

Golden Jubilee Celebration of Progressive Horticulture Journal
(1969-2019)



Progressive Horti **C**ulture Conclave (PHC)-2019

Futuristic Technologies in Horticulture



Abstracts

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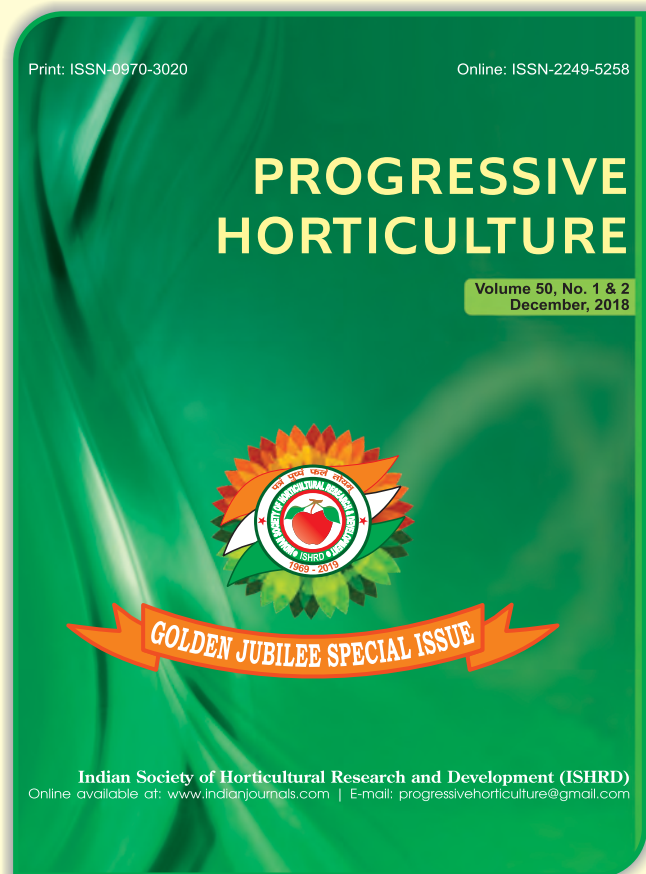




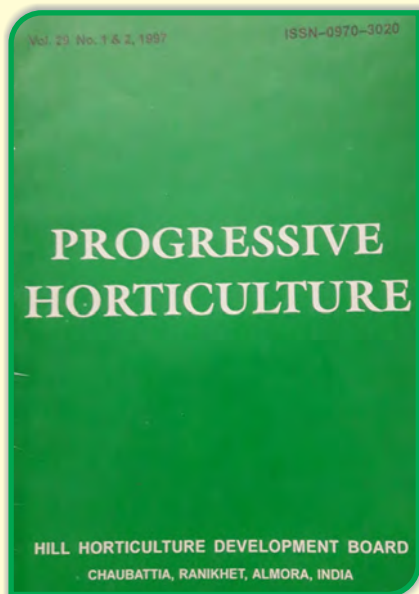
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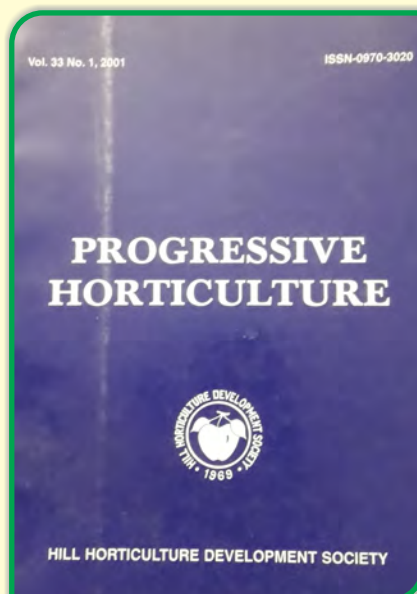
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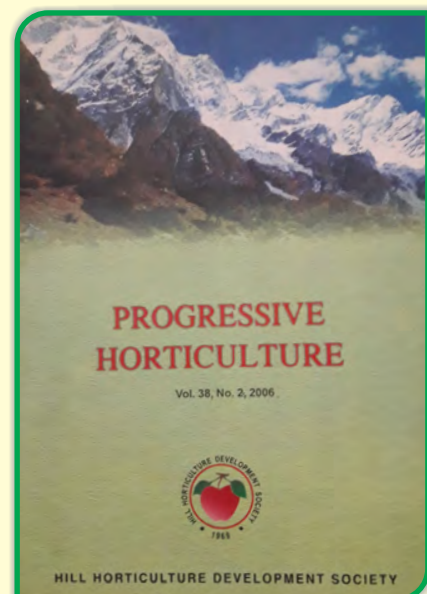
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Deepa H. Dwivedi
Sandhya Gupta
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ON
FUTURISTIC TECHNOLOGIES IN HORTICULTURE

December 8-10, 2019

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THEME 1

FUTURE HORTICULTURAL CROPS AND PRODUCTION TECHNOLOGIES

ORAL SESSION

O-1

Diversity of minor fruits of Arunachal Pradesh and their role in ethno-medicinal uses

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Arunachal Pradesh, the land of rising sun has lot of climatic variations because of its unique position in the Indian subcontinent. It has been blessed by nature with one of the richest flora and fauna on the earth and regarded as one of the 'Biodiversity Hot Spot' areas in the world. The state has rich diversity of minor fruits in wild and semi wild condition which however, have not been fully exploited for its potential and the trait they possess. However, there are tremendous possibilities to explore the genetic potential of some of the minor fruits crops available in the state which remains unexploited due to lack of awareness of their potential. The diversity of underutilised fruits and their uses mainly ethno medicinal uses are discussed in this paper.

O-2

Raktsey Karpo : A potential apricot cultivar of trans-Himalayan Ladakh for GI tagging

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The trans-Himalayan Ladakh region is known for its quality apricots. Apricots with white seed coats, popularly known as *Raktsey Karpo*, is unique to Ladakh and are associated with a sweet kernel and brightly colored fruit. It is a popular table purpose cultivar and the fruits are known for its sweetness. It has been ranked as the most preferred fruit for fresh consumption. Important quality attributes of *Raktsey Karpo* include its sweetness, aroma, juiciness, flesh color, stone color, fruit shape, and fruit weight. Significantly low amygdalin content ($2.4 \pm 1.2 \text{ mg g}^{-1}$) has been found in apricot kernel with white seed coat phenotype. The TSS of *Raktsey Karpo* ($28.1 \pm 3.8^\circ \text{Brix}$) is significantly higher than that of cultivars with brown seed coat. Fruits of *Raktsey Karpo* have also been reported to have 37.9°Brix , which to the best of our knowledge is the highest value reported till date in fresh apricots. Recent studies in trans-Himalayan Ladakh have shown that the fruit TSS increase with increasing altitude. Linear relationship between total sugar contents and increasing altitude was observed ($R^2=0.877$, $p < 0.01$). For every 100 m increase in altitude, total sugar increased by 64.8 mg/g DW. In view of the reputation of the product essentially due to origin of the cultivar from Ladakh and the high altitude dry environmental condition of Ladakh, *Raktsey Karpo* is a potential crop for Geographical Indication (GI) tagging.

O-3

Impact of spray of combination of N-ATCA and folic acid on retention, yield and reduction in spongy tissue in mango cv. Alphonso

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Alphonso mangoes are valued food delicacy because of its unique sugar acid blend. Fruit retention, improvement in quality and less incidence of spongy tissue are considered to be major requirements of mango growers. Hence, investigation on effect of spray of combination of N-ATCA (10%) and folic acid (0.20%) on increase in retention and yield of mango was conducted in RBD with six treatments and four replications for four years. The uniform trees of 30 years were selected for spraying at 50 per cent flowering, pea stage, egg stage and 75 days after fruit set. Spraying of NAA (20 ppm) at pea stage and 15 days after 1st spray was carried out as check. Harvesting was done by using criteria of specific gravity and 50 per cent of the fully ripened fruits were cut to check the incidence of spongy tissue. Spraying of combination on Alphonso mango fruits exhibited significant difference in retention, yield in terms of number of fruits and in kg, fruit weight and incidence of spongy tissue while, TSS and acidity did not vary significantly. Mango fruits sprayed with combination had significantly less incidence of spongy tissue ranging from 12.42 to 3.65 per cent from single spray to four sprays over check (25.61%) and control (28.36%). The maximum retention (57.18%) from marble to harvest stage and fruit weight (277g) were found in T₆ (4 sprays), which were at par with T₅ (3 sprays) and were significantly superior over control and check. Highest net profit per hectare of Rs. 154765/- (B: C ratio 1.95) was observed in T₆ over control.

O-4

Appemidi - An endangered treasure of western ghats of Karnataka

Veena G.L., Dinesh, M.R., Shivashankar, K.S., Ravishankar, K.V. and Sankaran, M.

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The Western Ghats region of Karnataka is having rich diversity of whole fruited pickle varieties which is locally called as 'Appemidi'. It is also popular as king of all tender mangoes as for as its pickle industry is concerned as its unique taste and dominant flavour adds more value to its pickle. In this study a survey was conducted to explore the diversity of Appemidi in the hot spots of Chikmagaluru district. Morphological and molecular diversity studies showed grouping of genotypes into different clusters irrespective of its place of collection. The Indigenous traditional knowledge associated in the local populace was also documented in this study. Because of negligence and unscientific management, some of these unique types are becoming extinct, therefore there is a need to conserve these endangered treasures of pickle mango. Not only that these little fruits are having unique aroma profile as well as fruits are rich source of vitamin C, Vitamin B complex, total phenols and flavonoids *etc.* These mango pickles are also having long shelf life and can be stored for number of years without any spoilage. Its unique taste has created huge market potential therefore, a well-planned conservation and awareness among people is needed to treasure our Indian pickle mango wealth.

O-5

Prospects of wild vegetables and efforts towards commercialization

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India is floristically rich and recognized as one of the 12 mega biodiversity centers of the world. Western Ghats of India is considered as one of the seventh hotspot biodiversity in the world. There are 45,000 species of wild plant out of which 9,500 species are ethno botanically important species, of these 7,500 species are in medicinal use for indigenous health practices. In Konkan region, 58 species of wild vegetables were documented. Among various wild vegetables *kartoli*, *kurdu*, *takala*, *bharangi*, *ghol* are important ones. These wild vegetables grow naturally in Western Ghats and are collected by the native people for home consumption as well as for sale in local as well as metropolitan markets like Mumbai and Pune. Besides their taste and nutritional abundance, they play important role in curing many chronic diseases. Realizing their nutraceutical role in human health, the demand for these vegetables are increasing day by day. However, inspite of potential for commercial exploitation, these vegetable have remain neglected as their variability is restricted to specific season as well as due to lack of post-harvest handling and propagation protocols. Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli has initiated work on propagation and preservation aspects of these vegetables. The protocols for rapid multiplication of *kartoli* by cuttings seed as well as by tissue culture, *bharangi* by cuttings have been studied. Additionally methodologies for preservation of *bharangi*, *takala*, *kurdu* vegetables have been developed, so that its consumption can be encouraged during off season.

O-6

Effect of nano nutrients on yield and quality of Sikkim mandarin grafted on different rootstocks

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Sikkim mandarin represents an important commercial fruit of Sikkim. It is cultivated in an area of about 12,380 ha with annual production 16,798 tonnes and productivity is 1,356 kg/ha which is very less as compared with other states. Sikkim mandarin is considered as highly nutrient responsive crop and to improve the production and productivity under organic management requires large quantities of FYM and organic fertilizers, which shall be very difficult to meet the complete nutrient requirements. Nano nutrients are cheap and required in very less quantity as 100-200 ml/acre in the form of foliar spray. The present study was conducted to evaluate the nano nutrients as alternative nutrient sources. The nano nutrient formulation were sprayed on Sikkim mandarin in various concentrations at different growth stages of 05 years old Sikkim mandarin plants grafted on four different rootstocks. Nano nutrient formulation @ 2 ml per litre sprayed at 45, 90 and 135 days after fruit set reduced fruit drop as compared to control. Highest per cent fruit retention was recorded in Sikkim mandarin grafted on Rangpur Lime (SM+RgLi) (72.02%), while it was 48.47 per cent in control (Sikkim Mandarin nucellar seedlings). The SM+RgLi recorded maximum TSS (11.8 °Brix), total sugar and sugar : acid ratio and lower acidity (1.44%). The ICP-MS analysis exhibited higher nitrogen content in SM+CM. Phosphorus was maximum in SM+RgLi. However, potash and magnesium content was found maximum in SM+RLe. Calcium content was maximum in SM+CM. Among micro nutrients, Iron, Copper, Nickle and Chloride content was maximum in SM+CM.

O-7

Management of sunshine resources in mango (*Mangifera indica* L.) orchards for enhancing productivity

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Old, senile and unproductive orchards are a major bottle neck in improving production and productivity of mango orchards. Hence, management of such orchards through technological interventions is essential and a sustainable way of improving mango production. Productivity in mango orchards basically depends on the utilization of light by the leaves and the translocation of photosynthates to the developing sinks/fruits. With this view mango orchards of cv. Dashehari at ICAR-CISH, Lucknow were rejuvenated in January 2016 and regular observations were recorded. During April-September, total light availability beneath the canopy was found to vary from 44.67-53.33 per cent. Net photosynthesis rate and stomatal conductance ranged from 4.33-12.77 $\mu\text{mol CO}_2\text{m}^{-2}\text{s}^{-1}$ and 57-117 $\text{mol H}_2\text{O m}^{-2}\text{s}^{-1}$ respectively. During October-March, total light availability beneath the tree varied from 41.33-48.67 per cent, net photosynthesis rate and stomatal conductance was from 7.44-16.67 $\mu\text{mol CO}_2\text{m}^{-2}\text{s}^{-1}$ and from 87-162 $\text{mol H}_2\text{O m}^{-2}\text{s}^{-1}$ in mature leaves of rejuvenated trees. Fruits were of better quality in trees where sequential rejuvenation of selected branches was done during three consecutive years followed by one time rejuvenated trees as compared to control. Branch angle of newly developed secondary branches (laterals) was found to be in the range of 45-60°. Study exemplifies that in rejuvenated trees optimal ratio of diffused and direct light inside canopy, higher net assimilation rate and stomatal conductance as well as favorable biochemical condition of leaves attribute better yield and quality fruits and may help to reduce the area under unproductive mango orchards.

O-8

Environmental regulation and chemical induction of litchi (*Litchi chinensis* Sonn.) flowering

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The timing and probability of flower initiation is a highly plastic developmental process. Environmental stresses, which change in a predictable fashion along the year, such as soil moisture, light, humidity and temperature are the most relevant in terms of triggering factors for litchi flowering. The flushes maturing earliest (before the winter period) produce flO shoots, while trees flushes maturing quite late produce vegetative shoots. Girdling (removal of bark of 2-3 mm width in 75 % branches), manual de-flushing during December month; application of paclobutrazol @ 2.0 g a.i. per m canopy diameter was able to induce flowering during "off" season because of effective measures to suppress summer flush, root growth and significantly improves fruit set. Alternate bearer trees shows lower net photosynthetic rate (P_n), transpiration rate (E), internal CO_2 concentration (C_i), stomatal conductance (g_s), leaf temperature (T_L) and lesser content of *Chl a*, *Chl b* and *total Chl*, total carbohydrate (total CHO), reducing sugar (RS) content than regular bearer litchi trees. The levels of endogenous gibberellic acid, indole acetic acid, trans-zeatin and trans-zeatin riboside and zeatin riboside (ZR) in bearing and non-bearing shoots were detected by high-performance liquid chromatography during vegetation period. A little higher dose of paclobutrazol reduced gibberellin acid almost by 20 per cent with increased abscisic acid. IAA reduces with increase in paclobutrazol dose. If salicylic acid found very effective for quality attributing characters

(ascorbic acid), KNO_3 does for highest yield. Pro-Ca increased WUE, paclobutrazol for higher fruit anthocyanin. Mainly non structural carbohydrate (soluble sugars and starch) are important indicators of carbon source and sink capacity of a plant and enable adaptation to environmental changes.

O-9

Eco-friendly pest management of major vegetable crops

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Insect pests are the major biotic constrains in vegetable production in India. Among these, tomato fruit borer (*Helicoverpa armigera*), brinjal shoot and fruit borer (*Leucinodes orbonalis*), chilli thrips (*Scirtothrips dorsalis*) and mite (*Polyphagotarsonemus latus*), fruit and shoot borer (*Earias* spp.) on okra, diamondback moth (*Plutella xylostella*) on cole crops, fruit fly (*Bactrocera cucurbitae*) on cucurbits are important ones. Average yield loss due to major insect pests in different parts of the country is reported to vary from 33 to 40 per cent. Intensive and indiscriminate use of pesticides causes resistance, resurgence and the problem of pesticide residue. Focus is to be given on development and use of resistant varieties, biopesticides and insect pheromones. The researches on biological control with promising microbial agents like *Bacillus thuringiensis* (Bt), Nuclear Polyhedrosis Virus (NPV), *Entomopathogenic* fungi like, *Beauveria bassiana*, *Metarhizium anisopliae* and *Nomurea rileyi* is to be re-oriented specifically for development of indigenous, economical and effective formulations. Pest monitoring and mass trapping using insect pheromones is an important and integral component to rationalize the insecticide based management system keeping harmony with natural enemies. In vegetables behavior control strategy has been successful in managing, *L. orbonalis*, *S. litura*, *Earias* spp. and *B. cucurbitae*. Special attention and emphasis has been given for development of various plant derived insecticides which are ecofriendly, safe to natural enemies with least residue problem. New tools of biotechnology such as transgenic and nanotechnology are also now available that can be used to accelerate the progress of crop protection.

O-10

Effect of vertical mulching on soil moisture content in plum (*Prunus salicina* Lindl.) cv. Red Beauty under rainfed condition

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The field investigation was carried out to study the effect of vertical mulching by using different organic manures as substrate on soil moisture content of plum (*Prunus salicina* Lindl.) grown under rainfed conditions in Himachal Pradesh. Around the tree basin, four holes were dug with the help of power auger, which were filled with FYM, vermicompost, mushroom compost and ghan jeevamrit and later covered with grass mulch (10 cm). Eleven treatment combinations viz., T₁: FYM, T₂: FYM with grass mulching, T₃: vermicompost, T₄: vermicompost with grass mulching, T₅: mushroom compost, T₆: mushroom compost with grass mulching, T₇: ghan jeevamrit, T₈: ghan jeevamrit with grass mulching, T₉: jeevamrit, T₁₀: jeevamrit with grass mulching and T₁₁: grass mulching. Soil moisture was measured using diviner 2000 where treatment T₄ was found to be efficient in preserving soil moisture more at the upper layer (10 and 30 cm) of the soil whereas, T₆ and T₈ both were recorded higher soil moisture at the lower depths (45 and 60 cm). Maximum soil water holding capacity (48.98 %), soil organic carbon (2.27

%) soil porosity (51.56 %) and leaf area index (2.79) were recorded to be highest in treatment T₄. Annual shoot growth and leaf area were found to be highest in T₈, which was statistically at par with T₄. The use of vermicompost and ghan jeevamrit with grass mulching lead to improvement in soil condition and soil moisture level during the period of stress enhancing the overall growth of the plant.

O-11

Phenological manipulation through planting time for higher productivity and quality of banana under subtropics

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Banana is one of the major and commercial fruit crops grown in tropical and subtropical region. The total area under banana cultivation in 0.846 million ha with annual production of 29.12 million tonnes (Indian Horticulture Database, 2015-16). In Uttar Pradesh, area under banana (cultivar Grand Naine) is increasing day by day due to profitability. The optimum temperature for proper growth and development for banana crop is 10-35°C and if temperature goes below 10°C it damages the crop drastically in winter season. The proper understanding of phenological cycle of banana plant in a particular region is needed, so that the farmers can intensify the level of management, plan the planting date and harvest in accordance with the market demand. Unlike other fruits, the vegetative growth, flowering and fruit growth is not seasonal in banana and are largely influenced by time of planting, size and type of planting material and prevailing climatic conditions. Experiments have been initiated to standardize the planting time of banana under subtropical conditions. The banana cv. Grand Naine (AAA) consisting of one month old tissue culture plants were planted at 1.8 x1.5m spacing at monthly intervals w.e.f. 15th June, 2017 to 15th May, 2018. A buffer strip of two meter was maintained between the planting rows. The results of the experiment clearly indicate that the banana planted during 15th of June and 15th of July performed better in respect yield (72.15 and 74.74 t/ha) and quality (TSS 21.4 and 20.8°Brix) of banana under subtropical conditions.

O-12

Captive production of papaya in subtropical region of India for higher productivity

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Papaya (*Carica papaya* L.) is one of the most important fruit cultivated throughout the tropical and subtropical regions of the India. It has tremendous yielding potential due to precocious bearing and indeterminate growth habit with simultaneous vegetative growth, flowering and fruiting. Polyhouse cultivation simultaneously provides both adequate temperatures and exclusion of papaya leaf curl virus (PaLCV) and papaya ring spot virus (PRSV). Growth and flowering benefit from the climate within green-houses, resulting in improved yields, both in fruit quantity and quality, with the critical additional benefit of the exclusion of frost damage, PaLCV and PRSV. The net house based production system altered with the need based use of polythene sheet offer immense scope to enhance the papaya fruit production, it also enhances the fruiting zone from 0.60 m to 1.5 m which facilitates the proper space for fruit set, growth and development. The enhanced fruiting zones also offer to retain the 40-65 fruits/plant with uniform size and quality. The intervention of protected production system will be able to

produce the fruit yield 45-60kg/plant which may lead a higher productivity in a range of 180-240 tonnes/ha. The intervention of net house will be able to reduce the movement of vectors of the viral disease and pests like fruit flies. Papaya crop plants often damaged severely due to frost in the subtropics particularly northern and western part of India which will take care under protected cultivation. The protected environment will reduce abnormalities in bisexual flowers of the gynodioecious varieties which leads the misshapen poor quality fruits. The experiences of the growing papaya under protected structures are being discussed in the present talk.

O-13

Role of rootstocks in commercial citrus cultivation

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Rootstocks have contributed largely to success and failures of citrus industry. Roots serve multiple functions. They absorb and transport water and nutrients to the above ground parts of the tree and serve as synthesis or conversion sites for growth regulators. They also anchor the tree in the ground and finally, the roots also store food reserves. They play a vital role in regulating resistance against pests & diseases. *Phytophthora* in citrus is one of the most damaging manifestations. The simplest mean of reducing losses from this disease is the use of tolerant rootstocks. Tree size controlling rootstocks are important for high density orchards while their pronounced effect on fruit yield and quality put their importance on summit. Citrus varieties are grafted onto several rootstocks. Rough lemon & Rangpur lime are the most widely used rootstocks in India. Rough lemon is a highly vigorous rootstock and shows good yield performance in early years. It produces large trees with well-developed root system. Rangpur limestone is predominant because of its good tolerance to saline soil conditions. Sour orange is a universal rootstock for citrus and widely used in the Mediterranean region. Volkamer lemon is used as rootstock for citrus, due to its tolerance and its acceptable resistance of a large scale of citrus disease. *Poncirus trifoliata* and most of its hybrids are considered to be tolerant against *Phytophthora*. Keeping different roles of rootstock in view and the degree to which a specific rootstock meets these requirements and enhances any factor that influences economic return, will determine its value for a given situation. More knowledge of a rootstock's characteristics should result in the correct rootstock choice for a particular situation.

O-14

Refinement of mango rejuvenation technology for enhanced success and sustainable yield production

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Poor yield and fruit quality production from existing old, senile and unproductive mango orchards has been a major constraint in the majority of mango growing belts of India as the maximum acreage comes under this category. Two decades ago, ICAR-CISH, Lucknow has developed rejuvenation technology by heading back at 2.5 to 3.5m height from the ground by cutting in one stroke. The resultant technology was adopted by the mango growers across the country through horticulture departments in different states assisted by government of India. After rejuvenation tremendous impact of the technology has done observed in areas where the trees were given proper care and maintenance following the recommended package of practices. The studies conducted in this regard have shown up to 60-70 per cent success at farmers' field with mortality of plants up to 30-40 per cent due to severe infestation of

stem borer which is major hurdle in the further expansion and adaptation of rejuvenation technology to the grower's field. Simultaneously, there was immediate loss of grower's income as all the major scaffold branches were severely headed back in one go. Hence, an experiment was initiated in the year 2015-16 with a view to refine the existing mango rejuvenation technology in response to the feedback received from the farmers. This paper focused in detail the concept of rejuvenation technology in mango and its manifold advantages in revolutionising the mango industry in India.

O-15

Canopy management and intercropping in mango orchards-a key for doubling farmers' income

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Mango is cultivated over an area of 2.262 million hectares in our country which produces 19.68 million MT of mangoes, recording an average productivity of 8.7 MT/ha. In view of burgeoning pressure of human population, increasing cost of inputs, declining land resource, emphasis is being laid on innovative technologies for enhanced total productivity, profitability on sustained basis. Pruning in mango was rarely recommended about twenty five years back. The success of rejuvenation technology in mango from different parts of country, though with few hurdle has lead to a major change in the concept of pruning in evergreen trees. Mango tree canopies are being managed today most efficiently by centre opening, central branch thinning or rejuvenation by successive heading back of selected branches over a period of three to five years. Such mango orchards offer immense scope for integration of various shade loving, high value intercrops for enhanced profitability. Approximately 35-40 per cent mango orchards in our country are thickly shaded, old, senile and overcrowded and farmers are not able to get quality production. Under such circumstances, there is a unique scope for their canopy management coupled with integration of some of the suitable intercrops to enhance the productivity and profitability. Keeping this in view, efforts were made to manage the canopy and evaluate different intercrops for their performance in the interspaces of mango orchard cv. Dashehari at ICAR-CISH, Lucknow. This paper deals with some of these issues.

O-16

Advances in cultivation of low chill temperate fruits in subtropics of India

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Among the temperate fruits, pear, peach and plum are grown successfully in Punjab, Haryana and Uttar Pradesh. Introduction of low chill varieties of peach and plum from USA further boosted their cultivation in India. However, in pear, the evaluation and selection of indigenous germplasm consequently helped in the release of varieties for the general cultivation in the region. Availability of good quality planting material is the base for expansion of area under a particular crop. Introduction of new rootstocks and development of new propagation techniques likely promoted the nursery production. High density planting in pear, peach and plum increased production and productivity. In hard pear 'Patharnakh' (*Pyrus pyrifolia* L.) high density planting is possible with canopy management. Peach can be planted under high density with Y-system of training. However, HDP in plum can be possible with modified leader system of training alongwith summer pinching to increase productivity. Integrated Nutrient Management for low chill temperate fruits has been developed for sustainable fruit production. Various

approaches like thinning, girdling and use of KNO_3 also helpful to improve the fruit size, quality and yield. Pear, peach and plum fruits mature early in the sub-tropical climate than temperate, but due to high temperature and low humidity during their ripening time leads to heavy postharvest losses. To reduce these losses, postharvest technologies were developed in pear, peach and plum. Postharvest treatment of CaCl_2 and $\text{Ca}(\text{NO}_3)_2$ are effective to enhance the postharvest life of peach 'Shan-i-Punjab' and plum 'Satluj Purple' respectively. Storage life of pear 'Punjab Soft' can be increased with postharvest dip treatment of calcium chloride.

