0.766**) and average bulb weight (r = 0.986**)while significantly negative correlation observed with delaying in time of planting(r = -0.391*). It can be concluded from the results of this study that planting sets of genotype EG-50 on 15thMarch give significant higher bulb yield and bulb quality under the environmental condition of Trans-Himalaya Ladakh, India.

P-9.8

Innovative production system for Betelvine (*Piper betle* L.)

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Betelvine or Paan *(Piper betle L.)* of Piperaceae family is a perennial creeper, grown for its leaves as an important cash crop. The crop generally survives in southern India in open orchards whereas it is cultivated in Northern India in closed structures, known as *Bareja* or *Bheet'.* These structures are meant to provide ideal conditions, diffused light and humid conditions; required for its cultivation. These conditions are conducive to pathogens *viz.* fungi and bacteria also. Betelvine is capital and labour intensive crop and high susceptibility to diseases further makes it a risky cash crop in northern states. The major cost is incurred on construction of *bareja*, planting material and disease management. Due to high growth and regular harvesting of leaves, its nutrient management is also very important. To address these issues, two varieties of betelvine; namely Mahoba and Kalkatiya Bangla were grown at CSIR-NBRI, Lucknow. Various experiments included bed composition, i.e. growing in traditional pond soil (farmers practices) and scientifically prepared soil mixtures [combination of soil, farm yard manure, press mud, neem cake, cocopeat and rice husk]. The traditional bamboo based *bareja* was

replaced by poly-net house, erected with GI pipes to provide diffused light, mild temperature and high humidity through micro-irrigation system using foggers. To advance the planting time to ensure early harvests, the two nodes cuttings were planted in poly-house in the end of January so that rooted cuttings were available by end of February. This method resulted in early start of harvestings for economic returns. The beds were raised up to 6 inches to avoid water logging. Once the vines reach sufficient height, they are provided support by split bamboo stacks. Under high humidity conditions, these stacks get rotten and invite termites. The bamboo stacking was replaced by coconut rope. It was observed that the modified production system resulted in early yield of large, healthy, disease free leaves at lower cost of cultivation.

Technical Session 10:

Improvement in Production Technologies

P-10.1

Impact of climate change on production and productivity of mango

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Mango (*Mangifera indica* L.) is most important fruit of India those belong to family anacardiaceae having chromosome number 2n=40. Mango is very well adopted in tropical and subtropical climatic conditions. It is also called king of fruits in India. Exponential growth of CO2 and other greenhouse gasses in the atmosphere is causing climate change. It affects agriculture, forestry, human health, biodiversity, snow cover and aquatic to mountain ecosystems. Climatic factors like temperature, rainfall, humidity, photoperiod, wind and frost are mainly affect the growth, flowering, and fruiting of mango. It cannot stand with severe frost, especially when trees are planted to juvenile phase. Temperature *e.i.* 23.9 to 26.7°C is optimum for growth. Higher temperature is not affect so much but lower humidity and high winds affect adversely the production and productivity of mango. Most of the cultivars of mango are well adopted with good rainfall of 75 to 225 cm/annum. Dry season especially during flowering time is required because dry weather before flowering is favourable for profuse flowering and fruit setting. Rain during flowering is affecting the pollination and favour incidence of pest and diseases that cause decrease the production as well as productivity of mango. So, proper care and management of the mango orchard with maintaining C: N ratio and taking suitable cultivar for specific region. Regular bearing cultivars like Amrapali, Mallika, Neelum and Swarnrekha is very suitable for higher production and productivity.

P-10.2

Characterization of salt-affected soils of main experiment station of the university

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An intensive survey was carried out at Main Experiment Station of N.D. University of Agriculture and Technology, Kumarganj, Faizabad (Uttar Pradesh) to characterize the salt-affected soils. In spite of surface and subsurface samples, profiles study was also undertaken at four sites representing various land uses. The pHs of the soils ranged from 8.3 to 10.5, ECe from 0.2 to 5.4 dSm-1, ESP from 21.43 to 75.94 and SAR from 8.4 to 88.6.