O-17

Insect pest management options in litchi through bioenhancers

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Litchi (*Litchi chinensis* Sonn.) is considered an important commercial fruit crop in India, due to high nutritive value and refreshing taste. Like most fruit tree crops, it is usually attacked by two or three key pests, several secondary pests and a large number of occasional pests in localized areas, where it is grown. Among biotic stress, insect pests are the major constraints in healthy litchi production. Like other crops, insecticides particularly organophosphates and carbamates are most powerful and widely accepted tool for the control of pests in litchi, however, excessive reliance on insecticides has posed several adverse effects such as buildup of pest resistance to insecticide, outbreak of secondary pests, harmful to non target organisms, health hazards and problems related to environmental pollution. Hence, judicious use of insecticides and use of insecticides with selective action are recommended in insect-pest management practices. To overcome the ill effects of chemical control measures, different bioenhancers/organic products *viz.*, *Panchgavya* 3 per cent, *Amrit Pani* 5 per cent and biodynamic pesticides 5 per cent have been evaluated on litchi and found effective for healthy and quality litchi production.

O-18

Synthesis and development of pest management modules against major insect pests of pumpkin

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The crop losses to the tune of 10-30 per cent due to insect pest have been reported in vegetable crops. Pumpkin (*Cucurbita moschata* Duch. ex Poir.), an important round the year cucurbitaceous vegetable in India, is attacked by several regular insect pests. Fruit damage up to 68 per cent was observed on pumpkin due to fruit fly alone. Keeping this in view, synthesis and development of multifaceted adaptable and economically viable IPM technology in pumpkin was formulated to reduce the over dependence and reliance on chemical pesticides and protecting the ecosystem as a whole. Field experiments were conducted in pumpkin during summer seasons 2018 and 2019 at Varanasi, Uttar Pradesh for the major insect pests of pumpkin. Among the three pest management modules tested *viz.*, biointensive module (M1), integrated module (M2) and chemical module (M3) synthesized and formulated against major insect pests of pumpkin, the integrated module (M2) comprising sprayings of DDVP 76% EC @ 0.75 ml/lat 20 and 30 days after sowing (DAS), *Bacillus thuringiensis* var. *kurstaki* @ 2 g/lat 40 DAS, Imidacloprid 17.8 SL @ 1 ml/3 l at 50 DAS, *Lecanicillium lecanii* @ 5 g/lat 60 DAS and Azadirachtin 300 ppm @ 5 ml/lat 70 DAS was most effective in reducing the red pumpkin beetle (75 and 67.27 per cent during 2018 and 2019, respectively), white fly (44.12 and 66.55) and mirid bug population on leaves (74.24 and 84.62) with

significant increase in the yield (291 q/ha) over chemical (287 q/ha), biointensive modules (269 q/ha) and untreated control (208 q/ha). Considering economics of the treatments, integrated module (M2) recorded highest cost benefit ratio of 1:7.06 followed by biointensive module (1:3.41) and chemical module (1:2.77).

O-19

Validation of production technologies to save and promote sapota crop

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Sapota, commonly known as sapodilla is longlived, evergreen tree suitable for coastal areas. Fruit is very sweet rich in carbohydrates, fibre and minerals like calcium, phosphorus, iron, etc. For last 5-7 years, problems like poor price realized by farmers due to short shelf life and market problem, poor size and quality of fruits, high post harvest losses and poor price in summer crops than winter season crop and competition of summer crop with mango. There is a need to improve winter season crop, which has much more market potential in Gujarat. In order to solve the problem, a research trial was done at my farm, i.e. Umarsadi village, Killa Pardi, District-Valsad for 6 years during 2007 to 2014 and continued till 2019 on Kalipatti variety with different split doses of fertilizers to obtain better flowering in Feb-March. Fertilizer dose of 1000 : 5000 : 500 NPK was applied in three split doses, i.e. 1st (50%) in January, 2nd (25%) in June-July and 3rd (25%) in October. Results indicated significant improvement in yield of winter season crop of sapota. As a result, net returns of Rs 1,57,650; 1,82,483; 1,57,540; 1,71,197 and 2,32,111 were recorded during 2014-15, 2015-16, 2016-17, 2017-18 and 2018-19, respectively and a fruit yield of 18,340 kg to 21348 kg/ha was obtained. As far as the yield during different months are concerned, the highest yield was obtained during December month. Highest prices were obtained during October to January. Application of 1st split dose in February resulted in good flowering, early fruit setting which also avoided incidence of bud borer, a major pest.

O-20

Variation in bearing behaviour and fruit quality of jamun (*Syzygium cumini* Skeels) in different accessions

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Jamun (*Syzygium Cuminni* Skeels) is an important underutilized minor fruit crop of tropics because of its high medicinal uses and nutritional value. It is good source of iron, antioxidants, anthocynin, vitamins and tannin. Jamun has a very short availability and possess very short shelf life. Information about the standard recognized varieties is limited. Keeping this in view, genetic diversity and antioxidant potential of Jamun have been studied. 24 identified accessions were evaluated for their growth, yield and quality characters. There were significant variations recorded for growth behaviour of different identified accessions/varieties. The tree height ranged from 6.92 to 13.00 m. and girths in the range of 78.10 to 140.00 cm. The data on fruit quality attributes revealed that fruit weight varied from 5.46 to 20.93 g and highest was recorded in CISH-Jamwant (J-37) 20.93 g followed by CISH J-15 (16.22 g), while it was the lowest in CISH J-45 (5.46 g). The maximum pulp weight and size was noticed in CISH-Jamwant (J-37) 18.14 g and 10.92 cm², respectively. Maximum pulp percentage was noticed in CISH J-42 (97.07%). The TSS was recorded maximum in Gokak-1 (16.10° Brix) followed by Gokak-III (15.90° Brix) whereas, the minimum TSS was observed in CISH J-5 (10.40° Brix). The maximum fruit yield 75.50 kg/plant was

recorded in CISH-Jamwant (J -37) followed by 46.00 kg/plant in CISH J-15, while the minimum fruit yield was recorded in CISH J-42 (12.83 kg/plant) on 11th years of age. Thus, due to its health promoting properties, there is a great possibility of Jamun cultivation for higher production and nutritional security.

O-21

Augmentation of *ber* (*Zizyphus mauritiana* L.) seedlings vigour by application of microbial inoculants and growth hormone

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The present investigation was conducted at Punjab Agricultural University, Regional Research Station Bathinda, Punjab, India to assess the growth vigour of *ber* seedlings in response to growth hormone and microbial inoculants. The stones of *ber* (seeds) were sown in April on well-prepared nursery beds at a distance of 15 cm in rows and spaced 30 cm apart. Further, after germination, seedlings of *ber* were treated with microbial inoculants and growth hormone. The experiment was laid out in randomized complete block design with five treatments (T₁: Control, T₂: GA₃, T₃: *Sphingobacterium* sp., T₄: *Azotobacter* sp. and T₅: *Sphingobacterium* sp. and *Azotobacter* sp.). The results of the present study revealed that vegetative growth parameters and biomass accumulation were revamped by the application of growth hormone and microbial inoculants. Nevertheless, the highest growth vigour was noticed in T₅ followed by T₃, T₄, T₂ and T₁. The percentage increase in number of shoots, number of leaves, shoot length, root length, collar diameter, biomass above ground, shoot weight and root weight with treatment T₅ was 27.45, 20.55, 13.63, 12.22, 15.17, 14.85 and 23.16 respectively. Thus, microbial inoculants could play a predominant role in escalating vegetative growth of *ber* seedlings under nursery conditions, which would further improve the success rate of budding on these healthy plants.

O-22

Effect of trellis training systems on quality and production of pear grown under subtropics

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Pear is primarily temperate zone fruit plant, however, low chill varieties are successfully grown under subtropical zones of north-western India. Pear plants have long juvenility period and considerable area is left underutilized during initial year of planting, which lowers the productivity. In present studies, the performance pear cv. Patharnakh (*Pyrus pyrifolia*) trained on Espalier system, Cordon system and Y-trellis system was studied. The plants were evaluated for fruit quality and yield characteristics. Results exhibited that fruit production per plant was maximum in Espalier system, while Cordon system of training recorded lowest fruit yield. In Espalier and Cordon training system the proportion of fruiting was maximum in middle canopy, while in Y-system highest fruit proportion was noted in the upper canopy. Maximum fruit size and weight was observed in Cordon system and minimum in Y-system. The fruits produced on Cordon system had minimum fruit firmness than the other two systems. Total soluble solids content and was greater in fruits borne on the Espalier system of training. These training systems showed good potential in production of quality fruits, however, the long term effect of these training systems need to be studied further.

O-23

An assessment of Lalit and Shweta varieties in the states of Andhra Pradesh and Maharashtra

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In India guava occupies an area of 2.03 lac hectares with annual production of 22.7 lacs MT. Cultivation of guava fetches good price to the farmers for adding their income as well as enhancing their socio-economic status. Now guava varieties like Sardar, Allahabad safeda, Allahabadi Surkha, Lalit and Shweta are adopted in major guava areas. A study was made to assess these two varieties in the states of Andhra Pradesh and Maharashtra, where these cultivars are being commercially grown. It was found that Lalit and Shweta, both are cultivated in high density planting (90 per cent) alongwith VNR, Allahabad Safeda and L-49 varieties. Two varieties started economical yield from the 3rd year of planting onwards. The reported yield of Lalit variety was 10-15 t/acre (2012). The guava fruits were sold from the field through auction. This farmer also sold the guava fruits to the processing unit at once @ Rs 40/kg acres orchard of Lalit guava. All the plants were survived and were in fruiting @ 20 kg/plant. Shweta was planted at a distance of 2 mx1m in ultra high density system. Ninety per cent plants survived after planting. The plants started fruiting in the year 2011 the reported yield was 4-5 kg/plant. During the 2014, an average yield of all the three varieties was reported 10 kg/plant. The guava variety Allahabad Safeda was preferred most due to its better demand in the market. However, Lalit fruits quality was good and was most preferred for processing.

O-24

Soil health related technologies for human health through horticultural production

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Ecosystem has a direct or indirect influence on human health. Indiscriminate and imbalanced use of fertilizer, pesticides, weedicides and tillage operations create unfavourable environmental conditions that leads to adverse effect on soil health. Widespread deficiency of secondary and micronutrients in soils have made the sustainability, livelihood and nutritional security of millions of Indians more vulnerable, deficiency of minerals in human diet is making them sick. Among the soil health indicators, soil physical properties are one of the important indicators for assessing the impact of resource utilization and input use efficiency. Horticulture technologies can play a significant role in improving human health, than therapeutic supplementation. Horticultural crops provide inorganic and organic nutrients. This requires urgent redressal of the major points of concern like development of the nutrient rich cultivars of horticultural crops, suppression of anti-nutrient factors, partitioning of more nutrients to edible parts and timely supply of customized fertilizers to the farmers. The paper advocates for proper harmonization of the soil health to address issues of human health and highlight urgent need to form strategies and planning for effective implementation of soil health and nutrient management, which will ultimately act as effective tool for sustaining agro-horticultural productivity *vis-à-vis* human health along with monetary benefits and safe environment.

O-25

Effect of integrated nutrient management on productivity and quality of banana fruits (*Musa paradisiaca* L.) cv. G-9

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Early vegetative phase of growth of banana especially up to 3rd/ 6th month after transplanting and bunch development stage are the critical stages of banana at which yield is affected. Organic manure alone may not be enough to meet the nutritional requirement of the crop. Integrated Nutrient Management (INM) is found beneficial for maintenance of soil fertility and plant nutrient supply to an optimum level for sustaining crop productivity. With this objective, the field experiment was conducted at ICAR-Central Institute for Women in Agriculture, Bhubaneswar, during 2014-15 to 2015-16 with eight treatments in RBD with three replications. Treatments comprises of T₁- fresh cow dung @ 500 g/ plant; T₂ - fresh cow dung @ 250 g/ plant + pond soil @ 250 g; T₃-fresh cow dung @ 500 g/plant + 5 g urea; T₄ - 500 g fresh cow dung + 5 g ammonium sulphate, T₅- 500 g fresh cow dung + 10 g sulphate of potash, T₆-fresh cow dung @ 500g/plant + 5 g ammonium sulphate and 10 g sulphate of potash, T₇- recommended doses of NPK in soil application and T₈- 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 + 5 g urea. Maximum fruit yield (26.60 kg/bunch) and quality in terms of TSS (22.74 %) were recorded with 500 g/plant of fresh cow dung + 5 g ammonium sulphate + 10 g sulphate of potash. The cost of treatment worked out to be Rs. 8 per plant as compared to Rs. 15 per plant in soil application of recommended dose of NPK indicating cost effectiveness.

O-26

Potato varieties performance in non traditional area of north-western Rajasthan of India

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Potato plays a vital role in food security for ever increasing world population. India is producing about 45-48 million tonnes of potato annually from about 2 million hectare of area. However, India would require 125 million metric tonnes of potato from 3.6 million hectare area in 2050. Demand for processing quality potatoes will increase from current level of 2.8 million t to 25 million t in the year 2050. It implies that the demand is expected to increase by 6 per cent ACGR up to 2050, where frozen potato products will have the highest ACGR (11.6%) followed by potato flakes/powder (7.6%) and potato chips (4.5%). On similar lines, the food demand for fresh potatoes will increase from the current 30 million t to 78 million t during 2050 at an ACGR of 2.34 per cent. The demand for seed potato will grow nearly 2.1 time by the year 2050, therefore, highly concerted efforts needs to be directed towards increasing area, production and productivity of potato.

In order to increase the area, there is need to venture in those regions which have very little area under potato but the climate and soil is suitable for it. As per the information available with us there is very negligible area under potato in western part of Rajasthan including Bikaner and potato cultivation restricted to few districts like Kota, Dholpur, Bharatpur, Ganganagar and Kota. ICAR-Central Potato

Research Institute, Shimla has developed a number of varieties for different agro-climatic conditions, these varieties vary in their response to production. It is possible to harvest these cultivars in the Western Rajasthan. So, yield of potato tuber of different varieties will determine not only yield but also the extent of their adoptability. In order to assess the performance of potato varieties in that area, an experiment was conducted at ICAR-Central Institute for Arid Horticulture, Bikaner in the collaboration with ICAR-Central Potato Research Institute, Shimla to find out suitable potato cultivars for processing as well as for table purpose under North Western Rajasthan during 2015-17 on seven potato cultivars *viz.* Kufri Khyati, Kufri Garima, Kufri Chipsona-4, Kufri Pukhraj, Kufri Frysona, Kufri Surya and Kufri Jyoti grown. Farmers were selected and eight potato cultivars seed were distributed to them.

Tuber yield varied significantly from variety to variety at different locations of Bikaner district. Maximum mean tuber yield, which was significantly higher over other varieties, was obtained from Kufri Frysona (364.64 q/ha) followed by Kufri Chipsona (337.45 q/ha) and Kufri Garima (304 q/ha/ha) while minimum yield was observed in Kufri Pukhraj (204.78 q/ha) and Kufri Jyoti (220.89 t/ha). While, K Khyati and K Surya gave 257.13 and 276.93 q/ha potato yield. Processing varieties Kufri Chipsona-4 and Kufri Frysona was suitable and proved to possess high dry matter content and was the most efficient variety in the arid region while for table purpose Kufri Garima and Jyoti produced higher yield and these varieties can be useful for processing and table purpose cultivars for cultivation in north western Rajasthan. These variety were more suitable than the other most common varieties of the region and convert, it into yield most economically. Potato has great potential in the state. If good quality seed, proper marketing system, sufficient cold storage and irrigation facilities are made available, definitely the prospect of the potato will be bright. The western Rajasthan is the most suitable area for the establishment of processing units. This will increase the demand and will further motivate the farmers to grow more potatoes in the state.

POSTER SESSION

P-1

Nutrients accumulation pattern in fruit growth of mango at varying stages (*Mangifera indica* L.)

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The experiment was conducted at Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari during December, 2016 to June, 2017. Estimation of macronutrients (N, P, K, Ca, Mg and S) and micronutrients (Zn, Fe, Mn and Cu) was done in mango cultivars Kesar, Alphonso, Sonpari and Totapuri at three different stages i.e, marble, egg and harvest stage for. The objective of the study was to assess the optimum concentration of at different stages. The findings of the study revealed, maximum accumulation of N (1.72%) and Mg (1.08%) at marble stage while Cu (49.89 ppm) at harvest stage in cv. Sonpari. The maximum Fe (120.53 ppm) and Mn (17.87 ppm) content were in recorded in Totapuri variety at egg and marble stage. Zn (45.05 ppm) was higher in the same cultivar but at marble stage. However, higher P (0.31%) and S (0.55%) accumulation was found in Alphonso cultivar while K (1.57%) and Ca (0.70%) in cv. Kesar at egg stage.

P-2

Influence of nutrients and plant growth regulators on growth, flowering and yield characteristics of strawberry cv. Chandler

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Field experiment was conducted at the experimental station of Department of Horticulture, Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India. Nine uniform runners of strawberry cv. Chandler were collected from Dr. Y. S. Parmar University of Horticulture & Forestry, Solan and planted at 1 m x 1 m raised bed at a distance of 30 x 30 cm and out of which nine plants per treatment were randomly selected for recording the data on the effect of plant nutrient and growth regulators. Planting was done in the first week of October 2010-11 and 2011-12. The foliar spray of 50 ppm GA₃ and ppm PP₃₃₃ was given ten days before the flowering (third week of January 2010-11 and 2011-12 respectively). Results revealed that application of 100 kg of N, 40 kg of K and 50 ppm of GA₃ enhanced plant height (25.62 and 26.97 cm), number of leaves (23.69 and 24.39), leaf area (142.29 and 143.68 cm²), number of runners (16.77 and 16.97) and number of plantlets per runner (5.56 and 6.14), whereas application of 60 kg of N, 40 kg of K and 300 ppm of PP₃₃₃ was found to be most effective in increasing the number of flowers per plant (16.56 and 19.41), berry set (83.91 and 84.30%) and berry yield (10.63 and 14.50 t ha⁻¹) besides ameliorating quality parameters.

P-3

Effect of gibberellic acid and zinc sulphate on growth, spike and bulb production of tuberose (*Polianthes tuberosa* L.) cv. Single

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The present investigation was carried experiment station, Department of Floriculture & Landscape, N. D. University of Agriculture & Technology, Kumarganj, Ayodhya (U.P.) during the year 2016-2017. The experiment was conducted in factorial RBD with 16 treatment combinations, comprising of 4 levels of GA₃ (0, 100, 200 and 300 ppm) and 4 levels of ZnSO₄ (0, 0.25%, 0.5% and 0.75%). Results revealed that dipping of bulb in GA₃ 200 ppm for 24 hrs before planting of bulb found most effective with the respect of highest sprouting percentage (97.67), number sprout per bulb (4.58), leaves per clumps (48.60), days taken for opening of first floret (108.47 days), length of spike (83.03 cm), number of spike per clump (2.75), no. of floret per spike (40.45), average weight of floret per spike (42.95 g) duration of flowering (15.28 days), number of spike per ha (3.05 lakh), weight of bulb per clump (132.87 g) and yield of bulb per ha (147.61 q/ha). But application of GA₃ 300 ppm helped early sprouting (14.33 days), height of plant (61.36 cm), early spike initiation (93.53 days) and vase life (10 days). Spraying of 0.50% ZnSO₄ at 30 and 60 DAP improved height of plant (58.10 cm), leaves per clumps (46.20) early spike initiation (93.60 days), average weight of floret per spike (41.58 g), duration of flowering (15.63 days), vase life (9.75 days), no. of bulb per clumps (7.20) and yield of bulb per ha (153.01 q) in tuberose cv. Single.

P-4

Effect of different storage media on corms of gladiolus (*Gladiolus hybridus* L.) var. *Psittacinus* Hybrid

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The present investigation was conducted at Floriculture Research Farm, Navsari Agricultural University, Navsari during the year 2018-19. The whole experiment was divided in two parts *viz.*, part A with Completely Randomized Design and part B was laid out in Randomized Block Design including 12 treatments *viz.*, cold storage (control), cocopeat (100%), sawdust (100%), sand (100%), rice husk (100%), cocopeat + sawdust (50 : 50), cocopeat + sand (50 : 50), cocopeat + rice husk (50 : 50), sawdust + sand (50 : 50), sawdust + rice husk (50 : 50), sand + rice husk (50 : 50) and control. Amongst all the treatments, corms stored in cocopeat exhibited maximum weight of corm (5.60 g), minimum physiological loss of weight (0.65 g), maximum corm diameter (2.70 cm) and minimum reduction in diameter (0.10 cm), whereas significantly lowest rotting (12.84 %) was observed in corms stored in cold storage but none of the treatments recorded sprouting of corms in var. *Psittacinus* Hybrid during storage period. During crop growth, corms stored in sand recorded minimum days to sprout (7.53), whereas treatment cocopeat and cocopeat + sawdust (50 : 50) recorded most primitive survival (86.63%). Maximum plant height (61.60 cm) at 90 DAP was recorded in corms placed in cocopeat, while maximum number of leaves per plant (12.93) were produced by corms stored in cocopeat + sawdust. The plants produced from corms stored in sand showed early spike initiation (68.67 days) and first floret opening (9.40 days), whereas corms stored in cocopeat + sawdust surpassed all other treatments and recorded longest spike and rachis length (65.67 cm and 38.22 cm respectively).

P-5

Standardization of combination of growing medium and primary nutrients for anthurium (*Anthurium andreaeanum*) cultivation under greenhouse

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The present experiment was carried out for two consecutive years to standardize the media along with primary nutrients for anthurium variety Tropical under fan and pad type greenhouse. The experiment was laid out in split plot design, having five main plots by using different media *viz.*, cocopeat, cocopeat + perlite + vermiculite (8:1:1), coconut fiber, coconut husk and coconut husk + charcoal (3:1) and five sub plots having different combinations of weekly once foliar application of NPK *viz.*, 30:10:10, 12:61:40, 13:40:13, 19:19:19 and 16:8:24 @ 0.2%. The experiment has twenty five different combinations of growing media and primary nutrients with three replications. According to pooled data of two years, among different combinations of growing media and weekly foliar spray of NPK, plants grown in coconut husk + charcoal media (3:1) with foliar spray of 30:10:10 NPK @ 0.2% on anthurium plants performed superior with respect to vegetative growth parameters, where maximum plant height (46.77 cm), number of leaves per plant (8.14), leaf area (180.46 cm²) and plant spread (33.08 cm) was recorded, while plants grown in coconut husk and charcoal as growing media with foliar application of 12:61:40 NPK @ 0.2 per cent weekly produced significantly maximum flower stalk length (39.12 cm), spathe length (10.87 cm), spathe width (8.53 cm) and maximum number of flowers per plant (8.04). The same treatment also resulted in advanced flowering (90.00 days).

P-6

Effect on influence of planting spacing and training system on light interception, yield attributes and quality traits of litchi cv. Shahi

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Effect on influence of planting spacing and training system on light interception, yield attributes and quality of litchi cv. Shahi was conducted at ICAR-NRC on Litchi, Muzaffarpur during 2018-19 with an objective to obtain optimum plant density to get higher fruit production per unit area without affecting fruit quality. Litchi plant of cv. Shahi were planted at eleven spacing viz., 2 x 2 m, 3 x 3 m, 4 x 4 m, 5 x 5m, 6 x 6m and 8 x 8 m (control) and were trained to three training systems viz., Y shaped with supporting system at 4 x 3 m, Y trellis without supporting system at 4 x 3 m, hedge row system with different spacing i.e, 5 x 3 m , 6 x 4 m and 8 x 4 m . The total light interception in the above and below parts of the canopy was higher in 6 x 6 m and 8 x 4 m (hedge row system). Mean light interception during the year was maximum in the above part of the canopy as compared to below part in both spacing and training systems. Litchi fruits harvested from 6 x 6 m and 8 x 4 m with hedge row system trained plants were superior in fruit quality (acidity, total soluble solids). The 6 x 6 m and 8 x 4 m (hedge row system) planted trees were found to be better in terms of light interception, fruit yield (t/h) and quality. Leaf area (cm²) of litchi was not affected significantly by different training systems and spacing during the present studies.

P-7

Effect of foliar feeding of nutrients on yield and quality of guava (*Psidium guajava* L.) cv. Lalit

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Guava (*Psidium guajava* L.) is an important fruit crop of the northern India with different fruiting seasons commonly as Bahar. Among all the bahars, economical yield and high quality fruits are harvested from the mrigbahar. However, fruits of mrigbahar encounter various physiological disorders and quality challenges due to poor nutritional conditions. Sugar, acid blend in ripened fruit, taste of the pulp and fruit cracking are notable problems being faced by guava growers of northern India. Keeping in view, an experiment was conducted at Babasaheb Bhimrao Ambedkar University Lucknow during the years 2017-18, with foliar application of calcium as calcium chloride and boron as borax to improve the yield and quality of cv. Lalit. The experiment was conducted in RBD with nine treatments comprising of two doses, each of CaCl₂ (0.1% and 0.2%) and Borax (0.1 % and 0.2 %) along with their combination and control. Two sprays (i.e. during 1st week of August and 2nd week of September) were done to observe and record effect on yield (kg fruit/tree) and physico-chemical conditions of harvested fruits following the standard procedures. The results revealed that the CaCl₂ (0.2%) along with Borax (0.1%) was most effective treatment combination for improving fruit yield (44.33 to 61.17 kg/tree) and quality i.e., TSS (7.61 to 11.60^o Brix), ascorbic acid content (155.45 to 176.34 mg/100g pulp), sugar (5.38 to 7.54%) and fruit weight (103.87 to 135.67 g). Paper deals with detailed effects of various treatments on yield and quality characters of guava fruits.

P-8

Cow Pat Pit and vermi wash: Comparative microbial dynamics and their properties

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Cow Pat Pit (CPP) and vermi wash are organic preparation for natural farming practices. CPP also known as soil shampoo is prepared by using fresh cow dung obtained from lactating and pasture going cows, whereas vermi wash is a liquid leachate obtained by excess water to saturate the vermi composting substrate. In this study both of these products (CPP & vermi wash) were prepared on farm and tested for microbial activity in terms of microbial count, isolation of PGP microorganisms, testing of PGPR properties, biochemical and molecular characterization of selected microorganisms. In CPP maximum population of actinomycetes (18.4×10^6 cfu ml⁻¹) and P-solubilizing (13.2×10^6 cfu ml⁻¹) microorganisms were observed, while in case of vermi wash, azospirillum (3.62×10^6 cfu ml⁻¹) and pseudomonas (3.36×10^6 cfu ml⁻¹) showed maximum populations. Total 17 bacteria from CPP and 14 bacteria from vermi wash were isolated. All isolated bacteria were tested for biochemical tests and PGPR properties including P-solubilization, siderophore production, Zn solubilization, IAA production, etc. Based on biochemical characterization and PGPR properties two test strain C7 (*Klebsiella varicola*) and C14 (*Pseudomonas aeruginosa*) from CPP were identified. From vermi wash also two test strains V11 (*Serratia marcescens*) and V12 (*Bacillus cereus*) were identified. The test isolates identified in this study have huge potential to reclaim soil from stress environment and can enhance trace nutrients bioavailability.

P-9

Studies on propagation of bharangi (*Clerodendrum serratum* L.) by stem cuttings

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The present investigation was conducted at Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra during the year 2017-18. Hardwood cuttings of 15-20 cm height with 2-3 buds of Bharangi *Clerodendrum serratum* L. Moon were used for experimentation during the year 2017-18. The cuttings were planted in different potting media such as soil, sand, rice husk, cocopeat, sawdust and vermicompost in varying proportion. Among all the potting media treatments, highest sprouting (70.67) and survival percentage (66.67), sprout length (30.79 cm), number of leaves (16.77), number of roots (11.87), root length (19.87 cm) were observed in treatment of potting medium containing soil + Rice husk + vermicompost (1:1:1). The medium soil + rice husk + vermicompost (1:1:1) proportion was found most suitable for growing stem cutting of *Clerodendrum serratum* L. (bharangi).

P-10

Efficacy of nitrification inhibitors in agriculture and horticulture

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Nitrification inhibitors applied with ammonium fertilizers are effective deterrents to leaching and denitrification losses of nitrogen. Production benefits may result from increased crop yield and quality, nitrogen and energy conservation, disease control, etc. obtained from usage of nitrification inhibitors. They show effects on soil characteristics as texture, organic matter content, pH moisture content, O₂-pressure and temperature. These aspects are seen in relation to yield and to the chemical composition of a number of agricultural and horticultural crops. Phytotoxicity, residual effects and residues in soils and plants are some effects of inhibitors on plant diseases. Most of the compounds are more or less effective in keeping nitrogen in the NH₄-form, thus leading to a relatively high content of NH₄-N over a shorter or longer period. In a number of situations this leads to more effective use of nitrogen, but not necessarily to higher yields, which can be explained by a decrease in leaching and or denitrification of nitrogen. Lower NO₃-contents in vegetables found in some of the experiments with nitrification inhibitors, cannot be used to declare the products as generally useful in this respect. The uptake and assimilation of nitrogen by plants in their overall diversity cannot be regulated by adding a simple compound to the soil not even in small quantities. It was revealed that addition of Dicyandiamide gave 30 and 23% more herb yield than prilled urea alone, the corresponding increase in oil yield being 27 and 22%, respectively. The results indicate pyrethrum flower dust can effectively be used as a potential nitrification inhibitor.

P-11

Biochemical status at different phenophases in shoots of *baramasi*, regular and irregular bearing cultivars of mango

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The potentiality to form flower buds in mango (*Mangifera indica* L.) mainly depends on the floriferous condition and biochemical status of the shoots. Hence, a study was carried out to understand the biochemical activities during different stages with four mango cultivars *Baramasi*, regular bearing (Amrapali) and biennial bearing (Langra and Alphonso) at BAU, Sabour. Significant variation in total carbohydrate content was found in all the cultivars irrespective of stage except *Baramasi* in which carbohydrate reserve was very high during all the stages than rest of the cultivars. This may be attributed to staggered flowering pattern during flowering process. Experimental evidence indicates that maturity of terminal shoots and accumulation of carbohydrate in the shoot apex are in some way associated with the synthesis of the flO stimulus. It was also noted that the nitrogen content was significantly highest in cultivar Alphonso, whereas the lowest value was observed in *Baramasi*. The maximum nitrogen content was estimated during the post flowering stage and the minimum value at flowering stage. Significant variations were also observed in carotenoids, total phenolics, flavonoids and total antioxidants capacity of shoots of all cultivars during all the phenophases. These variations may be associated with genotypic variation. This information could be used for breeding programs to improve mango productivity by producing fruits throughout the year.

P-12

Studies on effect of chemical and non-chemical means for induction of flowering and yield of mango cv. Alphonso

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Mango cv. Alphonso occupies about 90 per cent of area in Konkan region of Maharashtra. Early flowering is for early harvest, which assures premium rate in market. In recent years climatic aberrations such as delayed rains especially during initiation of flowering in month of September and October results in production of vegetative shoots in November instead of flowering panicle. In spite of paclobutrazol application, this new flush take another 80 – 100 days to get mature to induce flowers. Hence, flowering is considerably delayed till January. The delayed flowering further delay fruit development and harvesting. The late harvested fruits are often trapped in early rains and fetches low market price. Hence, the investigation was attempted to study the utility of removal of newly emerged shoots, foliar application of PBZ and Ortho-phosphoric acid for induction of early flowering in Randomized Block Design with three replications and seven treatments. The treatments comprised of T₁ (Removal of new shoots), T₂ (Removal of old shoot below new shoots), T₃ (Foliar application of PBZ @ 500 ppm), T₄ (Foliar application of PBZ @ 1000 ppm), T₅ (Foliar application of Ortho-phosphoric @ 0.5 %), T₆ (Foliar application of Ortho-phosphoric @ 1 % ppm) and T₇ (Control). The removal of new shoots (T₁) induced early flowering which led to early harvest by one month as compared to control. It also improved yield without affecting physico-chemical composition.

P-13

Effect of girdling and removal of new shoots for induction of early flowering and yield of mango cv. Ratna

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Ratna is a mango variety known for its regular bearing habit, high yield and its suitability for high density planting. Late flowering and late harvesting are major constraints for its commercial plantations. The agro techniques such as girdling and tip pruning have proved to be helpful to induce early flowering in mango even under climatic fluctuations. Hence, the study on effect of girdling and removal of new shoots for induction of flowering and yield of mango (*Mangifera indica* L.) cv. Ratna was conducted during 2018-19. The experiment was laid with eight treatments viz., T₁- Girdling on first fortnight of September, T₂- Girdling on first fortnight of October, T₃- Girdling on first fortnight of September and Girdling on first fortnight of October, T₄- Girdling on first fortnight of September and removal of new shoots, T₅- Girdling on first fortnight of October and removal of new shoots, T₆- Girdling on first fortnight of September and Girdling on first fortnight of October and removal of new shoots, T₇- Removal of new shoots and T₈- Control with three replications. Girdling in the first fortnight of October and removal of new shoots (T₃) resulted in 60 days early panicle emergence, which helps for early harvest by 40 days. Further, the treatment contributed for the maximum hermaphrodite flowers, fruit set and fruit retention. It also improved the yield without affecting physical and chemical parameters of fruits.

P-14

Evaluation of quality of guava cv. Pant Prabhat through management of canopy architecture under *Tarai* condition

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Guava, is an important fruit crop of tropical, sub tropical and some arid zone. Although, productivity of guava has been towards increasing trend quality of the produce is however, not upto the mark. Mismanagement of canopy architecture is attributed as the major cause. Therefore, the research work was carried out at Horticulture Research Centre, GBPUA&T Pantnagar, during the year 2017 - 2018 to study the effect of different canopy heights on production of quality fruits. The experiment was conducted on seven year old plant with four canopy heights *i.e.* 1.25 m (H_1), 1.5 m (H_2), 1.75 m (H_3) and unpruned (H_0) as control maintained from ground level for winter season crop. The plants were pruned according to the height for the experiment in 1st week of May. The observation on fruit yield (r plant⁻¹ and ha⁻¹e) was recorded before harvest and on quality parameters after harvest. Highest fruit weight (145.19 g), volume (135.52 ml), pulp weight (112.17 g), TSS (11.64°B), total sugars (10.85%), ascorbic acid (223.67 mg/100g), fruit yield per plant (4.66 kg) and fruit yield per hectare (191.88 q) were recorded at canopy height maintained at 1.25 m from ground level (H_1), whereas lowest were recorded at control (H_0). Titratable acidity content (0.21%) was recorded lowest at H_1 . It was concluded that plants maintained at 1.25 m from ground level (H_1) excelled over others in terms of producing high quality fruits with increased productivity during winter season in Uttarakhand.

P-15

Effect of potassium and zinc on growth, physiological parameters and yield on sweet orange (*Citrus sinensis* Osbeck) cv. Mosambi under high density planting

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The present investigation was carried out to study the effect of potassium and zinc on Sweet orange (*Citrus sinensis* Osbeck) cv. Mosambi during the year 2018. Eight years old Mosambi Sweet orange plants, grafted on *Karna Khatta* rootstock and planted at a distance of 3.0 × 2.5 m were used in this investigation. The experiment was designed in RBD with three replications and twelve treatments. The treatments comprised of T_1 (control), T_2 (300 g K_2O), T_3 (400 g K_2O), T_4 (500 g K_2O), T_5 (100 g $ZnSO_4$), T_6 (300 g K_2O + 100 g $ZnSO_4$), T_7 (400 g K_2O + 100 g $ZnSO_4$), T_8 (500 g K_2O + 100 g $ZnSO_4$), T_9 (200 g $ZnSO_4$), T_{10} (300 g K_2O + 200 g $ZnSO_4$), T_{11} (400 g K_2O + 200 g $ZnSO_4$) and T_{12} (500 g K_2O + 200 g $ZnSO_4$). Fertilizers were applied as basal dose. Treatments showed significant effect on physiological, vegetative and yield parameters. The maximum leaf area (23.53 cm²), total chlorophyll content (3.04 mg/g), leaf relative water content (75.82%), specific leaf weight (0.0164 g/cm²) were observed in T_{12} (K_2O @ 500 g + Zinc sulphate @ 200 g), whereas minimum in T_1 (control). The maximum increase in current season shoot length (13.22 cm), canopy spread (64.17 cm), trunk girth (1.93 cm) and plant height (36.67 cm) were also recorded in T_{12} , whereas minimum in control. The maximum number of fruits (92.67) per tree was counted in T_8 (500 g K_2O + 100 g $ZnSO_4$).

P-16

Impact of sowing date on the growth and yield of sweet pepper (*Capsicum annum* L.)

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Sweet pepper (*Capsicum annum* L.) is one of the most important vegetable crop belong to solanaceae family being grown all over country. Fruits can widely vary in color, shape and size both between and within species. Sweet pepper is a good source of vitamin A and C as well as phenolic compounds. The experiment was conducted at College of Agriculture Gwalior (M.P) during 2018-2019 to study the impact of sowing date on the growth and yield of sweet pepper in Randomized complete block design with three replications. There were seven level of sowing date *viz.*, 1st Sep, 1st Oct and 1st Nov. The result of the experiment demonstrated that majority of growth parameters and yield components were significantly increased at the earlier sowing *i.e.*, 1st Oct. The highest fruit yield (20.34 t/ha) was recorded from the earlier sowing. It is therefore concluded that earlier sowing combination is the best.

P-17

Legume pod borer, *Maruca testulalis* (Geyer) management in cowpea and their economics

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The legume pod borer, *Maruca testulalis* (Geyer) is an important legume crop grown in tropical and sub-tropical habitats both for vegetable and pulse. It is a cheap and nutritious vegetable grown mainly for its tender pods throughout India. It suffers serious damage from legume pod borer. In order to assess IPM modules of cowpea pod borer under irrigated condition, Emamectin benzoate 5 SG 0.5 gm/l and Bt @ 1 ml/l at 10 days interval during flowering and fruiting stage (RP-1), Chlorntraniliprole 18.5% SC @ 0.5 ml/l followed by Azadirachtin 0.15% @ 5ml/l at 10 days interval during flowering and fruiting stage (RP-2) were sprayed in different location of Rewa (MP) on 10 famers' field with three treatments during 2017-18 to 2019-20. The results revealed that spray of Chlorntraniliprole 18.5% SC @ 0.5 ml/l followed by Azadirachtin 0.15% @ 5 ml/l at 10 days interval during flowering and fruiting stage (RP-2) was found very effective to reduce the pod damage percentage followed by Emamectin benzoate 5 SG 0.5 gm/l and Bt @ 1 ml/l at 10 days interval during flowering and fruiting stage (RP-1) as compared to farmers practices (FP), which recorded more pod damage than recommended practice (RP). Average economics and benefit cost ratio revealed net profit of Rs. 138006.70/ha in RP-2, while in RP-1 it was Rs. 116032.41/ha and under FP Rs. 91903.71/ha as net profit was recorded. The assessed technology recommends spray of Chlorntraniliprole 18.5% SC @ 0.5 ml/l fallowed by Azadirachtin 0.15% @ 5ml/l at 10 days interval during flowering and fruiting stage (RP-2).

P-18

Response of arbuscular mycorrhizal fungus (AMF), plant growth-promoting rhizobacteria (PGPR) and their combination in uptake of radiolabelled ^{32}P in litchi air layers leaves

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It is well known that litchi plants have low rooting potential resulting in poor nutrient uptake from soil, which leads high field mortality and poor field establishment. Among the nutrients phosphorus is critical for plant growth and development. It is a key structural element in nucleic acids, phospholipids and several enzymes and coenzymes and is involved in energy metabolism, activation of metabolic intermediates, signal transduction cascades and enzyme regulation. In soil, it may be present in relatively large amounts but much of it is poorly available because of the very low solubility of phosphates of iron, aluminum and calcium. Nutrients uptake can be enhanced by microorganisms through direct and indirect processes. In view of the above mentioned problem an experiment was conducted to examine the response of bioinoculants on uptake and translocation of radiolabelled ^{32}P by the inoculated arbuscular mycorrhizal fungi, plant growth-promoting rhizobacteria and their combination in litchi air-layers in the pots. The experiment consisted of different treatments that includes arbuscular mycorrhizal fungi (*Glomus intraradices*), plant growth-promoting rhizobacteria (*Pseudomonas jessenni* strain R62 + *Pseudomonas synxantha* strain R81) and their combination of arbuscular mycorrhizal fungi and plant growth-promoting rhizobacteria [AMF (*Glomus intraradices*) + PGPR (*Pseudomonas jessenni* strain R62 + *Pseudomonas synxantha* strain R81)]. Experimental finding revealed that the litchi air-layered treated with combined inoculation of arbuscular mycorrhizal fungi and plant growth-promoting rhizobacteria showed significantly higher concentration of radiolabelled phosphorus in leaves as compared to individual treatments of arbuscular mycorrhizal fungi or plant growth-promoting rhizobacteria in the pots.

P-19

Effect of chemicals on growth, flowering and quality of *Gladiolus grandiflorus*

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Gladiolus has gained popularity in many parts of the world owing to its unsurpassed beauty and attractive flowers. However, the limitation in *gladiolus* is its availability throughout the year, which is a consequence of upsurge in dormancy. There is a need to identify various chemical combinations, so that the plant can overcome dormancy with an increase in flower quality. Keeping this in view, the present investigation was carried out at the farm of Horticulture Section, College of Agriculture, Nagpur from October, 2017 to April, 2018 to record the effect of thiourea and salicylic acid on growth, yield and quality of *gladiolus*. The treatments comprised of nine different combinations of thiourea and salicylic acid *viz.*, T₁ - Thiourea 1%, T₂ - Thiourea 2%, T₃ - Salicylic acid 100 ppm, T₄ - Salicylic acid 150 ppm, T₅ - Thiourea 1% + Salicylic acid 100 ppm, T₆ - Thiourea 2% + Salicylic acid 100 ppm, T₇ - Thiourea 1% + Salicylic acid 150 ppm, T₈ - Thiourea 2% + Salicylic acid 150 ppm, T₉ - Control. The growth parameters *viz.*, days for sprouting of corms, sprouting percentage of corms, the flowering parameters *viz.*, minimum days for first spike emergence, days for opening of first floret and days for 50 per cent flowering and the quality parameters like length of spike, diameter of spike, length of rachis, florets spike⁻¹, vase life of flower, were recorded maximum when *gladiolus* plants treated with Thiourea 1% + Salicylic acid 150 ppm.

P-20

Effect of various organic inputs on growth and its attributes of tomato (*Solanum lycopersicum*L.) cv. GS-600 under polyhouse condition

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An investigation was carried out at Research Field, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during Rabi season of 2017-18 to assess the effect of various organic inputs on growth and its attributes of tomato under polyhouse condition. The experiment was laid out in RBD with 10 treatments replicated thrice. The treatments consisted of different combinations of organic manures *i.e.*, FYM, vermicompost and poultry manure. The data were collected from five randomly selected plant of each treatment and subjected to statistical analysis. The results reflected that among 10 treatments under study, treatment T6 (Vermicompost 50% + Poultry manure 50%) was best in all characters and recorded maximum @ 30, 60, 90 and 120 DAT in term of plant height (56.68 cm, 94.99 cm, 199.44 cm and 250.31cm, respectively), number of branches per plant (6.00, 8.47, 15.47 and 25.93, respectively) and number of leaves per plant (6.93, 12.67, 23.53 and 36.07 respectively) and better vegetative growth promoted the flowering by producing more clusters per plant with the application of Vermicompost 50% + Poultry manure 50% in treatment T6 which was significantly highest in terms of number of clusters per plant (7.60), number of flowers per cluster (9.01) and number of flowers per plant (56.61), while the constantly lower performance in similar growth and flowering traits at all growth stages was recorded with treatment T0 (Control). These findings are reliable for enhancing organic tomato production under protected cultivation.

P-21

Performance of mango seedlings in various soilless media mixture

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It is cheapest and easy to procure soil and so, soil is generally used as a base medium. A nurseryman requires 200 tonnes of soil for preparing 1 lakh grafts annually for plant growth, support and in seed germination. The growing medium other than soil which plays an important role are cocopeat, leaf manure and compost. These growing medium can be used along with soil as a potting mixture as it is light in weight and have a good porous structure. So, an investigation was conducted in RBD with 6 treatments of different media mixture and four replications. In the present study, growth of seedlings ready to graft was found better in media containing mixture of soil + cocopeat followed by cocopeat + compost. So, it can become substitute for raising seedlings for softwood grafting. Mango seedlings raised in cocopeat + compost and cocopeat + leaf manure + compost gave maximum girth of stem. Media containing soil + cocopeat followed by cocopeat + compost recorded maximum number of leaves.

P-22

Soil cocopeat mixture is promising economical substitute for raising of mango stone grafts cv. Alphonso

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Good quality planting material for rapidly growing fruit industries in India is supplied by Konkan belt. To get required quantity of fertile soil, number of difficulties is faced by nursery men. Finding substitute to soil which would be economical, light in weight and tolerate transport shocks to root ball of evergreen mango plant is needed. Approximately 200 tonnes of soil is needed by nursery men for preparing 10 lakh grafts annually. So, above investigation, which was conducted in RBD with six treatments of different media mixture was conducted with four replicates. In present study maximum sprouting was recorded grafts raised in soil + compost (3:1) which was at par cocopeat + leaf manure + compost (1:1:1). Maximum survival was recorded in soil + compost (3:1) followed by graft raised in cocopeat + leaf manure + compost (1:1:1).

P-23

Effect of ethrel and potassic compounds to enhance flowering, fruiting quality, yield and shelf life of litchi (*Litchi chinensis* Sonn.) cv. Rose Scented

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Effect of ethrel and potassic compounds to enhance flowering, fruiting, quality, yield and shelf life of litchi (*Litchi chinensis* Sonn.) cv. Rose Scented was conducted at Horticultural Research Centre, Patharchatta, Department of Horticulture, GBPUA&T, Pantnagar, Udham Singh Nagar (Uttarakhand) during the year 2013-2015. The experiment was conducted to determine the effect of ethrel and potassic compounds viz., KNO_3 (1%), K_2HPO_4 (1%), KH_2PO_4 (1%), K_2HPO_4 (2%), KH_2PO_4 (2%), K_2HPO_4 (1%) + KNO_3 (1%), KH_2PO_4 (1%) + KNO_3 (1%), Ethrel (400 ppm) and water which were sprayed thrice at monthly interval from October to December. There were nine treatments, which replicated thrice in randomized block design. The results obtained indicate that foliar application of KNO_3 (1%) was effective for improving number of vegetative flushes (4.83), sex ratio (1.54 to 1.86%), number of shoots showing panicle emergence (90%), fruit breadth (3.82 cm), fruit weight (21.93g), fruit retention (28.33%), shelf life (5.8 days) and significantly reduced fruit drop (45.37%), total acidity (0.33%) of fruits in litchi. On the other hand, Ethrel (400 ppm) was effective for early panicle initiation i.e., on 3rd February, fruit set (2nd April), increasing fruit length (3.93cm), early fruit harvest (10th June and 5th June during the years 2014 and 2015), fruit yield (105.42 kg/tree), TSS (20.70^oB) and total sugars (13.19%).

P-24

Studies on the effect of time and levels of pruning in guava (*Psidium guajava* L.) cvs. Taiwan White and Taiwan Pink grown under high density planting system for growth and yield attributes

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An experiment on the effect of time and levels of pruning in guava (*Psidium guajava* L.) cvs. Taiwan White and Taiwan Pink grown under high density planting system for growth and yield of fruits was carried out during 2018 to 2019 in guava orchard at College of Horticulture Dr.Y.S.R. Horticultural University, Venkataramannagudem, West Godavari District of Andhra Pradesh. The experiment was laid down in a factorial randomized block design with two replications and eighteen treatment combinations with three factors *viz.*, V1-Taiwan Pink, V2- Taiwan White, D1-pruning on 15th June, D2-pruning on 30th June, D3-pruning on 15th July, P1-heading back up to 4th node, P2- heading back up to 6th node, P3-heading back up to 8th node. Significant results were recorded among the treatment combinations in which Taiwan Pink pruned on 15th June recorded maximum number of new shoots per pruned shoot (10.35), number of flowers per new shoot (7.23) and number of fruits per plant (50.02), whereas Taiwan White pruned on 15th June up to 4th node recorded maximum average fruit weight (373.50g) and fruit yield per plant (16.16kg).

P-25

Response of foliar spray of novel organic liquid fertilizer and micronutrients on yield of banana cv. Grand Nain

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Response of foliar spray of novel organic liquid fertilizer and micronutrients on yield of banana cv. Grand Nain was laid out in Randomized Block Design with factorial concept comprising of two factors *viz.*, different level of novel organic liquid fertilizer (0,1 and 2%) and Combi-F, Grade-IV micronutrient (0,1,1.5 and 2%). The treatments were replicated thrice. The individual effects of foliar applications at 3rd, 5th and 7th months after planting of different level of novel organic liquid fertilizer and micronutrient treatment as well as their interaction on yield of banana cv. Grand Nain were recorded. The result indicated that the novel organic liquid fertilizer treatment was significantly superior over the control. The foliar application of 1% novel organic liquid fertilizer recorded significantly maximum yield characteristics like, finger girth, length and girth of bunch, weight of 3rd hand, fingers per bunch, number of hands per bunch, bunch weight and yield. The foliar application of 1.5% Combi-F, Grade-IV micronutrient at 3rd, 5th and 7th month after planting (F₃) increased finger length, finger girth, length and girth of bunch, weight of 3rd hand, fingers per bunch, number of hands per bunch, weight of bunch and yield.

P-26

Pear tree performance with different growth controlling strategies in conventional orchards

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Pear is one of the most important temperate fruits next only in importance after apple. In J & K, Nakh Kashmiri is the most important cultivar of *Pyrus pyrifolia* group in term of its yield and consumer acceptability. But due to excessive vigour, there is problem of reduced flower bud development, light penetration and increased incidences of pests and diseases. Root pruning, trunk incision and pruning are considered as the major growth controlling strategies which were tested in the present study. In addition, application of growth regulators (paclobutrazol and ethephon) were tested for their efficiency in controlling tree vigour and flower induction on twenty-year-old Chinese Sand pear trees in experimental orchard/ laboratory of Division of Fruit Science, SKUAST-K, Srinagar (J&K). The experimental trees were treated with root pruning (during dormancy upto 35 cm depth and 30 cm away from trunk), trunk incision (during dormancy upto 20% of trunk diameter on both sides at 30 cm distance), summer pruning (mid June - thinning out of most of the extension shoots from middle of canopy and 50% from upper and lower canopy), application of paclobutrazol (at full bloom-800 ppm and 15 days after full bloom-500 ppm) and Ethephon (at full bloom-200 ppm and 15 days after full bloom-100 ppm). Plants treated with paclobutrazol showed better results with minimum trunk growth, TCSA, internodal length, leaf area and maximum chlorophyll content, carbohydrate and C : N ratio (shoots and leaves), flower intensity and bloom percentage. The overall results showed that paclobutrazol can be considered as best strategy for optimizing tree growth and flowering in pear.

P-27

Effect of propagation time and method of propagation on bud uptake in jamun

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Jamun (*Syzygium cuminii* Skeels) is an important but under exploited indigenous fruit tree of India. Jamun has promising therapeutic value due to its various phyto-constituents, such as tannins, alkaloids, steroids, flavonoids, terpenoids, fattyacids, phenols, minerals, carbohydrates and vitamins. Jamun is widely propagated by seeds. Since, no vegetative method of propagation have been standardised in jamun for north India, the study was undertaken on effect of propagation time and method of propagation on bud uptake in Jamun during 2013 to 2017 at MES Horticulture, NDUA&T, Ayodhya. This experiment comprised of seven propagational time along with two methods consisting of 14 treatment replicated thrice in randomized block design (Factorial). On the basis of this five year pooled data the maximum bud uptake was noted during the month of June (56.17%) which was significantly superior to rest months and patch budding done during the month of June (65.67%) was found to be more significant than any other methods. Hence, it may be concluded that for commercial propagation of jamun patch budding is more convenient and successful in eastern U.P. condition.

P-28

Effect of pruning on morpho-physiological character of mango (*Mangifera indica* L.) cv. Amrapali

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Pruning is an age old horticultural practice followed in deciduous and temperate fruit crops. Many evergreen fruit trees including mango respond to pruning and gainful results have been obtained as well. High density orcharding in some cultivars (Amrapali) of mango have been standardised. Nevertheless, the variety shows sharp decline in yield and quality after 10 to 12 years of fruiting owing to overlapping/ intermingling of branches, poor light interceptions, poor photosynthetic rate and poor relative humidity. The present investigation was therefore, undertaken to study the effect of pruning on morpho-physiological character of mango variety Amrapali comprising of four levels of pruning treatment with five replication. The findings of the study revealed maximum bud sprout under severe pruning, maximum shoot growth under moderate pruning, high tree canopy volume was registered under light pruning along with net photosynthetic rate.

P-29

Foliar feeding of nutrients on fruit drop, yield and quality of mango (*Mangifera indica* L.) cv. Amrapali

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The present investigation was conducted at Main Experiment Station, Department of Horticulture, NDUA&T, Kumarganj, Faizabad (U.P.) during the year 2016-2017. The experiment was conducted in Randomized Block Design with seven treatments *i.e.* Borax @ 0.2%, Borax @ 0.4%, ZnSO₄ @ 0.2% , ZnSO₄ @ 0.4%, Urea @ 1.0%, Urea @ 1.5% and control (untreated) in three replications and considering two plants as a unit. The observations were recorded for yield and physico-chemicals attributes of mango fruit. The maximum number of fruits per shoot, fruit retention per cent, fruit yield (kg/tree), fruit yield (q/ha) and minimum fruit drop were recorded with the application of ZnSO₄ 0.4% followed by ZnSO₄ 0.2%. All the physico-chemical characters were influenced by foliar spray of Borax 0.2%, Borax 0.4%, ZnSO₄ 0.2%, ZnSO₄ 0.4%, Urea 1.0%, Urea 1.5% in alone. The fruit length, width, fruit weight, volume, pulp weight, stone weight, pulp stone ratio, pulp per cent were recorded maximum with the foliar application of ZnSO₄ 0.4% followed by ZnSO₄ 0.2%. The maximum TSS, ascorbic acid, total sugars and minimum acidity content were observed with the foliar application of ZnSO₄ 0.4% followed by ZnSO₄ 0.2%.

P-30

Growth of dragon fruit as influenced by integrated nutrient application

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Dragon fruit (*Hylocereus costaricensis*) is one of the under exploited fruits of the world. But, it has immense potential for pharmaceutical industry having number of nutraceutical properties. It has some fatty acids, which are not produced by human body. It is also used for various purposes in processed products, such as fresh table fruit and many culinary dishes apart from its ornamental and religious values. Thus, this fruit is now gaining popularity all over the world due to its wider adaptability in dry areas and considered as the super future fruit of the world. Its cultivation in India is also gradually increasing. However, in India, its cultivation study is limited and especially nutritional (fertilizer) requirement is varied in many places and species as reported by several workers. Thus, the present experiment was carried out on dragon fruit field to see the effect on vegetative growth of newly planted dragon fruit with 8 treatments and 3 replications in randomized block design, using nitrogen through urea, FYM, vermicompost, poultry manure and their combinations. Results revealed that maximum plant height (64.05 cm) after six months of planting was recorded with FYM application. It was followed by application of urea which produced maximum number of segment and maximum number of side segment was obtained with integrated application of urea (50%) and poultry manure (3.44 kg). The results indicated a mixed reaction so far, but, it is clear that integrated approach may be a useful way for attaining its better growth and development.