The available soil nutrients viz. N, P and K ranged from 102 to 224, 8.0 to 10.5 and 190 to 230 kg ha-1, respectively. Sodium was the dominant cation in these soils. pHs, ECe and soluble cations were higher in surface layers and decreased down with the depth of profile. Soluble cations and anions and exchangeable cations in the surface soil were higher in barren soil, but slightly decreased in sub-surface soils. Bicarbonate content was relatively higher in the saturation extract. pHs, ECe, ESP, SAR and calcium carbonate contents found lower in soils under cultivation and increasing trend was noted in soils under plantation, soils under reclamation and barren land.

P-10.3

Effect of potash and varietal response on growth and yield attributes in brinjal (*Solanummelongena* L.)

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The present study was carried out to Effect of potash and varietal response on growth and yield attributes in brinjal (Solanummelongena L.) under field conditions. Potash was applied in three rates (30, 40 and 50 Kg/ha).The fruit yield per plot and per hectare was significantly influenced due to various treatments of levels of potash and varieties. The treatment V3 (Pusa hybrids - 5) and V4 (PusaUttam) were recorded with maximum fruit yield per plot and per hectare. The significantly highest fruit yield per plot and per hectare was observed in treatment combination of V1K3 (F-1, Hybrid Goal + 50 K2O/ha) and V4K3 (PusaUttam + 50 K2O/ha). The interaction of treatment combinations of levels of potash and varieties, V2K3 (Pusa Purple Cluster + 50 K2O/ha) treatment combination recorded higher fruits per plant.

P-10.4

Effect of diffrent sources of potassium and urea on fruit yield and quality of aonla (*Emblica officinalis* Gaertn) cv. chakaiya

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The present investigation “Effect of different sources of potassium and urea on yield and quality of aonla (*Emblica officinalis* Gaertn) cv. Chakaiya” was carried out at Main Experiment Station, Department of Horticulture, Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during the year 2013-2014.

The experiment was carried out on 15 years old plantation of aonla cv. “Chakaiya”. The experiment was laid out in Randomized Block Design (R.B.D.) with 8 treatments and replicated in 3 times, considering one plant as a unit per treatment. The observations were recorded for Flowering and fruiting behaviour, Physical and yield attributing characters of aonla fruits. Observations gathered with respect to maximum fruit retention (29.20%), fruit yield (111.09 kg/tree), fruit length (3.40 cm), fruit width (3.90cm), fruit weight (35.40 g), pulp weight (32.93g), pulp stone ratio (1.13:33) with minimised fruit drop (70.8%) and stone weight (2.47g) was obtained with the foliar application of K_2SO_4 (2%) + Urea (2%) compression to control (water spray).

P-10.5

Evaluation of summer greengram (*Vigna Radiata* L.) for their economic feasibility, nutrient content and soil fertilty

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A field experiment was conducted during 2010 at the student instructional farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.) India to study summer greengram for their economic feasibility, nutrient content and soil fertility. The twelve treatments were laid out in randomized block design with three replications. The application of 60 kg P_2O_5 ha^{-1} with VAM was more effective in increasing all the growth characters and yield attributes like pods $plant^{-1}$, test weight, seeds pod^{-1}, test weight, grain and straw yield, Dry matter accumulation $plant^{-1}$, nitrogen and phosphorus uptake and content in seed and stover were increased significantly with VAM and which was statistically at par with PSB and significantly superior with Uninoculated biofertilizers. 60 kg P_2O_5 ha^{-1} with VAM also performed significantly better in terms of gross return, net return and B: C ratio. However, system productivity of summer greengram was highest with VAM compared to PSB and Uninoculated plot.

P-10.6

Yield performance of amorphophallus variety under multilocational demonstration in Narayanpur district of Chhattisgarh

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The investigation was undertaken during the year of kharif season 2013-14 at five locations at the field of tribal farmers of Narayanpur district of Chhattisgarh {1. Shri Dhani Ram, Village-Palki; 2. Shri Rameshwar, Village-Palki; 3. Shri Mangal Singh, Village-Benur; 4. Shri Kamlesh, Village-Sulenga and 5. Shri Mahesh, Village-Binjali}. The demonstration was conducted with two varieties viz. Gajendra and Narayanpur Local in 0.10 ha area in each farmer field and tubers are planted dated from 03 to 06th June, 2014. The varieties were demonstrated in single plot of each varity at each location. The plot size was 100 m x 50 m and planting spacing was 75.0 x 75.0 cm. Observations were recorded from ten randomly selected sample plants from each plot and observed mean value used for statistical analysis. Under this demosntration 02 entries were evaluated and observed mean tuber yield 47.70 t/ha in Gajendra, and 24.80 t/ha in Narayanpur Local. It may be conclude that the variety Gajedra is most suitable for commercial production in Narayanpur district of Chhattisgarh and which may be helpful for improvement of livelihood security of tribal farmers of this areas.

P-10.7

Influence of micronutrients application on growth and seed yield in tomato (*Lycopersicon esculentum* MILL.)

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A field experiment was conducted during *rabi*-2010 to find out the response of foliar application of micronutrients on vegetative and reproductive growth attributes and seed yield, in two varieties of tomato *viz*., UtkalKumari and Utkal Raja. The treatments consisted of boron, zinc, molybdenum, copper, iron, manganese, mixture of all and control and the experiment was laid out in RBD with three replications. All the Micronutrients except manganese (@ 50ppm) were applied @ 100ppm in three sprays at an interval of ten days starting from 30 DAT. All the treatments resulted in improvement of plant growth characteristics *viz*., plant height, number of primary branches, compound leaves, tender and mature fruits per plant and seed yield characteristics like recovery percentage, 100 seed weight, seed yield per plant and seed yield per hectare in both the varieties out of which application of micronutrients mixture showed the maximum effect. In tomato cv. UtkalKumari, maximum growth rate (85.7 %) was observed with application of zinc, followed by application of micronutrients mixture (78.2 %) and boron (77.5 %). Tomato cv. Utkal Raja, maximum increase in branches per plant was observed with the application of manganese (148.7 %) followed by micronutrient combination (144.1 %). Highest seed recovery rates of 0.53 and 0.55 percent recorded in the varieties UtkalKumari and Utkal Raja, respectively by application of micronutrients mixture. The highest seed weight was observed with application of micro-nutrients mixture (Utkal Raja) and boron (UtkalKumari). In both varieties, application of micronutrients mixture gave maximum seed yield followed by boron treatment, in respect both the parameters, while the lowest yield was obtained in the control.

P-10.8

Efficacy of integrated nutrient management in ratoon of tissue cultured banana

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Banana is one of the leading fruit crops of the world and is very nourishing, which contains nearly all essential nutrients including minerals, vitamins and has several other medicinal properties. By nature, banana is a heavy nutrients feeder crop and requires large quantities of nutrients for its growth, development and quality yield. Fertilizer requirements of banana can be supplied through chemical and bio-fertilizers means but in recent years, a new approach has emerged which has already been receiving wide attention for utilization of available resources *viz.,* organic, inorganic and microbial inoculants with an integrated approach for sustainable economic yield and also for improvement in soil health and environment. In this regards efficacy of an integrated doses of NPK, *Azospirillum,* PSB and *Trichoderma harzianum* was studied in RBD with three replications and ten treatments in ratoon crop of tissue cultured banana cv. Grand Naine in the Department of Horticulture, C.S. Azad University of Agriculture and Technology, Kanpur, (U.P.), India. The results obtained shows that the treatment of 100% RDF of NPK+50g *Azospirillum*+50g PSB+50g *Trichoderma harzianum* per plant produced tallest plants (145.45 cm) with

maximum girth of pseudostem (64.00 cm), number of leaves (30.60) per plant, maximum length of inflorescence (105.80 cm), number of fingers per hand (17.66) and per bunch (140.00), finger length (19.33cm), weight of finger (138.00g), finger diameter (15.10 cm), total soluble solids (17.98 ^{0}Brix), total sugars (18.33%), pulp (80.36%) and pulp: peel ratio (4.58) with minimum number of days (232.33 days) taken from planting to flowering or initiation/ emergence of bunch and minimum amount of titratable acidity (0.25%) and peel (17.36%).