P-31

Effect of chlormequat chloride on growth and productivity of sub-tropical pears

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Pear cvs. Patharnakh and Punjab Beauty are the low chill cultivars grown commercially under the sub-tropical conditions of north-west India. Though pear has long juvenility and training system like Y-trellis training system can be helpful in lowering this long period providing better utilization of land. Pruning as a growth control strategy in vigorously growing plants creates more problem by breaking apical dominance and thus resulting in relatively more growth than before. Aiming to reduce vegetative growth of pear plants and to increase yield by enhancing light penetration, chlormequat chloride (CCC) @ 250, 500 and 1000 ppm was sprayed at 10 days after full bloom on pear plants of cvs. Patharnakh and Punjab Beauty grafted on vigorous rootstock *Pyrus pashia* trained on Y-trellis system. Canopy size of Patharnakh and Punjab Beauty decreased with the reduction in the shoot length (175.39, 131.89 cm), TCSA (74.62, 79.19 cm²) and leaf area (65.22, 33.72 cm²) with the highest dose of CCC (1000 ppm) as compared to control. This treatment also resulted in lowest pruned wood weight (9.47 kg/plant) in Patharnakh and 8.25 kg/plant in Punjab Beauty. This allowed better light penetration, improved net photosynthesis rate and thus increased fruit weight. Maximum yield of 15.52 and 5.45 kg/plant was obtained with CCC (1000 ppm) treatment in Patharnakh and Punjab Beauty pear, respectively. Return bloom, however, decreased with increasing dose of CCC but was obtained higher than control. Use of CCC proved to be a good growth control measure to increase yield and return bloom in sub-tropical pears.

P-32

Responses to seed dormancy breaking treatments in wild *Luffa* species

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Wild *Luffa* species have great problem of germination under normal condition and require long time to germinate. They have dormancy, because of the variation in the seed size, degree of hard seediness and variation in lignin content in seed coat among the species. Therefore, a systematic study was conducted to determine the most suitable pre sowing treatment for seed germination and seedling growth in two wild species *Luffa graveolence* and *Luffa echinata* (Four accessions). Seeds were exposed to various pre-treatments such as scarification and different chemical treatment with gibberellic acid and potassium nitrate. Treated seeds were evaluated for their viability to assess the impact of given treatments. Among the various treatments tried, scarification + GA₃ @ 200 ppm was found most effective in *Luffa echinata* and scarification + KNO₃ @ 0.2% for *Luffa graveolence* for germination percentage. The seedling vigour in terms of shoot length, root length, total fresh and dry weight were recorded highest with scarification + GA₃ @ 200 ppm for *Luffa echinata* and scarification + KNO₃ @ 0.2% for *Luffa graveolence*. The result of present investigation revealed that wild species required an additional pre sowing treatment to enhance seed germination, vigour and uniform plant stand in *Luffa*.

P-33

Efficacy of different organic manures and inorganic fertilizer on the yield and quality attributes of kiwifruit (*Actinidia deliciosa*. Chev) in midhills of Himalayan region

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The kiwifruit or chinese gooseberry (*Actinidia deliciosa*) [A. Chev.] has gained enormous popularity in the recent past due to wide adaptability, unique blend of taste and high medicinal value. Organic fruit production technology has gained momentum in the recent years, both in terms of consumer demand and as a genuine desire of many fruit orchardists to sustain crop production. A field experiment was carried out in the experimental block of Department of Fruit Science during the year 2017 and 2018 on seven years old trees of uniform size and vigour, planted at 6.0 m × 4.0 m spacing. The experiment was laid out in a RBD with 8 treatments *viz.*, T₁ [Recommended N, P & K through FYM (100%)], T₂ [Recommended N, P and K through vermicompost (100%)], T₃ [Recommended N, P and K through poultry manure (100%)], T₄ [Recommended N, P and K through FYM and poultry manure (50:50)], T₅ [Recommended N, P and K through FYM and vermicompost (50:50)], T₆ [Recommended N, P and K through poultry manure and vermicompost (50:50)], T₇ [Recommended N, P and K through FYM, PM and VC (in equal proportions)] and T₈ [Recommended nutrients (FYM : 40 kg, N : 800 g, P₂O₅ : 600 g, K₂O : 800 g)]. There were two common treatments applied in orchard except T₈ after the flower initiation *i.e.* spraying of panchgavya and jeevamrit at one month interval. The highest yield (24.86 kg/vine) was recorded with treatment T₈ (FYM : 40 kg , N : 800 g, P₂O₅ : 600 g, K₂O : 800 g) as compared all organic manures. Among different physical characteristics of fruit, the highest fruit length (74.58 mm), diameter (49.23 mm) and fruit weight (97.93 g) were noticed with treatment T₈, whereas the lowest fruit length (61.18 mm), fruit diameter (41.29 mm) and fruit weight (54.51 g) were recorded with T₃ [RDN through poultry manure (100 %)].

P-34

Role of *acdS* positive bacterial isolates in promoting plant growth and mitigating salinity stress

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As the population of the world is increasing day by day, ensuring adequate food production is a major issue. A variety of biotic and abiotic factors are responsible for large yield loss in horticulture crops. Salinity stress deleteriously affects the plant health as well as crop productivity throughout the world by affecting various physical as well as biochemical parameters. The relation between the plants and salinity is extremely complex, since, it adversely effects the nutrition balance by competitive uptake, nutrient availability and also nutrient transport within the plant ultimately limiting the growth of crops. The salinity threshold (EC_e) of the majority of vegetable crops is low (ranging from 1 to 2.5 dS m⁻¹ in saturated soil extracts), which not only causes deleterious effect to the crops and reduces the productivity of many horticultural crops including many fruits and vegetables. ACC deaminase positive Plant Growth Promoting Bacteria (PGPB) can be used to overcome salinity stress problem because ACC deaminase, an enzyme present in a bacterial cytoplasm, is involved in the ethylene breakdown. It overcomes the second peak of deleterious ethylene, which is increased under salinity stress inhibiting/reduce the crop growth. The *acdS* positive isolates maintain the homeostasis of crop growth under salinity stress and promote the growth and development of the crops as well. Hence, these PGPB can be used as a biofertilizer, which can even work under stress.

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Influence of seaweed extract on growth, yield and quality of kiwifruit [*Actinidia deliciosa* (A. Chev.) C.F. Liang & A.R. Ferguson]

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A study was conducted to elucidate the influence of seaweed extract on growth, yield and quality of kiwifruit [*Actinidia deliciosa* (A. Chev.) C.F. Liang & A.R. Ferguson]. Nine years old kiwifruit vines cv. Allsion of uniform size and vigour, planted at 4 m × 6 m spacing were selected. The experiment was laid out in RBD with 11 treatments *viz*; T₁ (SWE spray @ 1000 ppm at FS), T₂ (SWE spray @ 2000 ppm SWE at FS), T₃ (SWE spray @ 3000 ppm at FS), T₄ (SWE spray @ 1000 ppm at FS and 10 DAFS), T₅ (SWE spray @ 2000 ppm at FS and 10 DAFS), T₆ (SWE spray @ 3000 ppm at FS and 10 DAFS), T₇ (SWE dip @ 1000 ppm 10 DAFS), T₈ (SWE dip @ 2000 ppm 10 DAFS), T₉ (SWE dip @ 3000 ppm 10 DAFS), T₁₀ (CPPU dip @ 5 ppm 10 DAFS) and T₁₁ [Control (Untreated)]. The highest increase in fruit length and fruit diameter in developing kiwifruit was recorded with T₉ (SWE dip @ 3000 ppm 10 DAFS), which was non-significant with CPPU treatment and was superior to control. The average fruit length, fruit diameter, average fruit weight, fruit firmness and total fruit yield were also found to be the highest with the same treatment. Fruit quality parameters namely fruit TSS and total sugars were recorded maximum with T₆ (SWE spray @ 3000 ppm at FS and 10 DAFS). The TSS : acid ratio and reducing sugars were recorded highest with T₉ (SWE dip @ 3000 ppm 10 DAFS).

P-36

Impact of drip irrigation and mulching on fruit yield, quality and economic return of litchi (*Litchi chinensis* L.)

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Field experiments were carried out in the *tarai* region of India during the year 2017-18 to evaluate the effect of drip irrigation based on pan evaporation replenishment (50%, 75%, 100%, 125%) and bicolor (silver black) plastic mulch on yield and quality of litchi fruits. Surface irrigation provided in the basin of the trees was taken as control. The study revealed that 75% ER with plastic mulch resulted in highest contents of total soluble solids and ascorbic acid along with lowest acidity in the litchi fruits. The benefit : cost (B : C) was also highest in 75% ER. Further increase in irrigation level to 100 per cent and 125 per cent did not significantly affect the yield and quality. Ground mulching with bicolor plastic mulch showed significant effects on yields and quality parameters of litchi fruits.

P-37

Impact of mulching on growth and yield of water melon (*Citrullus lanatus* Thumb) cv. Madhuri

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An experiment was conducted during 2013-14 at farmer's field of village Dhaba by Krishi Vigyan Kendra, Burhanpur to evaluate the impact of mulching on growth and yield of water melon variety Madhuri. The study revealed that water melon under different mulching showed significant response over control in respect of growth and yield parameters. Plants without mulch resulted poor growth and low yield as compared to black polythene and straw mulch. Black polythene mulch followed by silver mulch exhibited highest yield 55.60t/ha and 53.80t/ha respectively over sugarcane dried leaves (48.68t/ha) and control (44.86t/ha). Besides above, quality of the fruit is also improved over control and the treatments also increased the moisture content, which save the water and increased the crop yield.

P-38

Effect of foliar application of boron, zinc and NAA on fruit drop, yield and quality attributes of aonla cv. NA-7

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An investigation was carried out in the Horticulture Garden of CSAUA&Technology, Kanpur (U.P.) during 2018 on 17 years old plantation using 10 treatments *viz.*, three concentrations each of Boron (0.1, 0.3 and 0.5%), Zinc (0.2, 0.4 and 0.6%) and NAA (10, 20 and 40 ppm) including a control (water spray) replicated thrice in Randomized Block Design. From the investigation, it is found that plants treated with NAA @ 40 ppm significantly reduced fruit drop (67.95%) and increased fruit retention (33.45%). This treatment also produced fruits with maximum fruit yield (83.25 kg/plant), fruit length (3.99 cm),

fruit width (4.80 cm) and fruit weight (35.45 g) as well as significantly higher specific gravity (1.15 g/cc), pulp weight (35.55 g) and fruit moisture (93.50%). Plant treated with Borax @ 0.5% gave increased total sugars (12.80%), TSS (14.93°Brix), ascorbic acid (630.05 mg/100g) and reduced the stone weight (1.30 g), when these were sprayed in the month of August under north Indian plains of U.P.

P-39

Influence of different bio-enhancer as rooting media on papaya (*Carica papaya* L.) seedlings growth

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The present investigation was carried out at main experiment station, Department of Horticulture, Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya (U.P.) during 2017-18 using five treatments and replicated four times in RBD with eight plant as unit in nursery stage and two plant as unit in after transplanting. Based on the results, it is concluded that different bio-enhancer showed significant positive response in papaya. At nursery stage the application of CPP gave better result on germination percentage fresh weight of shoot number of leaf and maximum net return per hectare. The application of Jivaamrit gave better result on germination days taken after sowing. Number of leaves was found to be most effective to improve growth parameters. The application of Amritpani resulted in enhanced height of seedling, root length, fresh weight of root, number of roots, root and shoot ratio and days required to attain transplantable size. The application of vermivash gave better result on reducing disease infected plant and pest control as well as stem diameter, leaf length and width, fresh weight of plant. Whereas, after transplanting all the bio-enhancer were found at par in all the influence of observation. Overall, application of Amritpani was found most effective in terms of growth, health and economics for production of papaya nursery. For the growth of papaya any bio-enhancer can be utilized as per the availability in indo-gangetic plains of eastern Uttar Pradesh with less economic expenditure.

P-40

Transplanting schedule and types of mulching contribution on yield and quality of tomato (*Lycopersicon esculentum* Mill.)

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Studies on transplanting schedule and types of mulching contribution on yield and quality of tomato was carried out in two consecutive years (2016-17 and 2017-18, respectively) at Vegetable Research Farm, Kalyanpur, Kanpur. The experiment consist of four different dates of transplanting *viz.*, 15th October, 31st October, 15th November and 30th November along with four types of mulches (black polythene, white poly polythene, paddy straw and control-without mulch) in factorial randomized block design with the objective to find out the frequency of different dates of transplanting, effect of different mulches, interaction of different dates and mulches and economics of above treatments of the experimentation. The present study revealed that the tomato seedlings transplanted on 30th October and application of paddy straw as mulch significantly increased the growth attributing traits *viz.* plant height, number of

branches (primary and secondary), flowering characters *viz.*, days to 50% flowering, number of flowers per inflorescence, inflorescence per plant, days taken to first and last harvest, yield attributing characters *viz.*, number of fruits per plant, fruit weight, marketable and non-marketable yield and total yield, quality characters *viz.*, fruit firmness, total soluble solids acidity and ascorbic acid content. The seedlings transplanted on second date *i.e.* 30th October and application of bio-mulch (paddy straw) found economically better than other treatments. The maximum benefit-cost ratio (3.73 and 3.86) was also found in 30th October transplanting as compare to control (without mulch) 2.75 and 2.85, respectively.

P-41

Management strategies through rootstocks and soil agro-techniques on growth and physiological parameters in the new plantation of apple under replant condition

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Commercial apple orchards planted in the late sixties in Himachal Pradesh, India have shown symptoms of declining productivity as these plants have completed their economic life span. There has been substantial increase in the proportion of declining orchards year after year, which needs to be addressed by developing suitable agro-techniques to combat replant problem for better field survival rate and sustainable productivity in the state. The effect of clonal rootstocks, soil agro-techniques and their consortium on growth and phenology of replanted apple orchards were studied. There were 20 treatments comprising of four apple clonal rootstocks *i.e.* Seedling, M.793, MM. 111 and M.7 and five soil agro-techniques *viz.*, control, soil fumigation (with formaldehyde), plant growth-promoting rhizobacteria (*Bacillus licheniformis* CK-1), biocontrol (*Trichoderma viride*) and combined (soil fumigation + PGPR + biocontrol) with four replications. Plant growth promoting rhizobacteria [(PGPR) 10⁸ CFU/gm minimum of 250 ml] and biocontrol [(*Trichoderma viride*) 10⁹ CFU/gm minimum of 10 gm] were applied at the time of planting in the pits and then repeated after every three months up to December 2016. The data over the years 2015 and 2016 revealed that M.793 rootstock had significantly highest plant growth parameters, chlorophyll content and photosynthetic efficiency. Among the techniques, highest plant growth parameters and photosynthetic efficiency were recorded in combined treatment. The interaction between rootstocks and treatments indicated that combinations of M.793 × combined treatment recorded maximum increase growth traits and photosynthetic efficiency compared to other rootstock and treatment combinations. The consortium of M.793 rootstock and combined treatment recorded appreciable increase in plant growth, vigour as well as chlorophyll content, rate of photosynthesis, transpiration rate, stomatal conductance, water use efficiency and minimum stomatal resistance of young plants growing under replant situation. The consortium of M.793 rootstock and combined treatment recorded significant increase in plant growth traits, chlorophyll and photosynthetic efficiency of new apple plants under sick soil, which can be exploited for the management of replanting problem in apple.

P-42

Sustainable eco-friendly raising of healthy tomato and brinjal nursery

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Raising healthy nursery is of prime importance for achieving high productivity. Among transplanted vegetables nematodes along with other biotic stress agents has become serious impediment in raising healthy nursery. Nematicides and soil fumigants are the popular methods however, indiscriminate use of chemicals has adverse impact on soil health. Sustainable agriculture emphasises on using eco-friendly methods based on integrated pest management strategies to minimize excess use of chemicals. In the backdrop of sustainable eco-friendly solution for raising healthy nursery, the study is based on the principle of exclusion of plant protection by studying use of soilless media and organic amendments *i.e.* Trichoderma, crucifer residues and AM fungus individually as well as in combination for raising healthy nursery for tomato and brinjal. It is noteworthy to state that soilless media with various organic amendments were superior in all plant growth attributes in comparison to the conventional soil media. The findings can serve as a building block for creating awareness and acknowledging the benefits of use of various eco-friendly biological amendments and soilless growing media in geographies and fields infested with root knot nematode.

P-43

Effects of the colour shade nets for growth and yield of fenugreek, coriander and garlic

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An investigation on photo selective netting concept was carried out at Soil and Water Management Research Unit Farm, Navsari Agricultural University, Navsari, Gujarat during summer season to study the effect of different colour shade nets on biomass yield and quality of fenugreek, coriander and garlic. Plant height was intended to increase with different photo-selective shade nets *i.e.* highest in red colour shade net (24.81 cm) and lowest open field condition (10.49 cm). The highest plant height was also observed in garlic (22.87 cm) crop as compared to fenugreek and coriander. The growth parameters *viz.*, number of leaves (20.99) and root length (6.65 cm) were significantly higher in red colour shade net treatment in fenugreek crop as compare to other. Number of primary branches was recorded maximum in green colour shade net (6.65) as well as in blue and red colour (6.57, 6.45) shade net. With the different spice crops *i.e.* coriander (5.65) had the maximum primary braches and minimum primary branches found in fenugreek (5.56). Minimum days taken for maturity to harvest at green stage of spice crop was found under red (34.0) and green (34.3) colour shade net, while the maximum days taken for harvest at green stage was observed under open field condition (44.7) as well as yellow colour (37.1) shade net. The highest fresh biomass yield of spice crops was registered with red colour shade net (88.39 kg/100m²) followed by green colour shade net (882.06 kg/100m²). Lower yield was obtained from open field condition (11.09 kg/100m²).

P-44

Effect of INM on quality and yield attributes of sweet pepper (*Capsicum annum* L.) cv. California

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The present investigation was conducted at the experimental farm of Faculty of Agricultural Sciences & Allied Industries, Rama University, Mandhna, Kanpur (U.P.) during *rabi* season of 2018-19. The experiment was laid out in randomized complete block design with three replications comprising of 9 treatments combinations. The treatments were T₀: Control, T₁: 100 per cent RDF Nitrogen + vermicompost, T₂: 100 per cent RDF Nitrogen + FYM, T₃: 100 per cent RDF Zn + Nitrogen, T₄: 100 per cent RDF Phosphorus + FYM, T₅: 100 per cent RDF Potash + Boron, T₆: 100% RDF Nitrogen + Phosphorus + Boron, T₇: 100 per cent RDF FYM + Vermicompost, T₈: 100 per cent RDF Nitrogen + Zn. Plant height was recorded maximum T₆ (55.65 cm) and minimum was observed in T₀ (30.75 cm), Number of branches/plant was recorded maximum T₆ (6.61) in T₇ (6.35), while minimum T₀ (3.40) was observed in T₁ (4.70). Plant spread was maximum T₆ (44.50 cm) through recommended package of fertilization and minimum T₀ (25.35 cm) was found in T₁ (33.16). Maximum and minimum stalk length were observed in T₇ (42.87 cm) and T₁ (33.16 cm). Application of 100 per cent RDF + Nitrogen+ phosphorus + Boron in sweet pepper var. California proved the best treatment, which produced superior growth and yield attributing characters and gave 686.39 q/ha more seed yield.

P-45

Development and validation of DUS testing guidelines in olive (*Olea europaea* L.)

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Distinctiveness, uniformity and stability (DUS) testing is useful for identification, registration and protection of varieties for varietal information systems and their classification in to different groups. Olive, originated from Asia minor, is an evergreen fruit crop having great commercial value due to its high quality oil. It was found growing in wild in some parts of India. The aim of the study was to develop and validate DUS testing guidelines under Indian conditions according to the principles and requirements of International Union for the Protection of New Varieties (UPOV) using 18 olive varieties maintained at ICAR-Central Institute of Temperate Horticulture-Srinagar as reference. In present study, subject, method of examination, selection of testing characteristics, determination of expression states of characteristics and assessment of distinctiveness, uniformity and stability were taken into consideration for varietal groupings. Out of forty-one testing characteristics selected, 32 were quantitative, 8 were pseudo quantitative and one was qualitative in the DUS test Guidelines. The development of these DUS guidelines will be useful for the application and protection of new plant varieties and for their entry into the national list. The guidelines will provide technical support for DUS testing of olive and also serve as scientific basis for the approval of Plant Breeders Rights (PBR).

P-46

Chip budding-A highly successful propagation method in walnut

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Walnut (*Juglan regia*) is one of the important nut crops of temperate region. In India walnut is grown mainly in Jammu & Kashmir, Uttarakhand and Himachal Pradesh and up to some extent in north eastern region. Most of the walnut plantation in India is of seedling origin possessing a great heterogeneity in the produce. There is very less systematic plantation of standard varieties which can yield produce of uniform quality. The major bottleneck in walnut is non availability of quality planting material (grafted/budded) of elite varieties? Due to less propagation success under open conditions, government sector is not able to fulfill the demand so, ICAR-CITH, Srinagar has played a significant role for increasing walnut area in India through production of quality planting material. To standardizes the propagation technique in walnut in polyhouse conditions, different propagation method were tried during February-March. Based on the overall performance of different methods and dates, it can be concluded that wedge grafting gave better success during February especially in 3rd week (63.33 %), while chip budding gave better success rate during 2nd week of March (70 %). The cleft grafting gave better success rate during 2nd week of February (60 %). The tongue grafting gave maximum but lower success rate during 2nd week of March (10 %). Keeping in view the scarcity of scion wood of standard cultivars, chip budding can serve a better alternate in future after further evaluation during next year.

P-47

Effect of different concentration of hormones and rooting media on growth and survivability of air layers in guava (*Psidium guajava* L.) cv. Gwalior 27

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Guava (*Psidium guajava* L.) is one of the popular fruits grown in tropical, sub-tropical and some parts of arid regions of India. Air layering is an easy method of propagation of this crop and it is widely used for commercial multiplication. Growth regulators have been used to increase the efficiency of propagation by layering. Therefore, the present experiment was undertaken in the Department of Horticulture, College of Agriculture, RVSKVV Gwalior, (M.P.) to study the effect of different concentration of growth regulators and rooting media on rooting of air layering of guava (*Psidium guajava* L.) cv. Gwalior 27. The experiment comprising seven sources of rooting media *viz.*, soil, soil + vermicompost, soil + cocopeat, soil + leaf mould, soil + vermicompost + cocopeat, soil + vermicompost + leaf mould and soil + cocopeat + leaf mould and five concentrations of hormones *viz.*, IBA 10000 ppm, IBA 15000 ppm and IAA 10000 ppm, IAA 15000 ppm and 0 ppm that is control were laid out in randomized block design with three replications. Results revealed that maximum values of callus formation (5.14), rooting percentage (71.47), dry weight of root (0.88), growth parameter *viz.*, number of leaves(13.43), number of new sprout/layer (4.90), length of shoot (28.14) and survival percentage (63.47) was obtained in soil + cocopeat + leaf mould rooting media. In case of different concentrations of hormone, the highest values of all these parameters were recorded with 15,000 ppm of IBA.

P-48

Effect of different combinations of rooting media and IBA concentration on rooting and survival of air layers of guava (*Psidium guajava* L.)

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Field experiment was conducted during 2015-2016 at research orchard of department of horticulture, college of agriculture, RVSKVV, Gwalior, (M.P.) to study the combine effect of different rooting media and IBA concentration on rooting and survival of air layers of guava. The experiment was laid out in Randomized Block Design with three replications and twenty treatments. There were different concentration of indole butyric acid (0 ppm, 7500 ppm, 10000 ppm and 15000 ppm) and rooting media (soil, coco peat, vermi compost, soil + coco peat, and soil + vermi compost) as treatments for air layering of guava. The results revealed that maximum callus formation, number of primary roots, length of primary roots, diameter of primary roots, number of secondary roots, length of secondary roots, diameter of secondary roots, dry weight of roots, success in rooting per cent was found in soil + vermi compost rooting media. In case of IBA treated layers, all the root and growth characters increased with increase in concentration and attained the highest magnitude at IBA 15000 ppm.

P-49

Hormonal influences elicited by paclobutrazol treatment on induction of flowering in mango cv. Dashehari

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Hormonal regulation of flowering is one of key mechanisms responsible for induction of flowering. Paclobutrazol (PBZ) treatment is a technological intervention that suppresses gibberellins and promotes flowering in mango under influence of various hormones. Therefore, a systematic study was conducted on the effect of PBZ (@ 3.2 ml/m²) on hormonal status with respect to auxins (Salkowski method) and gibberellins (phosphomolybdic acid method) in floral and vegetative shoots. Colorimetric estimations revealed higher auxin content in floral flush induced by PBZ treatment, in comparison to control vegetative shoots. High auxin levels was recorded in Dashehari treated floral flush (6.99 µg/g) and lower in vegetative flush (1.498 µg/g). Quite contrarily, a declining trend in gibberellic acid in PBZ induced floral flush (2.72 µg/g) as compared to the vegetative flush (0.08 µg/g) was observed which could be attributed to GA₃ biosynthesis inhibition by PBZ through kaurene and kaurenoic acid conversion. These results support the hormonal theory of flowering, which states that higher auxin levels with dip in temperature and decline in gibberellin levels promotes inductive flowering. Furthermore gene expression studies, revealed that floral repressor domain containing gene SAP18 was down regulated in PBZ treated shoots in comparison to control (vegetative shoots). CDK5 regulates protein phosphorylation and implicated in CO₂ fixation and stomatal opening was found to be upregulated in PBZ treated Dashehari flowering shoots. Further study is underway to establish this concept based on HPLC estimation of hormones and corroboration with real time PCR assays of genes governing hormone biosynthesis and mobilization to the Shoot Apical Meristem. This study gives a basic idea on the patterning of auxins and gibberellins in PBZ induced flowering in mango.

P-50

Effect of integrated nutrient management on growth, yield and quality of cabbage (*Brassica oleracea* L. var. *capitata*)

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The present investigation was conducted at the experimental farm of the faculty of Agricultural Science and Allied Industries, Rama University, Mandhana, Kanpur (U.P.) during rabi season of 2018-19 in randomized complete block design with three replications comprising of 8 treatment combinations of inorganic fertilizer and organic manures to know their effect on growth, yield and quality of cabbage (*Brassica oleracea* L. var. *capitata*) under mid-hill conditions of Uttar Pradesh. The treatments were T₁: Control, T₂: Nitrogen + Vermicompost, T₃: Nitrogen+ FYM, T₄: Zn + Nitrogen, T₅: Phosphorus + FYM, T₆: Potash + Boron, T₇: Nitrogen + Phosphorus + Boron, T₈: FYM + Vermicompost. Seeds of cabbage cv. NS-183 were sown in the nursery on 25th Sept., 2018 and transplanting was done on 27th Oct., 2018. The plot size was 2.0 m x 1.5 m and planting was done at spacing of 45 cm x 30 cm. Plant height was recorded maximum (27.25 cm) in T₇, while minimum (26.15 cm) was observed in T₅. Plant spread was maximum (67.70 cm) through recommended package of fertilization (T₇) followed by T₅ 64.97 cm. Maximum and minimum stalk length were observed in T₇ (4.80 cm) and T₅ (4.60 cm). Polar (11.88 cm) and equatorial diameter (14.35 cm) as well as head shape index (0.87) were observed to be the maximum through an integrated combination comprising of treatment T₇. The yield attributes viz. gross head weight (1601.95 g), net head weight (1026.35 g) was found to be maximum in T₇. The significantly highest yield (25.85 kg/plot) from a plot area (3.0 m²) was obtained with treatment module T₇ and minimum yield (20.65kg/plot) in T₁ control.