P-10.9

Improvement of growth, yield and quality of tomato (*Solanum lycopersicon* L.) cv. Azad T-6 with foliar application of zinc and boron

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The present investigation was conducted at the Horticultural Research Farm, Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, Lucknow (U.P.) during the rabi season of 2013-2014 to find out the response of Improvement of growth, yield and quality of tomato (*Solanum lycopersicon* L.) cv. Azad T-6 with foliar application of Zinc and Boron. The experiment was layout in Randomized Block Design with three replication and 12 treatments. Treatment combinations are T_0-Control (water spray), T_1-Zinc (50ppm), T_2-Zinc (100ppm), T_3-Zinc (150ppm), T_4-Boron (50ppm), T_5-Boron (100ppm), T_6-Boron (150ppm), T_7-Zinc (50ppm) + Boron (50ppm), T_8-Zinc (100ppm) + Boron (100ppm), T_9-Zinc (150ppm) + Boron(150ppm), T_{10}-Zinc (100ppm) + Boron (50ppm), T_{11}-Zinc (150ppm) +Boron (50ppm).The result showed that the vegetative growth in terms of plant height and number of branches at various stages (30,60 and 90 Days after transplanting) was greatly influenced by the application of micronutrients Zn and B. Among them treatment T_5-Boron (100ppm) significantly increased the plant height (61.23cm at 90 DAT) and number of branches (16.17 per plant at 90 DAT) compared to others. Whereas, application of zinc and boron each at 100ppm (T_8) caused early flowering (31.95 DAT) as well as showed maximum number of flowers (75.21) and fruit yield (93.10 t/ha). It was also revealed that the treatment T_8 improved the physico-chemical qualities of tomato fruits specially improved the TSS: acid ratio (10.98). Thus, the study indicated that application of boron and zinc either solely or in combination is quite beneficial for vegetative growth, flowering and fruiting as well as quality improvement of tomato fruits (Azad T-6) grown under high sodic soil (pH 8.2) of Lucknow.

P-10.10

Effect of time and intensity of pruning on yield and quality of guava (*Psidium guajava* L.) Cv. Sardar

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An experiment was conducted to know the effect of time and intensity of pruning on yield and quality of guava (*Psidium guajava* L.) Cv. Sardar had undertaken on eight years old guava plants at the Instructional-Cum-Research Farm, Department of Horticulture, College of Agriculture, Latur during 2013-14. The experiment was laid out in Randomized Block Design with seven treatments replicated thrice. The treatments comprises heading back of tertiary branches at 25 %, 50 % and 75 % in 1st , 2nd , 3rd and 4th week of May and unpruned as control. The

yield parameters like maximum no. of fruits per tree were observed in treatment heading back of tertiary branches at 25 % in the 3rd week of May (T7) whereas, maximum yield per tree and per hectare was recorded in treatment heading back of tertiary branches at 50 % in the 2nd week of May (T5). Physical and chemical parameters like maximum fruit weight, volume of fruit, TSS, ascorbic acid content, reducing sugars, total sugar and sugar: acidity ratio were recorded maximum in the treatment of heading back of tertiary branches at 75 % in the 2nd week of May (T6). Hence, it can be concluded that, the pruning of guava trees with 50 % and 75 % heading back of tertiary branches during 2nd and 3rd week of May is desirable for getting high yield and superior quality guava fruits.

P-10.11

Effect of integrated nutrient management on growth, yield and quality of carrot (*Daucus carota* L.) cv. Pusa Rudhira

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An experiment entitled “Effect of Integrated Nutrient Management on Growth, Yield and Quality of Carrot (*Daucus carota* L.) cv. Pusa Rudhira” was carried out at the Horticulture Research Farm , Department of Applied Plant Science (Horticulture) Babasaheb Bhimrao Ambedkar University (A Central university), Lucknow (U.P) . The observations were recorded on plant height (cm), length of leaves (cm), number of leaves, fresh weight of leaves (g), length of root (cm), diameter of root (cm), root yield (q/ha), T.S.S.(^{0}B), ascorbic acid (mg/100g) and carotene content of root (mg/100g). The maximum height of plant (53.05cm), length of leaves (42.55cm), number of leaves per plant (16.38), fresh weight of leaves (100.36g), diameter of root (3.08cm) and root yield (280.33q/ha) were found under the application of 25%NPK+25%FYM+25%Vermicompost +25%Phosphate Solubilizing Bacteria (T_{12}), Application of 50%RDF+50%PSB (T_8) recorded maximum length of root (15.25 cm). But highest total soluble solid (T.S.S.) were recorded (10.9^{o}B) in case of 50% PSB + 50%FYM (T_{11}), ascorbic acid (3.05 mg /100 g) in the case of 50% RDF + 50% FYM (T_7), carotene content of root (4.5 mg /100 g) in the case of 100% RDF (T_2). While, minimum height of plant (28.01cm), length of leaves (25.06 cm), number of leaves per plant (7.89), fresh weight of leaves (49.11g), length of root (8.32cm), diameter of root (1.99 cm), root yield (200.36 q/ha), total soluble solid (9.03^{0}B), lowest ascorbic acid (1.98 mg/100 g) and lowest carotene content of root (3.01mg /100 g) were found under control treatment (T_1).

P-10.12

Effect of pruning severity on quality of grapes (*Vitis vinifera* L.) cv. Red Globe in winter season

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Effect of pruning severity on quality of grapes cv. Red Globe in winter season was studied at Horticultural Orchard, Tamil Nadu Agricultural University, Coimbatore during 2012-2013. The vines were pruned at four different levels in a Randomized block design with five replications. Different pruning levels adopted are, I. Pruning all the

canes to 2 bud level for vegetative growth. II. Pruning all the canes to 5-6 bud level for crop load. III. Pruning 33 per cent of the canes for vegetative growth (2 bud level) and remaining 67 per cent of the canes for crop load (5-6 bud level). IV. Pruning 50 per cent of the canes for vegetative growth (2 bud level) and 50 per cent of the canes for crop load (5-6 bud level). Observations such as TSS, TSS-acid ratio, titrable acidity, sugar-acid ratio, reducing, non-reducing and total sugars were determined. Results revealed that, all the vines which were pruned at 2 bud level for winter season crop registered highest TSS (16.25 ^{0}Brix), TSS/acid ratio (31.60), lower titrable acidity (0.51 per cent), whereas, the maximum reducing sugars (13.91 per cent), total sugars (15.26 per cent) and sugar-acid ratio (30.11) was observed in vines pruned to 50 per cent of the canes for vegetative growth and 50 per cent of the canes for crop yield for winter season crop was found to be better among different pruning intensities.

P-10.13

Estimation of growth and quality of onion in response to three planting dates and sulphur fertilization

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An experiment was carried out on the planting dates and forms of sulphur on physico-chemical parameters of 'Pusa Red' cultivar of onion (*Allium cepa* L.) during *rabi* season of the two consecutive years of 2012-13 and 2013-14. Seedlings were planted at three different dates, namely 15th November, 15th December and 15th January and three doses of elemental sulphur and gypsum each 20kg/ha, 40kg/ha and 60kg/ha at Horticultural Research Farm of the Department of Applied Plant Science, School for Boiscience and Biotechnology, Babasaheb Bhimrao Ambedkar University, Lucknow (U.P.). The experiment was laid out in factorial randomized block design with three replications. The data clearly revealed that early date of planting *i.e.* 15th November with 40 kg/ha of elemental sulphur significantly influenced the growth, yield and yield attributing characters (plant height, number of leaves, neck thickness, bulb length, bulb diameter, bulb size and bulb weight of onion) compared to other two planting dates, sulphur and gypsum levels. However, it was at par with early date of planting *i.e.* 15th November with 60kg/ha elemental sulphur. Similarly, significantly higher TSS, ascorbic acid content in bulb were recorded in early planting (15th November with 60kg/ha and 40kg/ha) and significantly higher reducing sugar, non-reducing sugar and total sugars were obtained with early planting (15th November with 20kg/ha of elemental sulphur), while higher content of pyruvic acid was found in late planting (15th January with 60kg/h of elemental sulphur) of the onion crop.