P-51

Development and assessment of sponge gourd hybrids for better yield

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Sponge gourd (*Luffa cylindrica* (Roem) L.) is considered as one of the important cucurbitaceous vegetable crops both nutritionally and economically. However, the intensive efforts towards its improvement and development of new varieties/hybrids are lacking. To fulfil the above objectives, an experiment was conducted during the year 2018-19 (summer & rainy season) and 2019-20 (summer season). The material for experimentation comprised seventeen parents classified as line (12 parents) x testers (5 parents) and their 60 hybrids derived from the line x tester mating design of sponge gourd. These 77 genotype (60 hybrids + 17 parents) along with hybrid checks i.e. Priya (Golden Seeds), Utsav (Clause Seeds), KSP-1125 (Kalash Seeds), VNR Alok (VNR Seeds) were sown in randomized block design with three replication (10 plants in each). The mean values were used for statistical analysis. Heterosis was calculated as the percentage of F₁ performance as compared to mid parent and better parent heterosis for each cross. Out of 60 hybrids, VRSG-136 x Pusa Supriya, VRSG-2-12 x Kashi Shreya, VRSG-57 x Kashi Shreya, VRSG-214 x VRSG-1-12, Kashi Jyoti x VRSG-7-17, VRSG-136 x VRSG-2-12, VRSG-2-12 x VRSG-136, VRSG-1-12 x VRSG-214, VRSG-17-10 x Pusa Sneha, VRSG-57 x VRSG-7-17, VRSG-2-12 x VRSG-195, VRSG-57 x VRSG-195 and Phule Prajka x VRSG-195 were expressed better heterotic performance in the range of

48.0 per cent (VRSG-57 × VRSG-7-17) to 97.22 per cent (VRSG-2-12 × Kashi Shreya) for various yield traits and tolerant to downy mildew (DM) and Sponge Gourd Mosaic (SGM) diseases over the hybrid checks. These promising hybrid combinations exploited for potential commercial cultivation.

P-52

Botanical and physico chemical characterization of *Hippophae salicifolia* D. Don. from Arunachal Pradesh

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During last two decades, seabuckthorn (*Hippophae* L.) has attracted the attention of the researchers and health industries due to its unique food, nutraceutical, medicinal and also ecological potentials. It has made several breakthroughs in western Himalayan regions in India. Three species namely *H. rhamnoides*, *H. salicifolia* and *H. tibetana* have been reported from various states of India. *H. rhamnoides* is prominent species growing naturally in Ladakh (J&K) and Lahaul-Spiti (HP), whereas *H. salicifolia* is reported growing naturally in HP, Uttarakhand, Sikkim and Arunachal Pradesh. *H. tibetana* is found in limited patches of Zaskar (Ladakh). In Arunachal Pradesh *H. salicifolia* has been found growing naturally along the basin of river Naymjang Chu at Tawang district. Flowering has been seen to take place in the month of May-June and fruit ripening sets in during September-October. The tribal population uses it mostly as natural dye and leaves as a green tea, which removes the body ache. A preliminary survey is carried out its distribution, botany, ethnobotanical uses. A physico chemical studies shows that fruit pulp is a good source of vitamin C. Leaf extract shows a good antioxidant and antimicrobial activity. A detailed study on identification of local potential genotypes, its uses in traditional medicines, scientific propagation, conservation of valuable diversity and product development need to be initiated.

P-53

Rooting response of pear cv. Patharnakh as influenced by size and length of cuttings

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An attempt was made to propagate the pear cv. Patharnakh through stem cuttings without any rooting hormonal treatments at the nursery of Department of Horticulture, Khalsa College, Amritsar during 2018-2019. The cuttings were selected with three different lengths, viz. 20 cm (L_1), 30 cm (L_2), 40 cm (L_3), and 50 cm (L_4) and three types (T_1) apical, (T_2) sub-apical and (T_3) basal. The cuttings were planted in the nursery and observed for survival percentage, number of roots, shoots, leaves and their fresh and dry weight on 90 days after planting. The results revealed that the basal stem cuttings (T_3) with 50 cm length (L_4) was found to be the most suitable for propagation as compared to other types of cuttings. It proved to be the best in terms of minimum days to first sprouting (25.33), maximum sprouting percentage (61.66%), survival percentage (87.67%), rooting percentage (86.66%), number of roots per cutting (5.00), root length (10.50 cm), number of shoots per cutting (4.66), average shoot diameter (2.66 cm), number of leaves (32.00) and total leaf area (277.16 cm²).

P-54

Effect of different plant bio-regulator treatments on the hardwood cuttings of kiwifruit cultivars

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An investigation was carried out at ICAR-CITH RS, Mukteshwar to find out the effect of different plant bio-regulators treatments *i.e.* IBA and Paclobutrazol on the hardwood cuttings of kiwifruit cultivars Hayward, Allison, Abbott and Tomuri. The experiment comprised of sixteen treatments *viz.* IBA 1500 ppm + Paclobutrazol 250 ppm, IBA 1500 ppm + Paclobutrazol 500 ppm, IBA 1500 ppm + Paclobutrazol 750 ppm, IBA 2500 ppm + Paclobutrazol 250 ppm, IBA 2500 ppm + Paclobutrazol 500 ppm, IBA 2500 ppm + Paclobutrazol 750 ppm, IBA 3500 ppm + Paclobutrazol 250 ppm, IBA 3500 ppm + Paclobutrazol 500 ppm, IBA 3500 ppm + Paclobutrazol 750 ppm, IBA 4500 ppm + Paclobutrazol 250 ppm, IBA 4500 ppm + Paclobutrazol 500 ppm, IBA 4500 ppm + Paclobutrazol 750 ppm, IBA 5500 ppm + Paclobutrazol 250 ppm, IBA 5500 ppm + Paclobutrazol 500 ppm, IBA 5500 ppm + Paclobutrazol 750 ppm and Control (water). The experiment was laid out in Two Factorial Randomized Block Design with three replications per treatment. The results obtained from investigations revealed that the treatment of IBA at 3500 ppm + Paclobutrazol at 250 ppm and IBA at 4500 ppm + Paclobutrazol at 250 ppm taken less 12.28 days to sprouting and maximum sprouting percentage was recorded in cuttings treated with IBA at 3500 ppm + Paclobutrazol at 750 ppm. Cultivar Hayward provided best results of days taken to sprouting and sprouting percentage and survival per cent.

P-55

Effect of spacing on yield and physio-chemical characteristics of different cultivars of apple in mid hill conditions of Uttarakhand

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An experiment was carried out at ICAR-CITH RS, Mukteshwar during to find out the effect of different planting densities *i.e.* 1.5×1.5 m, 1.5 × 2.5 m, 2.5 × 2.5 m and 6 × 6 m on yield and physico-chemical characteristics of three apple cultivars Starkrimson, Golden Delicious and Mollies Delicious. Observation revealed that highest mean number of fruits per tree, yield per tree, fruit weight, fruit volume, fruit length, fruit diameter maximum total sugar, reducing sugar and carotene content were recorded at 6 × 6 m spacing. While, highest mean yield per hectare, fruit firmness and total anti-oxidant activity were recorded at 2.5 × 2.5 m spacing and lowest mean yield per hectare was registered at 6 × 6 m spacing. Cultivar Starkrimson exhibited highest fruits per tree, yield per tree, yield per hectare, fruit firmness, TSS and ascorbic acid content. While, maximum fruit weight, fruit volume, fruit length and diameter and total anti-oxidant activity were registered in cv. Mollies Delicious and maximum total sugar and reducing sugar were found highest in cv. Golden Delicious. Conclusively, Starkrimson cultivar was found superior in term of yield and physiochemical characteristic as compared to other cultivar and 2.5 × 2.5 m spacing was found best in terms of highest yield per unit area and better quality fruits as compared to other spacing.

P-56

Effect of different pruning intensities on growth and yield of nectarine (*Prunus persica* L. Batsch var. *nucipersica*) cv. Snow Queen

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The present investigation was carried out to evaluate the effect of different pruning intensities on growth and yield of nectarine cv. Snow Queen at fruit research farm, SKUAST-Kashmir Shalimar, Srinagar during the year 2016 and 2017. The experiment was laid out in randomized complete block design with nine pruning treatments and three replications. The results obtained revealed that there is a significant increase in shoot growth and leaf area with highest pruning intensity *viz.*, 2/3rd head back and 20 per cent thinning out. The results further revealed that with the increase in pruning intensities total yield was reduced however, marketable yield of quality fruits were increased. Highest total yield was obtained in those treatments where minimum pruning intensity *i.e.* 10 per cent and 20 per cent thinning out of the plants was performed.

P-57

Response of chemical thinning on growth, yield and quality of nectarine (*Prunus persica* L. Batsch var. *nucipersica*) cultivar Silver King

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Investigations were carried out at Experimental Farm of Division of Fruit Science, SKUAST-Kashmir to determine the effect of chemical thinning on growth, yield and quality of Silver King nectarine. The experiment was laid out in RBD replicated thrice for two consecutive years (2016 and 2017). Ten treatments including control comprised of different chemical thinners *viz.* NAA acid (10, 20 and 30 ppm), ethephon (50, 100, 150 ppm) and urea (0.2, 0.4 and 0.6 %) were sprayed one week after petal fall. The results obtained reveals that chemical thinners significantly increased the growth and reduced the fruit set and yield. Among different chemicals treatments, plants sprayed with NAA @ 30 ppm recorded highest annual shoot extension growth (52.21 and 52.72 cm), plant height (273.78 and 283.61 cm) and leaf area (36.54 and 37.36 cm²) alongwith reduction in fruit set (54.21 % and 53.15 %) and fruit yield (13.02 kg and 12.34 kg) during both the years, respectively followed by application of ethephon @ 150 ppm. Application of ethephon @ 150 ppm significantly increased fruit length (5.25 cm and 5.24 cm), fruit diameter (5.05 cm and 5.03 cm), fruit weight (73.62 g and 72.61 g), soluble solid content (12.77⁰ B and 13.11⁰ B), SSC/acidity ratio (26.04 and 25.72) and total sugars (9.45 % and 9.53 %) followed by NAA @ 30 ppm during both the years of study. On the basis of results obtained, it may be inferred that nectarine trees sprayed with ethephon @ 150 ppm and NAA @ 30 ppm one week after petal fall judiciously thinned the nectarine fruits, improved plant growth and physical and chemical parameters of fruits.

P-58

Most suitable rooting media for rooting success and survivability of marcottage at Fruit Research Station, Imalia, JNKVV, Jabalpur

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The present investigation effect of different growing media on rooting and survival of Marcottage in Pomegranate (*Punica granatum* L.) cv. Bhagwa was conducted at Fruit Research Station, Imalia, Department of Horticulture, College of Agriculture, JNKVV, Jabalpur (M.P.) during the year 2018-2019. The experiment was laid out in Factorial Randomized Block Design with three replications. To study the effect of different types of rooting media (*i.e.* Soil, Soil + Vermicompost, Soil + Vermicompost + Azotobacter, Soil + Vermicompost + Azospirillum, Soil + Vermicompost + Pseudomonas) The success percentage of layers at 60 and 90 days after transplanting was recorded. Data showed that the maximum success percentage of layers 73.33 noted under M₄ (Soil + Vermicompost + Azospirillum) at 60 days, respectively and it was significantly superior over rest of the soil media. The minimum success percentage of 60.00 was recorded under M₁ (only soil) at 60 days after transplanting and non-significant at 90 days respectively. The data regarding survival percentage as influenced by different growing media containing bio-inoculants and concentrations of IBA and soil media led down non-significant effect on survival percentage of marcottage.

P-59

Effect of foliar application of fertilizers on yield and quality of mango (*Mangifera indica* L.) cv. Keshar

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The field experiment on effect of foliar application of fertilizers on yield and quality of mango cv. Keshar was carried out at Instructional-cum-Research Orchard during 2017-18. The experiment was laid out in a RBD with three replications and fifteen treatments. The different fertilizers grades *viz.*, urea, 00 : 52 : 34, 19 : 19 : 19, 13 : 00 : 45, 13 : 40 : 13 and 12 : 61 : 00 (1 and 2 % each) were used to study their effect on fruiting, yield and quality characters. The fertilizers were sprayed thrice during mango fruit development stages, first foliar spray of fertilizers at mustard stage (2nd week of February), second spray at pea stage (last week of February) and third spray at marble stage (2nd week of March), The number of fruit per panicle at pea stage (7.53) as well as at marble stage (3.60) were maximum in the treatment urea (2 %). The treatment as 13 : 40 : 13 (2 %) recorded the maximum fruit length (11.50 cm), diameter (7.80 cm), average weight (273 g) and yield of fruits (129.60 kg/tree, 12.96 t/ha) was maximum in the treatment 13 : 40 : 13 (2 %). The quality of fruits in terms of TSS and total sugars was significantly influenced by different fertilizers. The treatment as 10 : 00 : 45 (2 %) recorded the quality of fruits in terms of TSS (19.20° Brix) and total sugars (17.00 %). From the present study, it is concluded that the folier sprays of 13 : 40 : 13 and 13 : 00 : 45 @ 2 % at musterd pea and marble stage of mango fruit devolepment were found to be beneficial for improving the yield and quality of mango fruits.

P-60

Impact of surface sterilization timing and plant bioregulators on *in-vitro* regeneration of bulbscale explants in asiatic hybrid liliium cv. Blackout

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A rapid and efficient *in-vitro* protocol has been proposed for Asiatic Liliium hybrid cv. Black Out with respect to standardize the surface sterilization time and media supplements for culture establishments carried out at Biotechnology-cum-Tissue Culture Centre, OUAT, Bhubaneswar during 2014-16. As explants, the bulb scales were treated with 0.1 % HgCl₂ (3 min, 4 min, 5 min, 6 min, 7 min, 8 min and 9 min) and control (without treatment) followed by culture on MS media for 30 days. For culture establishment, the explants were surface sterilized with the best treatment derived from above treatments and cultured on MS basal media supplemented with BAP (0.5, 1.0, 1.5, 2.0 mg/l) alone and in combination with NAA (0.25, 0.50 mg/l) with control being MS media only. Three replications per treatment and 10 cultures per replication were used and the data analyzed following the statistical method of analysis of CRD. The results revealed that 5 min. treatment of 0.1 % HgCl₂ was most efficient for sterilization of bulb scale explants with a maximum survival rate of 93.34 % and minimum contamination [fungal per cent (3.33), bacterial per cent (0.00)]. Earliest callusing (17 days) was recorded in MS medium supplemented with BAP (0.5 mg/l) and NAA (0.25 mg/l). MS medium fortified with 1.5 mg/l BAP significantly produced maximum callus % (93.33) with maximum spread of green colour compact callimass. Hence, the bulb scale explant should be sterilized in 0.1 % HgCl₂ (5 min.) for maximum survival of the explants and cultured on MS medium fortified with 1.5 mg/l for production of maximum percentage of culture producing callus in the Asiatic Hybrid Liliium cv. Black Out.

P-61

Studies on performance of different guava cultivars under north-east region

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Guava (*Psidium guajava* L.) is an important Commercial fruit crop cultivated in Sub tropical regions. The present investigation was made on four different guava cultivars viz., Shweta, Lalit, Sardar (L-49) and Allahabad Safeda at Krishi Viyan Kendra, Yachuli, Lower Subansiri district., Arunachal Pradesh. Results of two-year study indicated that the Cv. Shweta produced higher fruit yield (56.39 Kg/plant/year). All other three cultivars fruit yield was in 42.05 kg/plant/year (Sardar, L-49). Average number of fruits per plant and average fruit weight were significantly superior in Cv. Shweta (123.82 and 80.41g). The Cv. Lalit also recorded highest TSS and shelf life (12.92° Brix, and 80.41 hrs) respectively. However, it was observed that, seeds of Allahabad Safeda, and Sardar were soft whereas that of Lalit and Shweta were hard.

THEME 2

QUALITY INPUTS AND USE EFFICIENCY

ORAL SESSION

O-27

Emerging issues and innovative pest management approaches in temperate horticulture crops of Kashmir valley

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Horticulture with predominate apple cultivation contributes more than 20 per cent GSDP in annual revenue of Jammu and Kashmir (UT). However, such monoculture agriculture system lack diversity and remains prone to serious pest problems. Despite ten-fold increase in insecticide use during the last 80 years, losses inflicted by pests have nearly doubled. It is estimated that the region, consumes about 361 million Indian rupees on pesticides annually with only 1 per cent been target specific while 99 per cent reaches non-target sectors also. This is reflected by increasing trend in the incidence of primary malignant brain tumors in orchard farmers of Kashmir region. With such considerations, we herewith have aimed to explore horticulture pest dynamics in the Kashmir valley with emphasis on the major and newly emerging pests and there management. We provide monitoring procedures & treatment thresholds of major pests for proactive and reactive control measures, enabling application of control measures at appropriate. We provide detailing on several natural enemies, means of their mass multiplication and appraisal on their role in suppressing pest populations. A comprehensive account of regional botanicals used against these pests along with account of some prolific microbes is also detailed. In an ever changing contemporary environment we are aiming in deprecation of pesticide usage, removal of their ideological kudos and providing a par effective pest control means for our regional crops.

O-28

New molecules for increasing horticultural crop production

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Newly emerged synthetic compound are now used in the field of horticulture for enhancing production and productivity. It is estimated that it costs about 150-200 million to discover a new product, test it thoroughly for its action and its safety for the environment and develop manufacturing techniques for its synthesis. It takes an average of 10 to 15 years to do this so it is small wonder that, worldwide, only about 12 chemicals are introduced each year. However, these chemicals are key to the efficient production of food. New molecules are preferred over old molecules as it is more promising and durable, environment friendly, required in less quantity and have less residual effect. New class of hormones, synthetic chemicals, nano particles *etc.* has been playing important role in the horticultural field. These new molecules show effective biological response to avoid abiotic and biotic stress in the era of climate change. Need of new molecules is to increase productivity of crops, for improvement in efficiency of input use (cost saving), increase in crop intensity, tolerance against diseases *etc.* Brassinosteroid is a new class (sixth class) of

plant hormone. The time of application, crop stage, dosage, age of crop, plays an important role for effective utility of new molecules. However, the availability, toxic effect and cost were the limiting factors of these molecules and still needed to be explored. New molecules is ecofriendly and improved approach for increasing horticultural crop production.

O-29

Soil organic carbon dynamics and mitigation of greenhouse gas emissions in orchard ecosystem

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Orchards are structural ecosystems comprised of fruit trees along with all other flora and fauna that commonly coexist. Soil, the most vital and dynamic living entity in this system, is an organic carbon (OC) mediated realm where the solid, liquid, and gaseous phases interact at a scale ranging from nanometres to kilometres to create dynamic environments conducive for growth and development of plants and other biota. Soil organic matter (SOM) is organic substances consisting of carbon in the soil in the form of plant residues, particulate organic matter (POM), soil microbial biomass (active components (35 %) and “very dead” (humus) fractions (65 %). Tree roots and microorganisms mediated decomposed organic residues are the major contributors of both SOC and dissolved organic carbon (DOC) in orchard ecosystem. SOM and its decomposition by the microflora-fauna (bacteria, fungi, actinomycetes, and protozoa) as well as mesofauna (earthworm) serve three functions for the microorganisms, providing energy for growth, supplying carbon for the formation of new cells, and other nutrients elements for cell growth and development. This paper focuses on the soil organic carbon dynamics as affected by integrated orchard management practices and the carbon sequestration potential of fruit trees.

O-30

Performance of Dashehari-35 and 51 clones in comparison to local Dashehari mango

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A trial was conducted at G.B. Pant University of Agriculture and Technology, Pantnagar from the year 2008 to 2019 under ICAR-AICRP on fruits. This experiment was laid out in randomized block design with three clones (*i.e.* Dashehari 51 (clone 51), Dashehari 35 (clone 35) and local Dashehari) with seven replications. The observation on different parameters were started in the year 2015, when mango plants started bearing, thus the trial has been concluded on the basis of pooled data five years *i.e.* 2015-2019. Mango clone “Dashehari-51” had registered the significantly higher fruit weight (166.87 g), fruit yield (26.85 kg/tree and 2.68 t/ha) and TSS (19.03⁰ B) but maximum number of fruit (156.54 g fruits/tree) was recorded in local Dashehari. The maximum plant height (3.73 m) and canopy volume (51.84 m³) were found in clone Dashehari-51. Thus, on the basis of five years pooled data (2015 to 2019), the clone Dashehari-51 had excelled in terms of higher yield with maintained fruit quality as compared to local Dashehari.

O-31

Hybridization for improvement in quality and disease resistance in apple (*Malus domestica* Borkh)

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ICAR-Central Institute of Temperate Horticulture, Srinagar is having the largest field gene bank of temperate fruit crops in India representing about 250 indigenous and exotic cultivars of apple. Apple cultivars commercially grown in India have good color and taste but less shelf life and aroma. Besides this most of the commercially grown cultivars are susceptible to scab. The available scab resistant apple cultivars are having less consumer acceptability and market demand. Breeding programme for development of superior cultivars in apple was initiated in 2009 at Central Institute of Temperate Horticulture with the main aim of transferring the traits like pest and disease resistance, regular bearing habit, longer shelf life, earliness, fruit quality, pollinizer ability *etc.* into commercially acceptable apple cultivars. Trait specific varieties in apple (Prima, Firdous, Mayan, Mollies Delicious, Golden Delicious, Granny Smith *etc.*) were used as source for trait transfer to the elite cultivars like Ambri, Red Delicious, Top Red, Gold Spur, Well Spur, Oregon Spur, Cooper IV, Red Delicious *etc.* Hybrids obtained after top working, have been evaluated for quality traits and eight hybrids have been identified which are superior in respect to fruit quality traits. These are being multiplied on large scale for further evaluation and commercialization. Molecular markers specific to traits like scab resistance, S-allele typing *etc.* have been used for screening of hybrids. Furthermore, 5000 crosses were made between apple cultivar Ambri and cultivar Prima for introgression of scab resistant trait in cultivar Ambri and the population so obtained has been grafted on M-9 clonal rootstock for further evaluation.

POSTER SESSION

P-62

Hydroponics green wall : Qualitative, efficient and economical cultivation

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At present, a silent but revolutionary advancement is there in agricultural farming sector. Vertical farming (V-farming), is a method to produce leafy vegetables and some non-tree fruits (tomatoes, brinjal, strawberries), mostly, in peri-urban areas, for cities where land is a constraint. Soil-less V-farming can be either in the form of aeroponics or hydroponics. Hydroponic green wall systems can be either in modular containers or large panels, made up of PVC, equipped with an inert growing medium, such as a horticultural foam, a mineral fibre or a felt mat, that act as a nutrient reservoir and aqueous retentive sponge and chiefly water as nutrient translocating medium. Irrigation system is designed to minimize water consumption. Green wall can be energetically efficient and economically profitable. Moreover with a crop cycle of 3-4 times annually, a 1000 sq. feet can be as yielding as 3,000-4,000 sq. feet of plot, in addition, there is no any structural decay of growing media (no salt build up from fertilisers) and the nutrient medium is perfectly utilized and residual nutrient can be reutilized (nutrients are supplied in a

precise and controlled manner). V-farming (especially hydroponics) has reduced susceptibility to weather extremes and pests, way to reduce carbon footprints *i.e.* to feed the next billion people without destroying our planet, also owing to the perishable nature of leafy vegetables, it is best suited for growing in cities and its outskirt with assured farm-fresh, culling the cost of the transportation, with optimum nutrient quality to consumers.

P-63

Agricultural input use efficiency - A tool to feed the global population

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Global population has been increased by 40 per cent and food production needs to be increased by 70 per cent. It is necessary to aim the production of food with lesser harm to natural ecosystem as one third of greenhouse gas emission is found to be from agriculture, which is main cause for air, water and soil pollution. There are efficiency gains that must be taken instead of only dealing with the climate change. Nutrient use efficiency can be increased through the agronomic and genetic approaches. Higher CO₂ will generally increase C3 yields and may compensate somewhat for the lower rainfall and higher temperature expected will demand higher nutrient input. Incremental change can only take us at some stage of higher productivity but the change should be transformational. 4 R principle is very useful to increase the agricultural input use efficiency. Various agricultural inputs should be applied from the right source, in right rate, in right time and to right place. In order to increase the nutrient use efficiency the fertilizer should be in the form, which is easily available to the crop roots canopy. The amount of nutrient supplied should be in right amount. The fertilizers should not be applied closer to the root zone else the microbes will be affected leading to lower crop yield. Agricultural input efficiency if increased can be only a way to feed global population.

P-64

Studies on nutrient dynamics for the identification of sampling dates in grapes (*Vitis vinifera*)

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Grape (*Vitis vinifera* L.) is cultivated in almost all parts of India having diverse climatic conditions. The performance of the vine can be evaluated in many ways. The simplest measure is the volume or weight of the fruit produced which is adequate for many comparisons. The details regarding dynamics of nutrients in petioles and berries of grapes are rare. Accordingly, the present study on fruit development and nutrient dynamics of grape was carried out in the experimental orchard of Division of Fruit Science, SKUAST-K during 2010 and 2011. The leaf, fruit and shoot growth studies were carried out on periodical intervals from May-1 to August-30 at fortnightly intervals. The petioles and fruits were analysed for macro nutrients. The N, P and K content in petioles decreased throughout the season, however, in berries, K content increased throughout the season, while N content decreased with the advancement of season. The P content remained more or less stable throughout the season. The stability period for N and P was recorded from June 1 to 15, while for K content July 1 to 15 was the most stable period. Further, Ca and Mg content of petioles increased with the advancement of growing season. The Mg content of

Berries recorded a similar trend. The least variation period recorded with respect to nutrient content in the petioles was from June 1 to 15 and August 1- 30 for Ca. The month of June is therefore recommended for sampling of petioles for nutritional analysis.

P-65

Precision irrigation scheduling through evapotranspiration based drip irrigation in high density apple plantation - Potential effects on quality and water use efficiency

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High density orchards are advantageous because they optimize light penetration, improving fruit quality and produce higher yields much earlier after planting. The introduction of spur type varieties as well as efficient system of orchard management has widened the scope for high density plantation of apple. In this context, an experiment was laid out to ascertain daily crop water requirement and study the effect of different levels of irrigation at various crop phenological stages on growth, yield and quality of apple. In the experiment, the average daily irrigation requirement based on pan evaporation method ranged from 1.36-6.78 liter/ tree/ day based on two year data. Overall vegetative characteristics and yield increased by about 100 per cent under full irrigation as compared to rainfed conditions. Yield, yield efficiency, mean fruit weight and fruit diameter also substantially increased under drip irrigation compared to rainfed conditions. Polyphenol content in fruits were maximum in rainfed conditions and decreased with increased levels of irrigation. Water use efficiency (WUE) was also found to be influenced by different irrigation treatments. Therefore, irrigating apple trees at 100 per cent ET_c during flowering and fruit set and fruit growth stage and at 50 per cent ET_c during pre-harvest stage may be considered as the best possible levels of irrigation for quality apple production under HDP. Improvement in growth, yield and quality through the use of drip irrigation can therefore be achieved resulting in higher productivity and will further optimize the critical inputs like water and fertilizer and simultaneously increase the farmers' income, which is the national priority under doubling farmers' income by the year 2022.

P-66

Response of input use efficiency in guava under HDP for yield and quality

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Guava (*Psidium guajava* L.) is an important fruits grown in tropical and subtropical region of the world. It is most important fruit after banana, mango, citrus and papaya. For getting optimum yield of quality fruits from healthy trees of guava, it is imperative to provide two essential inputs in right dose, right time and at right place across different phenological and growth stages. Yield and quality of fruits are mostly controlled by two important components *viz.* irrigation scheduling and optimum nutrient management. Experiment on input use efficiency started during 2015-2016 under AICRP-Fruits, comprising raised bed + drip irrigation 80 per cent ER at all stages + fertigation 75 per cent RDF along with 100 micron UV stabilized poly-sheet mulching and sprayed all the trees with ZnSO₄ and boric acid @ 0.2%) during August - September. Maximum yield 28.25 kg per tree (2018) and 33.75 kg per tree (2017), yield efficiency (2.06, 2.29 kg/m³) was noted in 2017 and 2018 respectively in T₁ treatment combination. Fruit quality

parameters were found at par in all the treatment combinations. Water use was recorded significantly lower in T1, T4 and T3 treatments (15.54, 11.66 and 12.72 lit/tree/day, respectively) as compared to control (28.35 lit/day). Hence, 3-4 years old guava planted at 3 x 3 m spacing required 3060 to 4050 lit of water annually.