P-10.14

Effect of nutritional doses and canopy position on fruit quality of kinnow mandarin harvested in mid January

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Kinnow, a interspecific hybrid between 'King' (*Citrus nobilis* Lour) and 'Willow Leaf' (*Citrus deliciosa* Tenara) mandarin is liked by consumer due its nutritional richness and excellent flavour. In India, different varieties of mandarins are being produced in Punjab, Madhya Pradesh and Maharashtra and other states like Rajasthan.

However, 'Kinnow' cultivation confined to the few states of India (Punjab and Rajasthan). In Delhi and surrounding areas, Kinnow mainly harvested in the last week of December. These fruits are somewhat more acidic than the Kinnow grown in Punjab state. This harvesting date also coincide with extreme winter in which people generally not prefer to eat 'Kinnow'. Therefore, a study was undertaken to assess the quality aspect of Kinnow fruits harvested in the mid of January with different nutrient doses and two canopy position to improve consumer liking. There were nine treatments and one control. Treatments comprised of three levels of nitrogen (250 g, 300 g and 400 g) and potassium (160 g, 240 g and 320 g) with constant dose of phosphorous (600 g). Fruit harvested during mid-January from two canopy positions i.e., external and internal. Treatments T2, T6, T7, T8, T9 and T10 differed non significantly with respect to yield. Fruits located on external and internal canopy differed non significantly with respect to TSS and acidity. The treatment T8 (9.75°B) and T5 (9.5°B) recorded highest TSS. However, the treatment T1 (0.77%) and T8 (0.80%) recorded higher acidity. Treatments T2, T5, T8 and T9 recorded higher ascorbic acid content and differed non significantly. External canopy fruits recorded significantly higher ascorbic acid content (16.724 mg/100 g) as compared to internal one (15.255 mg/100 g ml juice). External canopy fruits (chroma =51.910) were brighter in colour as compared to internal one (chroma=49.437).

P-10.15

Effect of girdling on leaf nutrient status in pear cultivars '*Patharnakh*' and 'Punjab Beauty' under sub tropics of north India

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The response of girdling in hard and semi-soft pear cultivars '*Patharnakh*' and 'Punjab Beauty', respectively was investigated on 18 years old vigorous plants growing at Fruit Research Farm, PAU, Ludhiana (Punjab) situated at latitude 30° 4'N, longitude 75° 56'E and altitude 255 m. Various girdling treatments: Trunk (TG), Limb (LG) and Sub-limb (SLG) were applied at different stages i.e. flower initiation (FI), 15 days after flower initiation (15 DAFI) and 30 days after flower initiation (30 DAFI). Girdling performed at different positions on pear tree significantly decreased the leaf N and K levels; however, improved the leaf Ca content significantly, whereas, leaf P and Mg concentrations were not appreciably affected in both pear cultivars. Leaf micro-nutrients levels (Fe, Zn and Cu) were enhanced significantly in girdled trees, whereas, leaf Mn content had shown reversed trend and it was significantly lower in both the cultivars. In conclusion, girdling performed at different stages drastically improved the mobility of certain nutrients towards developing fruits, which in turned substantially helpful in the advancement of fruit maturity and effectively improved physic-chemical attributes in pear.

P-10.16

Study on propagation of carrizo rootstock through cutting

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Rootstocks have played vital role in citrus industry of the world. It is highly important to carefully use selected rootstocks of superior performance and also is equally important to standardize their method of commercial propagation. A trial was conducted at Punjab Agricultural University - Fruit Research Station, Jallowal - Lesriwal, Jalandhar on propagation of Carrizo rootstock through cutting. Three types of Carrizo rootstock cuttings (hardwood,