P-67

Optimizing quality attributes of high density apple cv. Red Velox by application of different levels of N, P and K under temperate conditions of Kashmir valley

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Nutrient management plays an important role in fruit production and is one of the major tools to optimize fruit yield and quality. Optimizing quality attributes of high density apple cv. Red Velox by application of different levels of nitrogen, phosphorous and potassium under temperate conditions of Kashmir was carried out at experimental field of Division of Fruit Science, SKUAS&T- Shalimar during 2017-2018 and 2018-2019. The experiment was laid out in Factorial Randomized Complete Block Design with 64 treatment combinations and four levels (0, 75%, 100% and 125%) each of NPK (RDF). Fertilizers such as Urea, SSP and MOP were applied through soil application. Maximum TSS (14.59, 15.53, 14.32, 14.96 and 14.29, 14.91°Brix), total sugar (9.55, 9.76, 9.46, 9.67 and 9.28, 9.44%), non-reducing sugar (2.550, 2.823, 2.415, 2.652 and 2.405, 2.641%), anthocyanin content (13.14, 13.66, 12.89, 13.34 and 13.46, 13.90 mg/100 g) and lowest mean titrable acidity (0.206, 0.215, 0.220, 0.227 and 0.219, 0.226%) were recorded at highest levels of phosphorus and potassium (*i.e.* P₃ and K₃) coupled with N₂ level of nitrogen during 2017 and 2018 respectively. Among the interaction effects, the treatment combination of N₂P₃K₃ resulted in significant increase in physico-chemical characteristics of high density apple cv. Red Velox. Thus, nitrogen level N₁ and N₂, phosphorus level P₃ and potassium level - K₃ proved to be best in improving fruit quality characteristics of apple. Therefore, it can be concluded that RDF of nitrogen, 125% of RDF of phosphorus and potassium proved to be the best in improving quality attributes of apple cv. Red Velox, hence can be recommended to farmers for getting better returns.

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Optimizing fertigation requirements for higher nutrient use efficiency, fruit/pod yield and net returns of sweet pepper-garden pea cropping sequence under protected conditions

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Sweet pepper is a high value summer vegetable requires optimum temperature, water and nutrients for obtaining high and stable yields. Therefore, the available water and nutrients are to be used judiciously and effectively. The present investigation was carried out at Division of Vegetable Science, SKUAST-Kashmir during the year 2017-18 and 2018-19 to study the influence of different fertigation treatments on NPK use efficiency, fruit yield and associated traits of main crop sweet pepper and its impact on garden pea grown on residual nutrients in sweet pepper-garden pea cropping sequence under protected

conditions. The experiment consisted of control treatment T_1 i.e. soil application of 100% recommended dose (120:90:60 kg per ha NPK) fertilizers (RDF) and six different combination of fertigation treatments viz., T_2 (75% RDF), T_3 (100% RDF), T_4 (125% RDF), T_5 (75% RDF + 75% RDM), T_6 (100% RDF + 100% RDM), T_7 (125% RDF + 125% RDM). The micronutrient mixture of Zn, Cu, Mn, B and Mo was applied at 0.5 per cent recommended dose (RDM) in the cv. Nishat-1 in sweet pepper followed by residual crop garden pea cv. Pb 89. Among all the treatments, fertigation treatments in general showed higher nutrient use efficiency irrespective of doses than soil application i.e. control treatment T_1 . The nutrient use efficiency of NPK was recorded maximum with treatment T_5 i.e. 59.87 per cent N, 66.47 per cent P and 67.31 per cent K respectively. The maximum average capsicum equivalent yield (CEY/ha) of 86.99 t/ha and net returns of 22.59 lakh/ha were observed with fertigation treatment T_5 with highest B : C ratio of 1 : 6.46 in sweet pepper - garden pea cropping sequence under greenhouse conditions.

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Influence of fertigation on quality attributes of sweet pepper and its impact on residual crop garden pea grown in cropping sequence under protected conditions

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In temperate regions, the extreme low temperatures and high moisture are the limiting factors in early summer crop production which drastically affect plant growth and quality of the produce. Therefore, the present experiment was carried out at Division of Vegetable Science, SKUAST-Kashmir during 2017-18 and 2018-19 to study the influence of different fertigation treatments on quality attributes of main crop sweet pepper and its impact on quality attributes of succeeding crop garden pea grown on residual nutrients in sweet pepper-garden pea cropping sequence under protected conditions. The experiment consist of control treatment T_1 i.e. soil application of 100 per cent recommended dose of 120 : 90 : 60 kg ha⁻¹ NPK fertilizers (RDF) and six different combination of fertigation treatments viz., T_2 (75% RDF), T_3 (100% RDF), T_4 (125% RDF), T_5 (75% RDF + 75% RDM), T_6 (100% RDF + 100% RDM), T_7 (125% RDF + 125% RDM). The micronutrient mixture of Zn, Cu, Mn, B and Mo was applied at 0.5 per cent recommended dose (RDM). The results indicated that timely and frequent application of nutrients through fertigation in general recorded superior quality in both sweet pepper and garden pea than soil application of nutrients. Among fertigation treatments, the combined application of macro and micronutrients proved better than sole application of macronutrients. Maximum TSS (4.54° Brix), ascorbic acid content (164.45 mg/100g) and fruit dry matter (25.95%) in sweet pepper were recorded with fertigation treatment T_5 receiving, while as in residual crop garden pea maximum total seed chlorophyll content (2.57 mg/g) and total protein content (27.73%) was recorded with residual treatment T_7 .

P-70

High density orcharding in fruit crops

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It is well known that the diversity in soil and climatic conditions in India permits growing of a large variety of tropical, sub-tropical and temperate fruit crops in different regions. Due to this, India is regarded

as a horticultural paradise. India is the second largest producer of the fruits in the world. Furthermore, the available land area for the fruit cultivation is becoming a limiting factor day by day due to rapid urbanization, fragmentation of the landholding and industrialization. In recent years, the concept of fruit production is undergoing a change, where emphasis is being given to higher production per unit area. High density planting system is the fastest way of reducing the gestation period and simultaneously increasing the productivity of the orchards and production per unit area of land. In present day scenario when land : man ratio is declining sharply, HDP offers high productivity per unit area both in short duration as well as perennial horticultural crops. In India, HDP has been successfully carried out in apple, peach, banana, pineapple, papaya, guava, mango and citrus, etc.

P-71

Effect of drip irrigation regimes and mulching on yield, quality and water use efficiency in potato (*Solanum tuberosum*)

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Potato is important crop of Uttar Pradesh and requires high irrigation frequency for improved yield and better quality. Crop is very sensitive to water scarcity and yield can drop by 40-60 per cent under water stress conditions. The ground water of potato growing areas of U.P. is declining very fast due to over exploitation, where furrow irrigation system is in use. Keeping in view the importance of judicious use of water, a study was conducted to find out efficient irrigation system regime for potato growing 2016-2018 on potato cv. Kufri Chipsona with an objective of improving yield and quality. The experiment comprised of seven treatment combinations i.e., T₁ (100% PE + polyethylene mulching), T₂ (80% PE + polyethylene mulching), T₃ (60% PE + polyethylene mulching), T₄ (100% PE without mulching), T₅ (80% without mulching), T₆ (60% without mulching) and T₇ (control) with three replications. The highest tuber weight (225 g) was recorded with application of irrigation at 80% PE per day per plant coupled with black polyethylene mulching. The minimum tuber weight (85 g) in the furrow irrigated plant (control). Yield varied from a maximum value of 38.3 t/ha in drip irrigation 80% PE level and black polyethylene mulching as compared to control (29.7 t/ha). Drip irrigation at 80% PE level coupled with polyethylene mulching resulted in improved quality of tubers in terms of increased starch content (20.9 %) followed by 100% drip irrigation with polyethylene mulching (19.2 %) as compared to control having comparable less starch (16.3 %). The study revealed that potato should be irrigated at 80% PE with polythene mulching for increased yield with starch content.

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Screening of mango hybrid population towards identification of hybrids with superior fruit quality attributes

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Mango (*Mangifera indica*) exhibits wide range of variability for various fruit morpho-physical traits in its natural population. With the changing consumer preference and awareness about the nutritional benefits of fruit the demand of nutritionally rich elite hybrids is increasing. Though there is increasing demand for superior mango hybrids from farmers, there are limited numbers of superior hybrids available for commercial cultivation. The present screening and evaluation was done with an objective of identifying

superior hybrids with better fruit quality parameters. Hybrid population consisting of hybrids resulting from hybridization between the diverse contrasting parental combinations was evaluated for various fruit physical parameters *viz.*, fruit weight, fruit length, peel weight, stone weight, pulp weight, stone length, stone width and stone thickness. The screening and evaluation revealed wide range of variability for various fruit physical parameters including fruit colour as indicated by wide CIE L*a*b* values. The pulp weight ranged from as low as 5 g to 992 g among the hybrids, while, the TSS varied between 7.2^oB to 28^oB with a mean of 19.48^oB. Appreciable number of hybrids (58.29 per cent) fell under the fruit weight range of 200-400 g and these hybrids will be further utilized to derive elite hybrid with attractive fruit quality attributes.

P-73

Bio-enhancers : A potential input for horticulture

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Bio-enhancers are organic preparation obtained by active fermentation of animal and plant residues over specific duration. These are the rich source of microbial consortia, macro and micronutrients and plant growth promoting substances including immunity enhancers. The popular bio-enhancers are *Panchgavya, Jivamrita, vermiwash, Beejamrita, Amritpani, etc.* These bio-enhancers are prepared by fermenting cow-based products over a definite time. In order to enhance its quality and attributes few other materials are also used in some bio enhancer. Bio-enhancers can be prepared at the farm with minimal infrastructure facilities and hands on training. The bio-enhancers can be applied through various ways *viz.* spraying, drenching, fertigation, *etc.* for all crop activities such as seed/seeding treatment, enhance decomposition of biomass, improve nutritive value of compost and thereby improve soil fertility, crop productivity & quality of produce. It has also been observed that these are effective tool for pest and disease management of horticultural crops. The miraculous effects of different bio-enhancers and their combinations have been observed in many horticultural crops like fruits (mango, guava, banana, strawberry, acid lime, *etc.*) vegetables (potato, tomato, cole crops, amaranth, spinach, *etc.*) and in commercial flower crops like rose, marigold, gladiolus, jasmine, *etc.* Use of bio-enhancers as an input in horticulture crops is a need of hour not to just produce organic product but also to safeguard to soil, human and environmental health. Further, bio-enhancers minimize the input cost, which make it commercially viable for growers to enhance their income.

P-74

Genetic studies in cherry tomato (*Solanum lycopersicum* var. *cerasiforme* L.)

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The present investigation was carried out at Experimental Field, Division of Vegetable Science, Sher-e-Kashmir University of Agricultural Science and Technology, Kashmir, Shalimar, Srinagar. The experimental material comprised of 29 genotypes of cherry tomato. The experiment was laid out in randomised complete block design (RCBD) with three replications. The analysis of variance was significant for all the characters indicating genetic variability in the genotypes under the study except number of locules per fruit. The highest phenotypic and genotypic coefficient of variation were observed for lycopene

(43.12, 42.94), total carotenoids (42.82, 42.51), average fruit weight (42.52, 42.50), fruit yield per hectare (42.29, 42.24). In general PCV was marginally higher than the corresponding GCV indicating the less influence of environment in the expression of traits under study. High heritability coupled with high genetic advance as percentage of mean was observed for almost all characters indicating that most of the traits studied were mainly controlled by additive gene effect and thus selection may be effective. Correlation coefficients revealed that the fruit yield per hectare exhibited significant positive association with plant height, number of branches, average fruit weight, number of flowers per cluster, number of fruits per cluster, average fruit length and average fruit width.

P-75

Dietary antioxidant profiling of diverse bael genotypes fruits

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The phytochemicals present in fruits have been reported to prevent oxidative stress related diseases. Bael fruits are considered rich in several natural bioactive compounds, antioxidants are among them. The natural antioxidants present in fruits, exhibit a wide range of biological effects and health benefits. Antioxidants are categorized in two broad group *i.e.*, non- enzymatic and enzymatic antioxidants. The experiment was laid out in a Completely Randomized Design, which was comprised of 18 different Bael genotypes. In the present study the non-enzymatic antioxidants evaluated in bael genotypes are ascorbic acid, pectin, riboflavin, total phenol, total carotenoids, total flavonoids and marmelosin, whereas, the enzymatic antioxidants evaluated are SOD, CAT, POD. The enzymatic activity measures by DPPH radical scavenging method. The DPPH radical scavenging activity varies from 40.32 to 81.10 per cent. The significant wide variations among the diverse bael genotypes were obtained for the presence of various non-enzymatic and enzymatic antioxidants and their activity. Therefore, bael fruits of different genotypes can be used as a potential source of dietary antioxidants and may impart health benefits when it is used as nutraceutically rich functional food product in future.

P-76

Establishing heterogeneity in clones of mango (*Mangifera indica* L.) cv. Dashehari through stone and kernel parameters

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The present study was carried out to assess the heterogeneity in clones of Dashehari mango on the basis of stone and kernel parameters. The study was conducted in two blocks of district Lucknow *viz.* Malihabad and Mal during the year 2016-18 and analysis of stone and kernel parameters was carried out in the Horticulture Laboratory, Department of Horticulture, BBAU, Lucknow. The significant clonal heterogeneity in stone weight was observed to range from 24.17 to 33.50 cm, pulp : stone ratio 4.36 to 8.04, stone volume 22.67 to 31.83, specific gravity of stone 1.02 to 1.10, stone length 8.99 to 11.75 cm, stone width 2.72 to 4.14 cm and stone thickness 1.44 to 1.93. Among the kernel parameters kernel length ranged from 3.65 to 6.64 cm, kernel width 1.46 to 4.13 and kernel thickness 1.04 to 2.07. Kernel parameters showed narrow difference between PCV and GCV indicating the expression of these parameters were not an effect of the environment and were thus, an expression of the genotype. Among the biometrical

parameters, the highest PCV (22.15 %) and GCV (19.65 %) were recorded for kernel width followed by kernel thickness and kernel length. The highest heritability (85.50 %) and genetic advance (2.80 %) was recorded for kernel length, while the highest genetic advance as percent of mean (75.35 %) was recorded for kernel thickness. The study indicates clonal heterogeneity in stone and kernel characters may be exploited for selection of improved Dashehari clones because these parameters show narrow differences between PCV and GCV indicating that they are influenced at genetic level, have high heritability aiding selection of superior morphotypes.

P-77

Influence of growth regulators on germination and growth of jackfruit (*Artocarpus heterophyllus* Lam.)

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The experiment was carried out during the year 2013 at Regional Horticultural Research Station, ASPEE College of Horticulture & Forestry, Navsari Agricultural University, Navsari. The experiment was laid out in Completely Randomized Design with Factorial concept having fourteen treatment combinations, comprising of two levels of soaking hour *viz.*, 12 and 24 hour and six levels of growth regulators *viz.*, NAA 10, 25 and 50 mg l⁻¹, GA₃ 50, 100 and 250 mg l⁻¹ and distilled water. The results revealed that among the different soaking hour and growth regulators, 12 hour and GA₃ 100 mg l⁻¹ were individually found to be most beneficial for minimized days for germination and improving germination percentage. Similar trend was observed on growth parameters such as height of plant, girth of plant, number of leaves, leaf area, length of longest shoot, number of internodes, fresh weight and dry weight of plant, length of longest root, girth of longest root and survival percentage. The interaction between soaking hour and growth regulators for all parameters were found non significant.

P-78

Effect of different shading conditions on growth and flowering response of heliconia (*Heliconia* spp.) varieties

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An experiment was conducted during 2014-17 to find out the growth and flowering response of four heliconia varieties *viz.*, *Heliconia psittacorum* cv. Red Torch, *Heliconia psittacorum* × *Heliconia stricta* cv. Golden Torch, *Heliconia psittacorum* cv. Kenea Red and *Heliconia latispatha* cv. Orange under varied shading conditions (25 %, 50 % and 75 % green shade net) at Floriculture Research Farm, NAU, Navsari. The experiment was laid out in Randomized Block Design with factorial concept (FRBD) with three replications. The pooled analysed data revealed that growth and yield parameters of all the four varieties were significantly influenced under varied shading conditions. The overall performance of all the four varieties was best under 25 % shade net condition for many growth and flowering parameters and recorded significantly maximum number of suckers per clump (20.53), number of rhizomes per clump (41.62), biomass content (5.90 kg), number of bracts per rachis (5.65), number of florets per bract (31.13), stalk length (66.49 cm) and number of spikes per clump (23.63) followed by 50 % and 75 % shade net conditions. The interaction effect between different shading conditions and heliconia varieties showed

that Orange variety recorded significantly maximum number of spikes per clump (38.02) followed by Golden Torch, Kenea Red and Red Torch under 25 % shade net.

P-79

Correlation and path analysis studies in *Anthurium andraeanum* [Hort.]

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Anthurium is one of the important tropical ornamental plants grown for its colourful spathe and attractive foliage. Many popular varieties of Anthurium can be grown commercially under protected structures in many parts of the country successfully. Therefore a study was conducted to analyze the relative performance and nature of characters association of ten different Anthurium varieties during 2013-2017 in the Department of Floriculture & Landscaping at Biotechnology-cum-Tissue culture Centre, OUAT, Bhubaneswar. The study was undertaken with an objective to find out the most promising commercial varieties following completely randomized design with three replications under shade net house condition. The observations on various plant and flower characters obtained from the experiment were analyzed using appropriate statistical methods. The study revealed that spathe area ($r_g = 0.916$; $r_p = 0.852$), spathe width ($r_g = 0.903$; $r_p = 0.843$), peduncle diameter ($r_g = 0.893$; $r_p = 0.842$), spathe length ($r_g = 0.887$; $r_p = 0.813$) and plant height ($r_g = 0.843$; $r_p = 0.787$) exhibited significant and positive association with flower yield whereas, inclination of spadix to spathe ($r_g = -0.529$, $r_p = -0.492$) and days to flower initiation ($r_g = -0.483$; $r_p = -0.451$) established significant negative correlation with flower yield both at genotypic and phenotypic levels. However, leaf width (0.683) manifested the highest positive direct contribution to flower yield followed by leaf area (0.446), spathe area (0.194) and plant spread (0.157) at genotypic level whereas, at phenotypic level plant height (1.022) contributed the highest direct effect on flower yield followed by spathe area (0.855) and leaf area (0.637).

THEME 3

STRUCTURES/MODELS, ARTIFICIAL INTELLIGENCE, AUTOMATION/ TECHNIQUES FOR FUTURE NEEDS

ORAL SESSION

O-32

Low cost ripening chamber : A boon for mango growers

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Mangoes are harvested at pre mature stage and are ripened by using chemicals such as calcium carbide, which not only poss health problem and environmental risks but also results in uneven ripening. Uniform ripening of mango is possible in ripening chambers which however, requires huge investment. Under such situations farmers have to sell unripe fruits to middlemen or traders who harvest maximum profit by selling them after ripening. The fruit ripening under Low Cost Ripening Chamber was standardized under south Gujarat climatic conditions during May, 2014 at Agriculture Experimental Station (NAU), Paria-Valsad, Gujarat, in which ethylene gas is used for ripening mango as in natural way. Mango fruits cv. Alphonso of different maturity stages were harvested and sorted out according to their maturity (M_1 - 80%, M_2 - 90% and M_3 - 100% maturity). The fruits were exposed to ethylene (100 ppm) for three different durations (E_1 - 12 hrs, E_2 - 24 hrs, E_3 - 36 hrs) under the low cost ripening chambers *i.e.* air tight plastic tents (7 x 7 x 7' size). Nine treatments (T_1 - M_1E_1 , T_2 - M_1E_2 , T_3 - M_1E_3 , T_4 - M_2E_1 , T_5 - M_2E_2 , T_6 - M_2E_3 , T_7 - M_3E_1 , T_8 - M_3E_2 , T_9 - M_3E_3) were given and the fruits were evaluated for physio-chemical characters. The treatment T_7 *i.e.* fruits harvested at 100 per cent maturity exposed to ethylene for 12 hours was found to be the best for obtaining good quality fruits with significantly best results in case of organoleptic score (8.37), total soluble sugars (20.05), reducing sugars (3.95), non reducing sugars (11.99) and total sugars (15.94). It is possible to get an early and uniform ripening of mango fruits to fetch high market prices by using this technique and hence, may prove to be l a boon for the mango growers and retailers.

O-33

Improving productivity of overcrowded and unproductive HDP mango orchard

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Canopy reorientation program was carried out in old unproductive and overcrowded high density mango orchard of 22 years old, involving three pruning heights (1.5, 2.0 and 2.5 meter) and organic mulching, during January, 2016 to evaluate the effect of mechanical intervention on overcrowded unproductive orchard of mango cv. Dashehari at two spacing (2.5 m X 2.5 m and 5 m X 2.5 m). Trees spaced at 2.5 m X 2.5 m had significantly highest primary and secondary shoot diameter by 20.87 and 52.91 per cent, respectively. Application of organic mulch improved tree spread and primary shoot diameter by 26.04 and 11.67 per cent, respectively. Fruit yield and fruit diameter were respectively 33.12 and 5.71 per cent more in orchard of 5 m X 2.5 m. More than 78 per cent of trees experienced flowering during 3rd years of severe pruning. Fruit weight was 8.94 per cent more in orchard of 2.5 m X 2.5 m. Trees pruned at 2.5 m recorded highest fruit yield (2.30 kg/ plant), which was at par with the trees

pruned at 2.0 m (1.80 kg/ plant). However, maximum fruit weight was recorded in trees pruned at 1.5 m height (292.08 g). Fruit yield was 48.98 per cent more in control trees than organic mulching. However, fruit length and weight were 8.39 and 15.16 per cent more in organic mulching. Thus canopy productivity can be improved in overcrowded high density orchard by standardizing the height of pruning and addition of organic mulch.

O-34

Integrated fruit crop model : a boon for doubling farmers income

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India is the second largest producer of fruit and vegetables in the world. During the year 2017-18 country produced 97 million metric tons of fruits and 179.69 million metric tons of vegetables. Fruit crops not only play an important role in providing nutritional security but its cultivation significantly enhances income of the fruit growers per unit area and time. On a changing scenario of shrinking land holding with increased cost of cultivation as well as water scarcity (depleting water table in several part of the country), the integrated farming of fruit crops involving planting of different fruits *i.e.* mango, jamun, pomegranate, guava and papaya at 5-6 meter distance on a raised bed with drip irrigation system on a same field proved to be boon for the farmers of Andhra Pradesh and Maharashtra. The survey made during the year 2013-15 revealed that high density planting of the above fruit crops along with guava varieties Lalit and Shweta not only provided more income per unit area and time but also provided fruit growers a crop insurance. Due to the involvement of the different fruit crops in the system, provides better return (in case of low price of any of the fruit crop of the system either due to more production or failure). Thus, farmers are always in a win-win situation by adopting the integrated fruit production model.

O-35

Genetic diversity, population structure of teasel gourd in north eastern states of India and strategies for improvement

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Teasel gourd (*Momordica subangulata* sub sp. *renigera*) is an important dioecious, vegetatively propagated, underutilized cucurbit vegetable crop of India. Genetic polymorphism amid plant species is a crucial factor for plant improvement and maintaining their biodiversity. The present investigation was undertaken during 2015-18 to assess the genetic diversity in teasel gourd based on morphological traits and microsatellite makers using 70 accessions including 8 males collected from different parts of north eastern states of India. Wide variation was recorded for leaf, flower and fruit characteristics. Fruit weight ranged from 22.8 g to 129.3 g, fruit length 4.76 to 11.23 cm, number of fruits/plant 3.67 to 25.33 and yield per plant 0.15-2.65 kg, number of seeds per fruits 23 to 51.33 and 100 seed weight 12.60 to 36.3 g and vitamin C content 44.80 to 79.68 mg/100g. Among the accessions, high yielding lines were RCTG-8 (2.6 kg) followed by RCTG-26 (1.79 kg), RCTG-20 (1.077 kg) and RCTG-15 (1.63 kg). In molecular analysis, out of 43 SSR markers 4 were found polymorphic and the polymorphism information content ranged from 0.08 (Sed-09) - 0.68 (McSSR-5). Cluster analysis based on Nei's genetic distance ranged from 0.25-0.69, indicating the presence of wider diversity in population. Among the individual the genetic diversity was 76.0 per cent, while within the individual, it was 24 per cent. Among the accessions, the proportion

of accessions with admixture in male and females were few due to the different geographical origin and clonal propagation. Being a dioecious crop, it can be improved through mating by induction of hermaphrodite sex form using silver nitrate (500 ppm) in female accessions.

O-36

Opportunities of turfgrass industry in India

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Turfgrasses are ubiquitous in urban landscape and works as the primary vegetative cover on home lawns, athletic fields, cemeteries, churches, commercial buildings, golf courses, airports, schools, parks, roadsides, etc. An increasing awareness about the sports, degrading environment and the increase in real estate value of the property has effectively increased the area under aesthetic and utility turfs. Turfgrasses industry covers more than 30,000 acres, in which around 6000 acre is under turfgrass cultivation and sod production in India and rest under functional turfs. The total number of international cricket grounds in India is 52 and more than 520 domestic cricket grounds and athletic fields are also in operation. In India, there are more than 255 golf courses and 25 per cent of them come under defence. Indian turfgrass industry is growing around 10 per cent annually. Landscape business contributes 2-3 per cent of total construction and turf has around 50-70 per cent of landscape business. India has varied agro-climatic conditions and diverse local turf genotypes are present as wild ecotypes so turfgrass breeding according to various purposes such as landscaping, utility, sports and for low maintenance area are the need of hour. The turfgrass industry will grow and change rapidly in the years to come, with increasing emphasis on protecting the environment through best management practices.

O-37

Rarity and prioritization of species for conservation and management in Uttarakhand

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The International Union for Conservation of Nature and Natural Resources (IUCN) has estimated about 10 per cent of the vascular plants of the globe under threat. The frequency of the vulnerability of species is increasing. Due to this the Indian Himalayan Region, 121 species of vascular plants have been listed in the Red Data Book of Indian plants and 120 species of medicinal plants have been placed into different categories of rarity. A few attempts have been made in the IHR for the identification of rarity using four attributes *i.e.*, habitat preference, population size, distribution range and anthropogenic pressures. However, the focused studies in the watersheds and catchments of the tropical, sub-tropical and temperate zones on rare-endangered plants have not been carried out so far. In the present study, 100 species (25 trees, 32 shrubs and 46 herbs) belonging to 92 genera and 60 families have been identified as rare endangered from the Gola catchment. Along an altitudinal gradient maximum species (95 spp.) were distributed in the zone 200-1800 m, followed by 46 spp. in the zone 1801-2610 m. Two species *i.e.*, *Dioscorea deltoidea* (vulnerable) and *Pittosporum eriocarpum* (indeterminate) have been recorded in the Red Data Book of Indian Plants (IUCN). The species have been also categorized as critically endangered (*Lilium polyphyllum*), endangered (*Berberis aristata*, *Datisca cannabina*, *Dioscorea deltoidea*, *Paris polyphylla*, *Swertia*

angustifolia and *Zanthoxylum armatum*), vulnerable (*Didymocarpus pedicellata*), near threatened (*Celastrus paniculata*) and least concerned (*Evolvulus alsinoides*). In order to protect and multiply the endangered species a regional botanical garden, horticulture tourism with knowledge and skill based activities need to be established at different altitudes.