semi-hardwood and softwood) were prepared during first week of February and were planted in open beds. The data regarding shoot and root growth was recorded after one year of planting of the cuttings. Maximum number of primary shoots was recorded in softwood cuttings followed by hardwood cuttings, while least was in semi-hardwood cuttings. In term of length of primary shoots, maximum lever of this parameter was registered in hardwood cuttings. Second best value of this parameter was observed in softwood cuttings closely followed semi-hardwood cuttings. As per the diameter of the primary shoots, hardwood cuttings were found on top while semi-hardwood cuttings and softwood cuttings were at par. The data regarding sub-shoots revealed that maximum number of sub-shoots was found in hardwood cuttings while least in semi-hardwood cuttings. As per the length of sub-shoots, highest value was recorded in hardwood cuttings and little difference was observed between semi-hardwood and softwood cuttings. Maximum diameter of sub-shoots was also registered by hardwood cuttings. Maximum number of leaves was observed in hardwood cuttings while next best value of the parameter was in softwood cuttings. Minimum leave number was in semi-hardwood cuttings. The data on root growth revealed that maximum root length and number of primary roots was observed in hardwood cuttings. Also the highest level of fresh and dry root weight was in hardwood cuttings.

P-10.17

Studies on changes during growth and development of phalsa (*Grewia subinaequalis* D.C.) fruit

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The present investigation entitled studies on changes during growth and development of phalsa (*Grewia subinaequalis* D.C.) fruit was carried out during the year 2012-13. The experiments were conducted at ambient temperature in P. G. Laboratory at the Department of Horticulture, and data were analysed using CRD design with three replications. The observations were recorded on fruit weight, volume of fruit, specific gravity, TSS, reducing sugars, total sugars, ascorbic acid and anthocyanins content of the phalsa fruits were increased during growth and development whereas non-reducing sugar and chlorophyll contents were decreased. The acidity content of phalsa fruit first increased then decreased.

P-10.18

Studies of integrated nutrient management on physico-chemical charecters of strawberry (Fragaria x ananassa Duch) cv. chandler

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The cultivated strawberry (Fragaria x ananasaDuch.) is a man made hybrid that was originated from the hybridization of two American species Fragariachilioensis and Fragariavirgianana in France in seventeen century. The integrated nutrient management have immense important role in improving physico-chemical characters of fruits. The aim of this research was to see the influence of integrated nutrient management consisting T1: FYM@20t/ha (control), T2: NPK Recommended dose of fertilizer (100:80:60 kg/ha), T3: Vermicompost@5t/ha, T4: Poultry manure@5t/ha, T5: Neem cake@3t/ha, T6:

Vermicompost @2.5t/ha + half dose of NPK, T7: Poultry manure @2.5t/ha + half dose NPK, &T8: Neem cake @ 1.5t/ha + half dose NPK, on Length of berry (cm), Width of berry (cm), Volume of berry (cm3 Ascorbic acid (mg/100g juice), Acidity (%), Reducing & Non-reducing sugar (%) and Total sugar (%). Statistical design used was R.B.D. with three replications, having five plants as unit. The maximum Fruit length (4.61cm), Width of berry (3.31cm), Volume of berry (8.50cm3 Ascorbic acid (55.77mg/100g juice), Reducing & Non-reducing sugar (5.50,1.93% respectibily), Total sugar (7.54%) and lowest acidity (0.82%) were recorded by T6: Vermicompost @2.5t/ha + half dose of NPK, whereas control (FYM) shows minimum results.), Weight of berry (g), TSS (0Brix),), Weight of berry (9.33g), TSS (10.730Brix).

P-10.19

Importance of water managements for quality production of nursery plants in horticulture

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Propagating and maintaining high quality plants requires large amounts of water, fertilizer, and pesticides. These high inputs, however, increase the potential for both surface and ground water pollution. Therefore, nursery producers have an important role to play in protecting water quality. Water is essential to plant life and is a critical input to nursery crop production. Growing a healthy plant to market specifications requires the correct amount of water and nutrients as well as a suitable growing environment. Water is taken up by plant roots and is lost to the environment through the small openings on the leaf called the stomata and from the leaf cuticle. Irrigation can shorten the production period for field nursery crops and increase quality, which has a positive impact on nursery profitability.