O-38

Scope of Blueberry (*Vaccinium corymbosum*) as a future fruit for diversification under changing climatic scenario in India

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Blueberries are being grown on commercial scale worldwide. USA is leading producer in the world followed by Canada. In Asia, the total area under its production is estimated to be 4506 ha. Its commercial cultivation has not been reported in India, but at CSKHPKV, Palampur HP, few cultivars were introduced during 2006-07 and have shown adaptive under mid-hill condition of HP. From the experiments conducted in the university, it was observed that southern highbush cultivars *viz.*, Jewel, Misty, Gulf Coast and Sharpblue have shown very encouraging results with satisfactory growth, flowering and fruiting under prevailing agro-climatic conditions. Besides SHB, two rabbiteye blueberry cultivars (Alapaha and Austin) are also performing well under these conditions. All these genotypes had TSS content more than 10 per cent with titratable acidity ranging from 0.57 to 0.87 per cent. Similarly, the variation in berry size was also observed and it was recorded maximum (1.83 g) in cultivar Jewel and minimum (0.99 g) in Alapaha. In terms of production efficiency of these genotypes, the average yield was observed to be 200 - 250 g per bush, which is very low as compared to other blueberry growing countries of the world. However, in some cultivars the yield was recorded maximum (up to 3.0 kg/bush) in the year 2018-19. From our studies, it can be concluded that the highbush blueberries can be grown under mid-hill conditions of the state Himachal Pradesh, India and have very good potential in diversification of fruits for future.

O-39

Organic fruit culture: Need of the day

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Organic farming is a method of crop and livestock production that involves much more than choosing not to use pesticides, fertilizers, genetically modified organisms, antibiotics and growth hormones. Organic production is a holistic system designed to optimize the productivity and fitness of diverse communities within the agro-ecosystem, including soil organisms, plants, crop residues, animal manures, livestock, legumes, green manures, off-farm organic wastes and people. The principal goal of organic production is to develop enterprises that are sustainable and harmonious with the environment to maintain soil productivity and tilt, to support plant nutrients and to control the infestation of weeds insect/pest and diseases. International organic community and Canadian Organic Standards (2006) agreed on a common understanding of what the principles of organic agriculture and made standards based on a number of principles that show that organic culture is much more than renouncing the use of agro-chemicals. The major inputs demanding in making strategies for organic cultivation, which required to be addressed, are nutrient management, insect-pest management and disease management. The options such as Homa farming, Biodynamic farming, Nature farming, Bio-dynamic farming, compost and composting,

mulching *etc.* are available for suitable use as resources in organic cultivation. In this way by using above techniques, one can successfully do organic cultivation of fruits without reduction in yield. These produces are highly beneficial for human health and are free from harmful effect of insecticide, pesticides and other chemicals. This paper deals in detail with the prospects of organic food culture for the present and future generation.

O-40

Futuristic approach for nutritional security and farmer's prosperity through harnessing potential of underutilized fruit bael (*Aegle mormelos* L. Correa)

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Bael (*Aegle mormelos* Correa) is an important indigenous underutilized fruit tree of India. The presence of many bioactive components throughout the tree renders it a therapeutically important fruit tree. Bael fruit is rich in antioxidants and phytochemicals along with some essential nutrients like vitamins, minerals and dietary fibers. The phytochemicals and vitamins present in bael fruit are marmelosin, psoralen, luvangetin, carotene, ascorbic acid, *etc.* Marmelosin (C₁₆H₁₄O₄) is believed to be the main therapeutically active principle of bael due to its antihelminthic, antibacterial, laxative and diuretic properties. It is known as panacea of stomach ailments. It is also found effective in curing two skin diseases, psoriasis and vitiligo, by increasing skin's tolerance to sunlight. Tannic acid or tannin is believed to be the only phenolic compound detected in fruit. The characteristics of Indian bael fruit in terms of bioactive molecules and specific flavour can be considered to have a potential for use as functional foods and value added products in days to come. Improved varieties of bael, *viz.*, Narendra Bael-5, Narendra Bael-9, Pant Shivani, Pant Aparna, Pant Sujata, CISH-B-1 and CISH-B-2 have been developed, characterized and evaluated for different traits of horticultural importance and nutraceutical value. These varieties have been advocated for commercial cultivation. Apart from that the work on germplasm collection (having high marmolasin and processing attributes) is also in progress. Hence, nutraceutical value of different bael cultivars along with recent developments in plant propagation, agro techniques, management of diseases, pest and disorder, processing as well as strategy for organic production of bael will be discussed.

O-41

Technological interventions for sustaining hill horticulture under changing climate

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Horticulture sector has gained prominence over the last few years in terms of economy and production. Significant progress in area and production has been made in horticulture resulting in higher production. Over the last decade, the area under horticulture grew by 2.6 per cent per annum and annual production increased by 4.8 per cent. During the year 2017-18, the production of horticultural crops was 311.71 m.t. from an area of 25.43 m.ha. The horticulture sector in India is characterized by small and segregated farms with low yield per unit area and huge post-harvest loses, owing to outdated package of practices and poor adoption of climate resilient technologies. The world economy has adversely been influenced by extreme weather conditions *viz.*, hot and cold waves, droughts, floods, hailstorm, avalanche, thunder clouds, landslides associated with lightning and rise of sea level as well as natural calamities, such as earthquake, tsunami and volcanic eruption may responsible for the change of chemical composition of

atmosphere (IPCC, 2013). Horticultural crops particularly fruit and vegetable crops are relatively resilient to the climate change. Vegetables are mostly grown by small and marginal farmers and augment the income of the farmers. The technological change has been major driving force for increasing horticultural and agricultural productivity and promoting development of these sectors. Number of useful cost effective technologies are available to sustain the hill horticulture. Some of the technologies developed by ICAR-Central Institute of Temperate Horticulture are discussed in this paper.

O-42

***In vitro* conservation of plant diversity for future**

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About 80,000 species of plants have been used since human civilization for various purposes. At present 30 crops are reported to feed the world. Wheat, rice, maize, sorghum, millet, potato, sweet potato, soybean, sugarcane and sugarbeet are the 10 crops which provide 75 per cent of the total plant-based calorie intake. Besides, region based-underutilized crops, species and crop wild relatives play an important role towards the food security and income generation. Globally, many species have been lost due to habitat destruction and/or over exploitation. A lot of efforts have been put in world-wide to conserve the diversity of plants and plant genetic resources using various strategies and approaches. *In situ* and *ex situ* conservation methods have been practiced for conserving the diversity. In the *in vitro* gene bank germplasm could be conserved at normal growth, slow growth or suspended growth conditions. Conservation at slow growth conditions can be achieved using many approaches such as reducing temperature and light, altering media composition, adding growth retardants *etc.* For long-term conservation, diverse explants (seeds, zygotic embryos, shoot tips, dormant buds, pollen, DNA *etc.*) are cryopreserved under the liquid nitrogen at -196°C. Several techniques, which are based on phenomenon of vitrification, are being used for cryopreservation of shoot tips. The commonly used techniques are encapsulation dehydration, vitrification, encapsulation vitrification, droplet vitrification and very recent ones: V cryo plate and D cryoplate. India has world's second largest National Genebank at ICAR-NBPGR, New Delhi, that has state of art facilities including Seed Genebank (~4 lakh accessions), In Vitro Genebank (~1,800 accessions) and Cryo Genebank (~13,000 accessions). This review paper presents an overview of various aspects of conservation of plant diversity.

O-43

Future of protected cultivation and grafting in vegetable crops

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Protected cultivation is a fastest developing horticulture sector across the globe and has taken a new dimension in recent years. To a large extent, vegetable grafting is credited for the success of protected cultivation in many western and eastern Asia countries, including China, who is leader in both protected cultivation and grafted plants use. Technological advancement is going on in the area of protected cultivation and vegetable grafting. Development of trait specific interspecific hybrid rootstocks, advent of grafting robots and setting up of specialized grafting nurseries in vegetable grafting, while climate controlled greenhouse with or without deploying renewable energy, targeted spectra based LED grow lights, artificial intelligence, hydroponics and vertical farming/ plant factory, and so on in protected

cultivation are new dimension in these sectors. Though India is far behind in matching with the technological advancement happened elsewhere, marching ahead with a greater pace in these direction. A great potential exists in the country to enhance vegetables production with conservative use of natural resources by harnessing the potential of these technologies.

O-44

Genetic resources and improvement of apricot (*Prunus armeniaca* L.) in north western Himalayan region

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Apricot (*Prunus armeniaca*) is an attractive, delicious and highly nutritious fruit being cultivated in temperate climate. In India, apricot is mainly cultivated in Jammu and Kashmir, Himachal Pradesh, Uttarakhand, and to a limited extent in North-eastern hills. At ICAR-IARI Regional Station, Amartara Cottage, Shimla twenty five apricot germplasm have been collected and same is being evaluated for its improvement. Based on observations during 2013 to 2016 tree height varied from 2.16 - 5.75 m, girth from 30.5 cm to 98.5 cm with maximum in Charmagaz (98.5 cm) and minimum in Nugget (30.5 cm). Canopy spread in East-West direction varied from 2.13 m - 7.0 m with the maximum in Charmagaz (7.0 m) and minimum in Harcot (2.13 m). Plant dormancy varies from 129-154 days in different genotypes of apricot. Highest fruit set was recorded in EC-168342 (46.32 %) and minimum found in Harcot (11.78 %). The fruit weight was maximum in EC-168342 (86.56 g) and minimum in Nugget (20.07 g). Pulp weight was also recorded maximum in EC-168342 (82.44 g) and minimum in Nugget (17.74 g). Fruit yield varied from 5.31-26.13t/ha with maximum in EC-168342 (26.13 t/ha) and minimum in Nugget (5.31 t/ha). Dry matter content varied from 18.01-26.66 % with maximum in New Castle (26.66 %). Total soluble solids (TSS) was recorded maximum in Charmagaz (18.31 %) and minimum in Harcot (12.83 %). Acidity in fruit was recorded highest in EC-168342 (2.01 %) and minimum in Nari Kinnaur (0.98 %). The highest reducing sugar was observed in Nari Kinnaur (7.21 %) with minimum was recorded in EC-232328 (3.16 %). Non-reducing sugar varied from 4.52-9.24 % with maximum in Castle (9.24 %).

O-45

Genetic improvement of onion and garlic in India

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Onion (*Allium cepa* L.) is highly cross pollinated and important spices as well as vegetable crop throughout the world. Diverse genetic materials are required to meet the ever changing demands of plant improvement. Diversity in onion species occurs in the form of land races, traditional varieties, wild edible forms and related non-edible wild and weedy species. ICAR-Directorate of Onion and Garlic Research, Rajgurunagar, Pune has been identified as a National Active Germplasm Site for onion and garlic germplasm collection and conservation in the country. Extensive germplasm surveys have been done from 15 states of the country. A gene pool of dark red, light red, white and yellow onion types has been collected. A total of 1231 onion and 650 garlic germplasm are being maintained at ICAR-DOGR. About 70 onion varieties and 25 garlic varieties have been developed and released from public sectors for different locations and seasons at state or national level. Based on genetic improvement and selection in the available germplasm at ICAR-DOGR, ten onion and two garlic varieties have been released at

national level. Among these red onion varieties *viz.*; Bhima Super, Bhima Red, Bhima Raj, Bhima Dark Red, and white onion varieties Bhima Shubhra and Bhima Safed are suitable for *kharif* season whereas Bhima Shakti (red), Bhima Kiran (red), Bhima Light Red (red) and Bhima Shweta (white) are suitable for *rabi* season. Bhima Shakti, Bhima Super, Bhima Red, Bhima Raj and Bhima Shubhra are also suitable for late *kharif* which indicates that these varieties have wider adaptability for changing climate.

O-46

Potential roles of information technology (IT) tools in increasing farmers' income

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Horticultural crops play a unique role in India's economy by improving the income of rural people. India has emerged as the second largest producer of fruits and vegetables in the world. Digital India programme, launched by Hon'ble PM of India in the year 2015, with targets to the advancement of the knowledge in the area of Information and Communication Technology (ICT) and creation of ICT infrastructure for enabling rural peoples. The share of Indian population is about 30 per cent of the total number of the smart phone users in the world, making it the second largest Smartphone user's country in the world. Mobile apps are excellent tools to provide different types of information on smart phones such as market price, package of practices for crops, preparation of quality processed products of fruits, and similar types of other information dissemination. The applications of Information Technology to ameliorate the dissemination of information, thereby improve the knowledge of farmers, which results working towards making agriculture sustainable. This digital transformation is working for transforming of Indian agricultural conditions. Six mobile apps on processed fruit products and an expert system on mango for crop production and protection advisories have been developed at ICAR-CISH. These apps are- Raw Mango products (in Hindi and English separately), Ripe Mango Products (Hindi and English separately), Guava Kitchen Recipes (in Hindi) and Guava Processed Products (in English) Android apps are available on GOOGLE PLAY for free download and use. It provides recipes for preparation of quality products of mango and guava.

O-47

Underutilized edible wild fruits of Manipur: Need for conservation and domestication

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Hill districts of Manipur, under Indo-Burma biodiversity hotspot, comprise of a large variety of wild-growing plants species that are used for food and other requirements by the local communities. These areas harbor a variety of indigenous fruit trees also that grow in the wild. The six most prominent fruit species such as *Prunus nepalensis* Ser. (Steud) (Rosaceae), *Pyrus pashia* Buch. Ham. ex. D. Don (Rosaceae), *Docynia indica* (Wall.) (Rosaceae), *Spondias axillaris* Roxb. (Anacardiaceae), *Flacourtia jangomas* (Lour.) Raeusch. (Salicaceae) and *Baccaurea ramiflora* Lour. (Euphorbiaceae) are facing maximum pressure in their natural habitats as there are high demands by the locals and vendors of nearby towns. Parameter such as proximate values and mineral content were analyzed. These fruits were observed to be nutritionally rich. These fruits could be explored and utilized for the production of value added products, which could fetch higher price in the market. The counts of these species are very less in their natural

habitats, though the yield per tree is comparable to commercial species. Moreover, collection of any edible wild fruit is unsystematic and threatening for the survival of the plant itself. Therefore, these fruit trees need to be prioritized for conservation in their natural habitats, domesticate in farmer land or homestead. Considering their demands and nutritional status, the fruit trees need to be cultivated in large scale for household and commercial purpose.

O-48

Adopt grape growing in new areas for better returns

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Presence of grape growing in many countries shows its wide adaptability under different climatic conditions, consumer demand, better returns and processing ability. In India, grape is commercially grown in tropical regions of Maharashtra and Karnataka states. These regions produce about 95 per cent of total production. Main factors contributing towards profitable grape production in these areas are varieties, rootstocks, adoption of micro-irrigation and fertigation techniques, staggered pruning, weather forecast based advisories, well established processing industry, awareness amongst grape growers, traceability system for export through Grapenet, supportive Govt. policies, etc. Identification of suitable varieties, proper training and pruning of vines with desired canopy, growth stagewise application of water, nutrient application based on soil and petiole analysis, application of growth regulators, etc. are key factors to produce quality grapes with commercial yield. Improved know-how, technological interventions, support of processing industry and encouraging policies can lead to develop grape industry in temperate and sub-tropical regions of country. Grape production under plastic cover will open unlimited opportunities to farmers. With introduction of ICAR-NRCG varieties Manjari Naveen for fresh grapes and Manjari Kishmish for raisin making along with adoption of Manjari Medika variety for zero waste processing can change the grape viticultural scenario. Development of strong supply chain and establishment of processing industry will not only support grape growing in new areas, it will ensure improved return to farmers, better produce quality to satisfy consumers and employment opportunities.

O-49

A modern tool for future horticulture - Smart hydroponics

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Agriculture as we all know has always been the backbone of India's Economy, still in the absence of progressive technologies in horticulture our growers despite their hard efforts lag behind in quality and quantity produce, but now as the technology is taking leap in every aspect of life, horticulture too deserve a deep look into the futuristic technologies to take the sector to the new heights the need of the hour. Our company Saveer Biotech Ltd. constantly working in the arena almost 10 years back, anticipated hydroponic can address those questions and indeed will prove a futuristic horticulture solution. The tools like different sensors temperature, humidity, light, carbon dioxide, soil and water evaluation which are aligned with the software takes care of nutrition, other plant care, weather tracking and efficient climate control *i.e.* to provide ambient climatic conditions to the hydroponic crops in greenhouses. The greenhouses for the hydroponic crop production are specially designed keeping in view the monitoring of the hydroponic crops and to avert the danger threshold of climatic conditions we usually have in most of the states in India. This offers many advantages, the most obvious is the ability to grow within

urban environments and thus have fresher foods available faster and at lower costs and that too throughout the year, farmers and prospective entrepreneurs in all areas can use it to make better use of available land and to grow crops that wouldn't normally be viable in those locations.

O-50

Decision support tools for effective pest management in mango (*Mangifera indica* L.)

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Integrated Pest Management (IPM) strategies have acquired importance under the plant protection umbrella, but they are found inadequate in terms of utilization of weather based information that can improve their efficacy many folds. The most sensible approach is to make the best use of knowledge on meteorological influence on the incidence on insect pests and diseases for adoption of suitable management practices. In order to reduce the losses, the farmers need to be informed regarding the prevailing weather and forewarn the farmers about the impending weather, its effect on pest incidence and for implementation of management operations. The main requirements for developing pest forecasting models are data on weather parameters, pest population, disease severity, natural enemies and crop phenology. Models when developed on the lead time concept will indeed provide opportunity for use in preparation of Agrometeorological Advisories and thereby help in forewarning the farmers for taking up necessary steps in time. Pest management involves intensive decision making requiring effective decision support tools. Mango is grown throughout the subtropics and tropics and is one of the world's most important fruit crops. Although mango is affected by large number of insect pests and diseases but some are of great economic importance and are responsible for high loss in the mango production in our country. These insect pests are mango hopper, mealy bug, midge, leaf webber, scale insects, stem borer and fruit fly. As it is not possible to control all insect pests completely, decision support tools helps in keeping the pest under check by adopting management strategies in advance. Decision support tools developed for the important mango pests will be presented.

O-51

Application of information technology to curtail the cost of pest management by appropriate diagnosis : A case study with mango and guava

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Mango and guava farmers, many a times have immense misunderstanding in symptoms and ultimately whatever management efforts they made it will go in vain. Farmers' use to try quite a lot of alternate treatments at shorter intervals and cost of crop protection goes high. The major confusions have been observed in the symptoms caused by insects like yellowing and shedding of leaves due to scale insect infestation, necrosis caused by gall midge and galls created by shoot gall psylla insect. It has been difficult for farmers to differentiate between the symptoms of twig drying, dieback, decline and wilt. Similarly, symptoms of guava decline are confused with nutrient deficiency or wilt. Therefore, it is quite necessary to know the symptoms of diseases and insect pests of the crops. Our observations indicated 4 times use of chemical means of pest management at critical stages in mango may provide maximum economic returns with the protection of ecosystem. With this background our effort must be towards enhancement of knowledge of farmers and their understanding towards nature and human health along with

maximizing net returns from crop production. The best options available with us to reach the needy farmers' are the revolution in electronic means of knowledge flow, particularly by internet on mobile and gradually increasing literacy among the farmers. We have made efforts to reach the farmers through the whatsapp groups and web based agro advisories. These initiative yielded best results and we curtailed the cost of pest management effectively and educated the farmers to save the environment from dreaded pesticides.

O-52

Will dragon fruit become a super future fruit for India?

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Dragon fruit a native of South America (Mexico) is now continuing its journey over 22 countries around the world. India is one of the countries adopting the crop very fast in recent few years as an exotic fruit crop. In the present day research and development the question is whether we should promote this fruit or not for Indian farmers, since it is exotic in nature. Yes, it can be a super future fruit for India and it is being categorically discussing here. Firstly, demand is increasing day by day in Indian market leading to increase the rate of dragon fruit at Rs. 250-400 per kg (Rs. 700 - 900 in Nepal) since 95 per cent is imported from other south Asian countries. So, there is scope for the farmers to get better profit through it. Secondly, it is clear that the increase of its demand is due to its immense potential for pharmaceutical industry having number of nutraceuticals to be used against heart problems, diabetes, cancer therapy, indigestion, bone related problems *etc.* Further, it has wide adaptability to grow from sandy loam soil to calcareous soil with subtropical to tropical rainforest and to the drier tracts in India having less water requirement. It is estimated that a progressive growers can earn at least 15-20 lakhs of rupees from one hectare land from 4-5 years of establishment at the present market price. Besides this, it has a good Agro-tourism option for some areas. However, proper information, research and policy are needed for its wide cultivation and to boost up the economy of India.

O-53

Futuristic technologies in horticulture : Scope and prospects through postharvest management of fruits

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Indian Agro- industry, based on horticulture, contributes maximum to the income of small and marginal entrepreneurs (SME). Horticulture industries are technology driven for precise use of resource and services. In order to sustain livelihood and meet the near future demand; SMEs has to be technology driven with respect to postharvest management of fruits. Use of newer technologies for improved productivity and profitability of fruits. Low cost technologies for protocol development and maintain quality standards for processing and export of fruits are of prime importance. Technologies such as cutting-edge information on nanotechnology, automation and packaging, and storage of fruits are still in infant stage. Protocol and standard operating procedure for use of nano-molecules for use in supply chain of fruits. Automation and packaging are part of the chain in order to provide high end services based on consumer preferences. Storage of fruits for long distance markets and use of dynamic control storage system, maintaining

quality of produce to meet the market demand, consumer preferences, reduce cost in supply chain and traceability of the produce. Such tech-driven postharvest system will involve newer traditional products with use of local raw materials. For smooth functioning of postharvest system adoption to newer technology like sensors and block chain may be the future option for sustainable fruit industries.

O-54

Container fruit growing : A technique for urban horticulture

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India is economically fast growing country, resulting shrinking of land man ratios further use of agriculture land for non agricultural purpose worsening the situation due to which area under green cover has been reduced significantly resulting many cities into gas chamber. Mostly the particulate matter level of Indian cities have crossed the danger level, even cities of Pakistan, Bangladesh and Nepal PM level is many folds more than Indian cities. In order to increase the green cover in urban areas, ICAR-CISH initiated research on container gardening which could helps to cultivate fruit trees in the container and containerized fruit plants can be placed on the roof top and balcony. To standardize the fruit growing techniques, experiment started three years back preliminary results obtained are quite encouraging. The experiment comprises of container size, growing media and variety of fruit plants. The experimental findings revealed that guava, custard apple, kinnow, lime, lemon, strawberry, sapota, ber and pomegranate are suitable to grow in the container. Trees in container were trained in typical bush shape, so that maximum fruiting surface area are available for fruit bearing. Guava plants experienced 10-15 fruits per containerized plant during 1st year and 30-55 fruits harvested in 2nd year. The equal proportion of media ingredients (sand, soil, FYM and vermi-compost) were found most appropriate. The size of fruits as compared to land grown plants was 15-20 per cent less than plants grown on the normal ground. The container size showed that 45 x 60 cm, 45 x 45 cm diameter and depth of container were found most appropriate to hold 35-55 kg growing media.

O-55

Ayurvet ProGreen hydroponic (soil-less) technology for green bio-mass production and raising nurseries : A solution for climate change

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The word hydroponics has been derived from the Greek word where 'Hydro' means water and 'Ponic' means working, *i.e.* working with water. To address the constraints of water availability & reducing land, Climate-change, Ayurvet (formely Dabur Ayurvet) developed Ayurvet Pro Green Hydroponics Technology. It is the first first Indian Hydroponics machine which has got commercial test report from Ministry of Agriculture, India. The Machine raises green fodder, nurseries (paddy, sugarcane, moringa, onion, garlic, moringa). A specific application was done in raising wheat nursery which is generally done by seeds. To address the delay in wheat sowing due to late harvesting of paddy or sugarcane, hydroponic wheat nursery was raised in just seven days. Experiments were conducted in Ayurvet Research Center in Sonipat district along with trials at farmer's field. Today, delay in wheat sowing mainly in rice wheat cropping system is perhaps one of the major factors responsible for low crop yield. This reduction in yield is due to the sub-optimal temperature during the germination, poor stand

establishment and supra-optimal reproductive growth. In this study, performance of wheat cultivar **PBW 373** sown during first and second week of December was evaluated under both the hydroponics system and conventional method of production. Crop emergence was impaired when sowing was delayed under conventional system due to low temperature prevailing during crop establishment. It affected the number of productive tillers and ultimately the final yield but in hydroponic system this factor is minimized as it is an Environmental control Chamber. The seedling/nursery of six inches were ready for transplanting in just after 7 days. The same growth in the field had taken 20 days in the field. In conventional system, high temperature (32-39°C) at reproductive stage during March and April reduced the patterns of dry matter accumulation as was evident from decreased yield whether in case of hydroponically raised seedlings better characters *i.e.*, grains per spike, seed weight and yield were observed.

POSTER SESSION

P-80

Dragon fruit : An edible cactus

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Dragon fruit is one of the edible cactus species which has its origin from tropical and sub-tropical forest regions of Mexico, South and Central America. It is known by several names like Pitaya, Moonflower, Lady of the night, Noble woman, Night blooming cereus, Belle of the night, Strawberry pear, Conderella plant and Jesus in the Cradle all around the world. Dragon fruit has 3 different species, which are commercially cultivated - *Hylocereus undatus*- (White fleshed pink skin fruits), *H. polyrhizus* (Red fleshed pink skin fruits) and *H. megalanthus* (*Selenicereus megalanthus*) (White fleshed yellow skin fruits). It is a perennial, climbing, long day and cross pollinated cactus. It produces edible fruits with white or red flesh, which has small black seeds embedded in it, similar to kiwi fruit. The fruits are non-climacteric in nature with low ethylene production rate. The fruits are considered highly nutritious due to presence of vitamin C, vitamin B, phosphorus, protein, calcium, fiber and antioxidants. It is valued due to its capability to control blood sugar level, blood pressure, strengthen immune system and protects from cancer and heart disease due to presence of lycopene. It follows CAM pathway and requires higher temperature for growth and reproduction. Moreover it is a cactus, hence it is a suitable crop for the arid and dry regions. This crop is in cultivation in a lesser quantity and is a potential crop. The drawbacks for the spread of this crop are its exotic nature, insufficient knowledge and research on this crop.

P-81

Potentiality of aquatic vegetables as an underexploited crop in tropical and subtropical regions in India

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South East Asian countries have access to the large water bodies *viz.*, fresh, saline, and brackish water. The region is characterized with a rapid population growth and resulting in increased area under vegetables. Aquatic vegetables are underexploited and underutilized crops that demand a natural habitat

that compensates space, water, energy and nutrient requirements for completing its life cycle. Edible aquatic plants are commonly grown in the SE countries such as Cambodia, Indonesia, Vietnam, India, etc., The common aquatic vegetables are Cattail, Common Water Plantain, Duck-Lettuce, Eel grass, Fragrant Water Lily, Papyrus, Water Spinach, Wasabi, etc. These vegetables are basically alkaline in nature, rich in fibers and have low calorific value. Water hyacinth on analysis for amino acid content was found to be rich in cystine, phenylalanine and lysine. Further health and medicinal properties are attributed to their consumption. These vegetables have the potential to supplement and substitute existing terrestrial vegetables of Asia. With advances in food processing technology many of the aquatic vegetables could provide raw materials to synthesize new food items suited to the Asian cuisine. Poor people in South-East Asia spend almost three quarters of their income on food alone leaving meagre portion to facilitate shelter, clothing, education and health. Aquatic vegetables may play a major role by reducing the budget on vegetables and are eco-friendly and free from pesticide residues.