This water protection program has been divided into three stages for ease of implementation. Stage I should be implemented wherever feasible by all nurseries. Stage II is strongly recommended for implementation whenever physically and financially possible, whereas Stage III illustrates the ideal in water quality management. The specific recommendations for protecting water quality have been broadly categorized into the following three management areas: irrigation, fertilization, and pest and pesticide management.

The potential consequences of inefficient irrigation include wasted water, increased nutrient and pesticide leaching (removing nutrients and pesticides from the foliage, root zone and production surfaces), increased water runoff and movement of contaminants in runoff, increased biotic and abiotic stresses, reduced plant growth, increased plant death and increased production duration. The potential consequences of under-irrigation include the latter four. It is thus, of utmost importance that the water scheduling be taken up scientifically using advanced irrigation systems in nurseries so that better quality plants free from disease and insect-pest infestation can be produced which would result in a higher returns and profit from the nursery.

P-10.20

Biological control of soil-borne pathogens and growth promotion by potent *Trichoderma* isolates under North Western Himalayan conditions

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Sclerotinia sclerotiorum (Lib.) de Bary, *Sclerotium rolfsii* Sacc., *Rhizoctonia solani* Kuhn, *Fusarium oxysporum* and *F. solani* are soil borne pathogens affecting several economically important vegetable crops under North Western Himalayan (NWH) region of India, causing diseases like root rots, wilts, stalk rots, collar rots, white mold etc. Use of chemical fungicides is no longer a viable long-term option for disease management due to the fragile Himalayan ecosystem and there has been a growing emphasis on use of eco-friendly options like biological control. *Trichoderma* spp. are cosmopolitan fungi which have been credited with the ability to inhibit diverse plant pathogens along with ability to promote plant growth and induce resistance against biotic and biotic stresses. However, biocontrol potential of *Trichoderma* strains is strongly influenced by various environmental, edaphic and biological parameters and it has been suggested that isolating potent strains from the targeted agro-ecological niche itself may yield more effective results. Keeping in view the multifaceted potential of *Trichoderma* sp., experiments were undertaken to evaluate and identify *Trichoderma* isolates, indigenous to NWH, possessing (i) high antagonistic activity against major soil-borne pathogens *in vitro* and *in vivo* (ii) plant growth promoting activity (iii) growth at low temperatures and (iv) high competitive saprophytic ability. Based on various laboratory and glasshouse evaluations three highly potent isolates of *Trichoderma* (Tr-11, Tr-28, Tr-34) were identified. The isolates exhibited inhibition in the range of 47-50.6%, 45-50.8%, 56-68.1%, 34-38% and 28-46.4% against *R. solani, S. rolfsii, S. sclerotiorum, F. oxysporum* and *F. solani* respectively, in dual culture studies. Growth promoting activity of the isolates was assessed in tomato, capsicum, garden pea and French bean under glasshouse conditions. In general, significant increase in root and shoot length over control was observed with isolates Tr-11 and Tr-34 in all crops except French bean. While none of the three isolates was able to grow at 5^0C, the isolates exhibited good growth at 10, 15 and 20^0C (30-40mm, 56-60 mm, 90-95 mm diameter respectively, after 3 days. Competitive saprophytic ability (CSA) of the isolates was assessed by soil agar disc method and all three isolates exhibited high CSA. In field evaluation studies using garden pea, talc based formulations of the isolates were applied as seed treatment and foliar sprays. Significant improvement in seedling emergence over control was observed in all three isolates. The isolates also exhibited significant reduction in white rot (21-40%) and leaf blight (38-47%) diseases as well as a significant improvement in yield relative to control. The three potent isolates were identified as *T. harzianum* based on their morphological characters from MTCC Chandigarh and the promising isolate Tr-28 (*Trichoderma harzianum* strain MTCC 8620) was commercialized for wide spread use under hilly conditions.

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- पी.पी.एफ खाता
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अन्य योजनाओं एवं अधिक जानकारी हेतु कृपया निकटतम शाखा में सम्पर्क करें।

आपकी सेवा में अग्रसर