P-82

A review of vertical farming

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India will take over China in terms of population in next five years. According to Malthusian theory of population is a theory of exponential population growth and arithmetic food supply growth, so now a day vertical farming becomes considerable. Vertical farming is the practice of producing food and medicine in vertically stacked layers, vertically inclined surfaces and integrated in other structures, such as in skyscrapers, used warehouse or shipping containers. Vertical farming is becoming very popular in urban areas. Urban planners and agriculture leaders have argued that cities will used to produce food to respond to demand by increasing population, harmful pollution and unaffordable food prices. Vertical farming represent a paradigm shift in farming and food production and offer suitable and efficient method for city farming by minimizing maintenance and maximum yield. Vertical farming simultaneously helps to reduce poverty ads to fresh food and increases human well being.

P-83

Collection and evaluation of shatavar (*Asparagus racemosus*) germplasm towards enhancing profitability in Madhya Pradesh

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Shatavar (*Asparagus racemosus*), also known as Satavari, Sathmuli, etc. is an important medicinal plant of Madhya Pradesh and commonly used in traditional medicine. The roots are used in Ayurvedic medicine following a regimen of processing and drying as uterine tonic, galactagogue (to improve breast milk), cooling agent, demulscent and as a best general health tonic. Collection and evaluation of shatavar (*Asparagus racemosus*) germplasm towards enhancing profitability in Madhya Pradesh was carried out at experimental field, Department of Plant Physiology, College of Agriculture, JNKVV Jabalpur (M.P) during 2014 - 15. The thirteen genotypes collected from different locations of Madhya Pradesh were evaluated for various traits. The results revealed that the number of cladode/node varied from 1 to 3, the length of cladode from 5.9 cm to 15.2 cm, number of roots/plant from 142.5 to 389.5, root length from 14.3 to 34.3 cm, root dia. from 8.80 to 14.6 mm, fresh weight of roots/plant from 1391 to 4629 g and dry weight of roots from 145.5 to 642.50 g. Among the various accession, JBP8-9-118 recorded

significantly maximum number of roots/plant (389.5) fresh root yield (4629 g), dry root yield (653.5 g), root length (31.5 cm) and diameter (14.6 mm) and number of cladode (3) followed by accession JBP8-9-120 with corresponding values of 366.5 no, 4428 g, 642.50 g, 34.3 cm and 10.90 mm, while the minimum number of roots was recorded in accession JBP8-9-122 (142.5). Thus, the identification and multiplication of elite genotype shall be useful in not only increasing yield and quality of shatavar but also in improving income of the farmers.

P-84

Recent advances in development of rootstocks of temperate fruit crops

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The average productivity of temperate fruit crops in India is low as compared to developed countries. The main reasons for low productivity are old and senile orchards, low yielding varieties, poor canopy architecture, poor orchard management and inadequate technological upgradation and adoption. Rootstocks play a crucial role in determining orchard efficiency in fruit crops. The role of rootstocks and its use in different fruit crops has significant impact on fruit crop production by influencing canopy architecture, nutritional uptake, flowering, yield and fruit quality. Horticulture Research International-East Malling (formerly East Malling Research Station) has a reputation worldwide for the breeding and development of rootstocks for temperate fruit species. According to the ability of controlling vigor of Gala, G.10 and G.757 are more efficient than M.9EMLA. Quince rootstocks also produce better fruit size and quality fruits of pears than seedling or *Pyrus communis* rootstocks. Apricot rootstock PADAC 01-47 appears to induce higher yield, yield efficiency and good fruit quality in heavy and calcareous soil conditions. Peach cultivar trees grafted on Evrica, PAC 9801-02, Tetra and ROOTPAC® 40 appear to control tree size and to induce high yield efficiency because they seem to be well adapted to calcareous and replanted soil conditions and can perform even better than the commonly used genotype GF 677. Dream of higher productivity and quality, profitability and sustainability under integrated/organic fruit farming can be seen through the eyes of clonal rootstocks in coming times.

P-85

Exploration and documentation of edible wild fruits of Assam

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The state of Assam is well known for its rich plant diversity including many edible wild fruit plants. The wild fruits are popular among the indigenous inhabitants, since ancient time and consumed either raw or cooked as traditional recipe and also used in traditional health practices, religious and cultural ceremonies. It is documented that fruits are rich source of essential minerals, fiber, vitamins, sugar and antioxidant, and thus they play an important role in providing health benefits. Unfortunately, many of these fruit plants are on the verge of disappearance due to rapid shrinking of their natural habitats, less market demand and lack of organized cultivation practices. Hence, the present study was attempted to document these under-exploited wild edible fruits. Field survey was conducted randomly, during the period from Oct 2018 to Aug 2019 in Tezpur and adjoining villages in Assam. About 30 edible wild fruits were collected from homestead and natural habitats, identified and preserved for future use as ready reference. A document of 108 fruit plant species belonging to 62 genera under 43 families, along

with their local names, scientific names, uses and botanical features, was compiled in consultation with the local people and reviewing related scientific literatures. The most dominated family is Moraceae (13 genera), followed by Clusiaceae (10 genera) and Phyllanthaceae (9 genera). The data gathered from the study emphasized that systematic investigation on wild edible fruits for potential nutritional value and conservation is of prime importance.

P-86

Developing indirect method for tree volume estimation of mango cultivar Dashehari

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Carbon sequestration by the perennial trees is the cheap and best method for reducing atmospheric CO₂. Estimation of tree biomass is necessary to know the amount of sequestered carbon. Since, tree cutting is ban in India, non destructive assessment by allometric equations has been widely used for biomass estimation, which is further used to calculate sequestered carbon by tree. Volume and wood density of a tree are the important parameter in non-destructive method. To minimize error in biomass estimation, especially wood volume by non destructive method in mango variety Dashehari, tree branches were harvested for destructive assessment at ICAR-Central Institute for Subtropical Horticulture, Rehmankhera. Data was recorded for wood volume from different positions and it was validated with formula for volume of wood log $\frac{\delta h}{3} (r_1^2 + r_2^2 + r_1 r_2)$ and volume of cylindrical shape by $\delta r^2 h$, and compared with the findings of water displacement method. Close finding with water displacement (852.11 cm³) was found with volume of cylindrical shape (831.19 cm³) at maximum length and diameter of branch whereas volume for wood log was recorded 770.48 cm³. Wood volume estimated by water displacement method was 2.46% higher than volume of wood log $\frac{\delta h}{3} (r_1^2 + r_2^2 + r_1 r_2)$ and 9.56% higher than volume of cylindrical shape ($\delta r^2 h$). The above finding will give close accuracy in calculation of tree biomass of Dashahari by non-destructive method where, volume of cylindrical shape can be used for volume of Dashehari tree.

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Comparative study of growing system (hydroponic, soilless and soil) on growth, development and yield of celery (*Apium graveolans* L.)

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Plants are an important source of natural active products, which help in overcoming various ailments when taken in correct proportions. Celery (*Apium graveolens* L.) is such a herb from the apiaceae family, which provides variety of phenolic and antioxidant compounds to treat various disorders. Cultivating celery in safe and residue free growing medium is important to harness the desired benefit of this plant. Growing plant under hydroponics system (soil-less system) offer this opportunity. This experiment was conducted at DIBER, DRDO, Haldwani, Nainital (Uttarakhand). Nursery of celery was prepared in the portrays and 20 days old seedlings were transplanted under the three growing conditions *i.e.* hydroponic, soilless and field condition. Among all treatments, hydroponic media resulted higher in several parameters *viz.* plant height (56.67 cm), length of stalk (58.13 cm), length of root (39.70 cm), fresh weight of stalk (68.37 g), total weight (793.97 g), edible weight (694.50 g), dry weight of stalk (68.37 g), chlorophyll

content (49.63), whereas fresh weight (157.93 g) and dry weight (16.60 g) of root was noticed higher in the soil media. The paper deals with comparative performance of celery under various growing medium.

P-88

Zero budget natural farming

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Zero budget natural farming is an eco-friendly and economically viable method of farming. Desi cow (*Bos indicus*) products are the important components in making any kind of botanicals. This concept of farming came into limelight by Mr. Subhash Palekar and Prof. R K. Pathak, who have made a deep study on the natural cycles of the ecosystem, relating them with our ancient indigenous practices and formulated a variety of cow and plant based botanicals which are liquified and applied as inoculum to the soil. Botanicals like Neemastram (controls sucking pests), Agniastram (controls leaf rollers and stem borers), Shilindranashini (natural fungicide), Dashaparnikashayam (wide range natural pesticide), etc. contain butter-milk (antifungal compound reuterin), turmeric powder (*Curcuma longa*; antifungal compound Curcumin), mango leaves (*Mangifera indica* contain antimicrobial flavonoids), neem seeds (*Azadirachta indica* contains *Azadirachtin*), tobacco leaves (*Nicotiana tabacum* contain Nicotine a natural insecticide), garlic paste (*Allium sativa* contains pungent compound Allicin) and green chilly (*Capsicum annum*) and black pepper (*Piper nigrum*) both of them contain a pungent group of compounds Capsaicin. The seed treatment with Beejamritham (composed of water, cow dung, cow urine, fistful of soil and lime) protects the crops from soil-borne pathogens. Jeevamritham (composed of water, cow dung, cow urine, jaggary, besan and fistful of soil). Tonic-1 prepared from coconut water (*Cocos nucifera*) contains liquid endosperm Kinetin (Cytokinin, a naturally occurring plant growth hormone), helps in vigorous growth of the plants. These botanicals can be easily prepared by any farmer with very less inputs for doing zero budget natural farming at large scale.

P-89

Citrus : The boon crop of nature

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The genus Citrus belongs to sub-family Aurantioideae and family Rutaceae. This genus includes some of the major fruits such as Limes (*Citrus aurantifolia* Christm & Panz.) Swingle, Citron (*C. medica* L.), Rough Lemons (*C. jambhiri* Lush.), Lemons (*C. limon* L.) Burm, Oranges (*C. reticulata* Blanco, *C. sinensis* L. Osbeck), Pummelos (*C. maxima* Burn Merr.) and Grapefruits (*C. paradisi* Macfad). Citrus occupies a place of considerable importance in the fruit industry of the country. Citrus fruits economically important with a large scale production in both form *i.e.* fresh fruit and processed products. Citriculture as a garden industry existed for centuries in India. It comprises the third largest fruit industry. Among the citrus fruits oranges contribute to roughly 80 per cent of the world's citrus fruit production. Citrus fruits are recognized as an important component of the human diet, providing a variety of constituents, which are very important to human nutrition including vitamin C, folic acid, potassium, flavonoids have a broad spectrum of biological activities including antibacterial, antioxidant, antibiotic, anticancer, cardiovascular, analgesic, anti-inflammatory, antianxiety *etc.*

P-90

Dragon fruit : An emerging future horticultural crop

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The dragon fruit (*Hylocereus undatus*) a new recent introduction in India, is highly valued for its nutraceutical properties. It is a tropical fruit that is becoming more popular now-a-days. Fruits are 200-700 g in weight, bright pink or red in colour, usually eaten fresh after peeling, mild sweet in taste and are produced on vine like plants having cactus on the stem but no leaves. It belongs to the genus *Hylocereus* and *Selenicereus* and family cactaceae. This fruit is probably native of Central America and Northern South America. It's fruits are decent source of iron, magnesium with high amount of fibre and provide extremely low calories as they are free from fat and contain 1.2 g protein and 13 g carbohydrate. This fruit also contain several types of antioxidants which protects our cells from unstable molecules called free radicals, which are linked to chronic diseases and aging. Antioxidant Betalains found in the pulp of red dragon fruits. This deep red pigment has been shown to protect "bad" LDL cholesterol from becoming oxidized or damaged. Compound hydroxycinnamates has anticancer activity, where, as large and diverse group of antioxidants called flavonoids is linked to better brain health and a reduced risk of heart disease. Many health benefits of dragon fruit were also reported by many scientists as protective against cancer, boosts immune system, control diabetes, prevent anaemia, improves respiration, strong bones and teeth with anti-inflammatory properties.

P-91

Jackfruit (*Artocarpus heterophyllus*) : An underutilized but versatile food source

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A Moraceae family member *Artocarpus heterophyllus* Lam, well known as jackfruit, is an age old plant. Jackfruit is the largest tree-borne fruit in the world which can weight from a mere 3 kg to 36 kg. Major two types of varieties, soft flesh and firm flesh are found. Some jackfruit varieties can reach up to 100 feet in height and there are some dwarf varieties like black gold that restrict up to only 10-20 feet height. The jackfruit can be used raw as vegetable and ripe as fruit. The medicinal properties of jackfruit include anti-asthmatic, antioxidant, antibacterial, antifungal, anticancer, hypoglycemic, antimalarial, anti-diarrhoeal, anti-arthritis, anti-helminthic, anti-inflammatory, anti-carcinogenic, anti-platelet, antiviral, anti-tubercular, anti-atherosclerotic activities. It has also shown wound healing effect and causes decrease in the sexual arousal, libido, performance and vigor in men. The health benefits of jackfruit have been attributed to its wide range of physicochemical applications. In spite of such a vast potential and usefulness, jackfruit remains an underutilized fruit species and deserves to be given the needed thrust for research and development. A wide gap in the marketing of jackfruits and its processed value added products can be fully explored for additional income as well as food security. Encouragements should be done to the marketing as well as value added food products from this underutilized fruit tree to make it more popular as a versatile human food.

P-92

Phytochemistry and medicinal importance of *Psidium guajava*

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Psidium guajava (guava) is well known tropic tree which is profusely grown for nutritive value. Many countries including India, have a long history of using guava for medicinal and therapeutic purposes. This plant finds applications for the cure of diaorrhoea, dysentery, gastroenteritis, hypertension, diabetes, caries and pain relief and for enhancement in locomotors harmonization. Leaf extract of guava is being used as a medicine in cough, diarrhea, and O ulcers and in some swollen gums wound. Its fruits are rich in vitamins A, C, iron, phosphorus, calcium and other minerals. It also contains high amount of organic and inorganic compounds like secondary metabolites e.g. antioxidants, polyphenols, antiviral compounds, anti-inflammatory compounds. Guava leaves contain several compounds that act as fungistatic and bacteriostatic agents. Guava has a high amount of important antioxidants and has radio-protective ability. Quercetin is well thought-out as most active antioxidant in the guava leaves and is responsible for its spasmolytic activity. The phenolic compounds present in guava acts as an assistance to cure cancerous cells and prevent skin aging before time. The presence of terpenes, caryophyllene oxide and *p*-selinene in guava produces relaxation effects. Its ethyl-acetate takes out the germ infection, thymus production and also possesses anti-viral, anti-inflammatory, anti-plaque and anti-mutagenic activities. Guava extract shows antinociceptive activity and is also effective in liver damage, tenderness and serum production. It is also reported that ethanolic extract of guava may increase the sperm quality as well as quantity and can be used for the treatment of infertile males.

P-93

Banana: A novel fruit

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Banana and plantains are one of the most important commercial food crops in the tropics. Banana is the second most important fruit crops in India. Its year round availability, varietal range, test, nutritive and medicinal value makes it the favourite fruit among all classes of people. It has also good export potential. The major producing states of India are Tamilnadu, Maharashtra, Karnataka, Gujarat. The total annual world production is estimation at 86 million tones of fruit. India leads the worlds in banana production with annual output of about 14.2 million tones. Banana is a rich source of carbohydrate and rich in vitamins particularly vitamin B. It helps reducing risk of heart risk of heart disease when used regularly and recommended for patients suffering from high blood pressure, arthritis, ulcer, gastro nutrient and kidney disorder. The banana fruit is used in making chips, jam, jelly, juice, etc. Hi- tech cultivation of the crops is an economically viable enterprise leading to increase in productivity, productivity improvement in produce quality and early crops maturity with the produce commanding premium price.

P-94

Horticulture: bright spot of Indian farming

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Consecutive droughts and freak weather in 2014 and 2015 dented India's food grain production and worsened rural distress. For farmers, the weather woes came on top of a drop in prices of key crops like rice, wheat, cotton and sugar. But one sector that escaped the weather shocks if not the price drops is horticulture. Production of fruits and vegetables overtook India's foodgrain production by a whopping 31 million tonnes in 2014-15 (284 million tonnes against 253 million tonnes). This was the third straight year when horticulture output outstripped that of foodgrains. Another positive for horticulture is that fruits and vegetables are mostly grown by marginal and small farmers (with less than 2 hectare of land). This means that resource-poor farmers are likely to have benefitted most from the growth in horticulture sector. Better incomes, urbanization and higher consumption of fruits and vegetable seem to be driving the demand, which is addressed by small farms. Consumption data from the National Sample Survey Organisation (NSSO) shows that while monthly consumption of cereals per person in rural areas declined from 13.4 kg in 1993-94 to 11.2 kg in 2011-12, consumption of vegetables went up from 2.7 kg to 4.3 kg during this period. For betterment in horticulture government started new methodology for assessment of horticulture produce is known as CHAMAN (coordinated programme on horticulture assessment and management using geoinformatics). This uses a combination of remote sensing technology, sample surveys and market arrivals to estimate horticulture output and area.

P-95

Differential response of pomegranate genotypes to salinity stress under nursery conditions

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Pomegranate (*Punica granatum* L.) is a hardy crop with good potential for commercial cultivation in marginal areas suffering from constraints like salinity and drought. This experiment was conducted to assess the response of 20 different pomegranate genotypes collected from Rajasthan, India to salinity stress under nursery conditions. Plants were raised in polybags containing sodic soil ($\text{pH}_s \sim 8.2$; $\text{EC}_e \sim 2\text{dS m}^{-1}$) and arranged on a plastic sheet in a manner that virtually no salt leaching occurred after irrigation. Different physiyo-biochemical parameters like leaf relative water content (RWC, %), proline ($\mu\text{g g}^{-1}\text{FW}$), chlorophyll ($\text{mg g}^{-1}\text{FW}$), Na^+ (%DW), K^+ (%DW), K^+/Na^+ ratio and vegetative growth parameters (length and number of shoots and roots, and number of leaves) were recorded after four months of planting the cuttings. Results showed considerable genotypic variation among the genotypes screened. Genotype Jaipur 1 was found to have the highest number of roots in the seedling stage. Vegetative growth of genotypes Jaipur 1, Ajmer 2 and Jaipur 3 was much better than rest of the genotypes due presumably to maintenance of leaf chlorophyll and proline, and a higher leaf $\text{K}^+:\text{Na}^+$ ratio. It implied that these genotypes could have better potential for use as scion and rootstock cultivars in salt-affected soils. The bio-chemical parameters used for identifying the salt tolerant genotypes in this experiment may be applied to screen pomegranate germplasm for salt tolerance in the future.

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Panchagavya: Microbial evaluation and their characterization

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Panchagavya is an organic preparation, presently used for agriculture farming practices. In this study, we have evaluated Panchagavya (PG) for microbial populations and their activity. Initially PG was evaluated for different Plant Growth Promoting (PGP) isolates in different specific media like CRYEMA (for *Rhizobium*), N-free maleate media (for *Azospirillum*), Actinomycetes Agar (for Actinomycetes) etc. Highest colony forming unit (cfu ml⁻¹) were found in Azotobacter agar media i.e 20.8× 10⁶ cfu ml⁻¹, 9.6× 10⁶ cfu ml⁻¹ in Azospirillum agar, 6.0× 10⁶ cfu/ml⁻¹ CRYEMA and in Pikovskaya's 4.4× 10⁶ cfu ml⁻¹ were found. Based on microbial populations on different media types, finally total 20 bacterial isolates were selected for biochemical characterization and PGPR properties. For Biochemical characterization all test isolated showed positive result for Nitrate reduction, Esculin hydrolysis, Trehalose utilization and catalase test. All test isolates showed negative for Indole test except P8, while citrate utilization showed positive results by all isolated except P8. Among 20 bacterial cultures test isolates P3, P4 & P8 were effectively solubilized phosphate in Pikovskaya's Agar medium. On the basis of above mentioned tests the selected bacterial isolates (P3, P4 & P8) showed best PGPR properties therefore, these isolates can be used and explore for field scale applications.

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Panchagavya in organic crop production

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Panchgavya is a term used to describe five major substances, obtained from cow, which include cow's urine, milk, ghee, curd and dung. All the five products possess medicinal properties against many disorders and are used for the medicinal purpose singly or in combination with some other herbs. This kind of treatment is called Panchgavya therapy or cowpathy. It has the potential to play the role of promoting growth and providing immunity in plant system thereby confers resistance against pest and diseases. Panchagavya contains several nutrients i.e. macronutrients like N, P, K and micronutrients which are required for the growth and development of plants and also contains various amino acids, vitamins, growth regulators like Auxins, Gibberellins and also beneficial micro organisms like pseudomonas, azotobacter and phosphor bacteria etc.

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Vermicompost a potent source of futuristic plant nutrition of organic plant nutrient management system

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Indiscriminate use of chemical fertilizers and pesticides for the last few decades made the soil unproductive with loss of biodiversity and the environment polluted. So, rejection or reduced use of chemicals and

practice of organic farming for recovery of soil health, increase in food grain production and biodiversity conservation have been suggested. Organic manures play an importance role in crop production and sustainable agriculture development. Vermicompost has been emerging as an important source in supplementing/substituting chemical fertilizers in agriculture besides higher concentration of available nutrients (macro, secondary and micro) than the ordinary FYM. Millions of tones of agricultural and industrial wastes are discarded every year at considerable financial and environmental cost. Instead of discarding the food scraps and wastes, we can recycle these with the help of earthworms. Vermiculture technology involves the beneficial use of earthworms for the production vermicompost from agricultural and industrial wastes which is rich in macronutrients, micronutrients and beneficial micro-organisms. Integrated use of vermicompost along with FYM, biofertilizer and chemical fertilizer in french bean improve soil health and production. Research reveals that vermin-technology has a prominent role in the development of ideal soil structure, nutrient and water management, waste management, better crop response, plant disease and pest control pollution abatement and production of chief animal protein in the form of earthworms for poultry farming and aquaculture. The fruits, flowers and vegetables and other plant products grown using vermi-compost are reported to have better nutritional and keeping quality, besides free from hazardous chemical residues.

P-99

A survey of apple replant sites: Isolation and identification of fungal, nematodes and soil nutrients in the rhizospheric soil of old declining apple orchards

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Apple, is a major fruit crop in the temperate regions of the world. At present, apple replant problem is a major concern in the production of apple. The reasons for apple replant problem in old declining apple orchards and the causes are frequently attributed to the biotic and abiotic *i.e.* fungal pathogens, nematode activities and abiotic factors. In the study, the survey was conducted to determine and compare to the populations and density of soil microbial counts, nematode populations, fungal pathogens and soil nutrient content in the rhizosphere soil of declining apple orchards from ten diverse sites of Shimla and Sirmaur districts of Himachal Pradesh. Almost all the declining apple orchards sites of soil samples were observed high soil organic carbon. The fungal pathogens and nematodes were identified *i.e.*, *Rhizoctonia solani*, *Pythium ultimum*, *Phytophthora cactorum*, *Fusarium oxysporum*, *Dematophora necatrix*, and *Tylenchorhynchus mashhoodi*, *Pratylenchus coffeae*, *Xiphinema sp.*, *Helicotylenchus dihystra*, *Paratylenchus curvatus* from the samples of declining apple orchard sites. The maximum of 787 *Tylenchorhynchus mashhoodi* was recovered from 250 g of declining apple orchard soil and the least population of 30/250 g of soil *Paratylenchus curvatus* were found; however, these two nematode genera were recovered from four declining orchards soils and not from all apple-declining sites. Among all the various locations, Habban has highest been counts of 130.49×10^5 CFU/g soil bacterial populations, fungal pathogens were counted significantly maximum of 15.33×10^4 CFU/g soil on Pulbhahal site and maximum actinomycetes count of 18.00×10^2 CFU/g soil in Rohru.

P-100

Effect of canopy architectural engineering on quality of apple (*Malus domestica*)

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Plant architectural engineering in temperate fruit crops is most important aspect of apple production. The present study aimed to develop efficient plant architectural systems using different rootstocks and scion cultivars on six training systems consisting of four rootstocks and two varieties. Various parameters were taken into consideration among which highest fruit weight (186.26 g) was observed in modified central leader system on MM-111 in Red Delicious where as lowest fruit weight (81.73 g) was observed in vertical axis on M-9 in Oregon spur. Fruit colour was also observed in different apple cultivars which showed variation in L, a, b and Tint color parameters *viz.* "L" was found highest in Espalier system on MM-106 in red delicious (65.69) "a" was found highest in Vertical Axis on seedling rootstock in Oregon Spur (23.58) and "b" was found highest in Oregon Spur on MM-111 trained on Spindle Bush (-7.407). However, firmness (71.63 RI) was observed highest in Oregon Spur on MM-111 trained on Vertical Axis. Fruit yield was found highest (52.41 t/ha) in Oregon Spur on MM-111 trained on vertical axis followed by Red Delicious on MM-106 trained on vertical axis (51.61 t/ha). Among all these observation, varieties showed TSS of varying ranges *i.e.* 12-21^o B. Highest light interception was recorded in Red Delicious-Seedling combination on spindle bush training system. Based on present study vertical axis system was found best to increase productivity. Hence, to boost the quality of apple production, the main role is played by canopy architectural engineering using rootstock and scion combinations.

P-101

Effect of different training system, rootstocks and varieties on quality of pear (*Pyrus communis*)

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Canopy management and plant architectural engineering in temperate fruit crops was started to develop efficient plant architectural systems using different rootstocks and scion cultivars, to harvest solar energy through increased light interception and improve sink source relationship, to utilize maximum vertical space & energy and to maximize production and improve color and quality of produce. In pear four varieties were evaluated under four training systems on two different rootstocks. The highest fruit weight (198.5 g) was found in Starkrimson under Modified central leader system on rootstock BA-29-C followed by William Bartlett on Y-shape system on rootstock BA-29-C (192.43 g). While lowest fruit weight was recorded in Kashmiri Nakh on Y- Shape training system on rootstock Quince-C (64.53 g). Training system (Y-Shape) recorded highest TSS in William Bartlett on Q-C in Modified central leader system (19.76^o B) where as lowest TSS was recorded in Kashmiri Nakh on Espalier system in BA-29-C (10.66^o B). Highest yield was found in Kashmiri Nakh in Vertical Axis on Quince-C (3.617 kg/plant) followed by William Bartlett in Vertical Axis on BA-29-C (3.03 kg/plant) where as lowest in Red Bartlett on Vertical Axis on Quince-C (0.547 kg/plant). Fruit yield was found highest (32.15 t/ha) in Kashmiri Nakh on vertical axis on rootstock Quince-C.

P-102

Climate change and perennial fruit and nut production: Investing in resilience in uncertain times

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Unlike seasonal crops, perennial fruit and nut crops require juvenile period and long investment for several years after planting. Freezing temperatures during bloom period in stone fruits could render an already risky crop commercially nonviable because “no flowers equals no fruit”. Fruit and nut trees in temperate regions are predicted to be highly affected by rising temperatures because of inadequate chilling period. Extreme weather events Excessive or untimely heat or cold, hail, early or late freezes, wind, strongly blowing rain, and other events can be damaging to fruit and fruit plants in and of themselves, but they can also impact the spread, incidence, and severity of fruit diseases. In response to the challenges of climate change, four main strategies consistently come to the fore: diversification, water stewardship, soil building; and technology, information and policy. We should wake up to the reality of climate change and switch to cultivars that are appropriate in the future, construct more and deeper wells, farm ponds, and use more efficient irrigation techniques, adopt permaculture, Increase soil organic matter (A high-organic-matter soil is like a sponge, soaking up water and holding it in the soil reserve), shift to more flood-tolerant crops (pecans) and adopt best affordable technology but promising in times of climate change like frost prevention, to make the very most of every water drop, to provide protection for the nation’s soils. Furthermore, information, especially weather and climate, will be in great demand that one of the best quote is “more feet on the ground, more eyes on the land”.

P-103

Use of wild species as sources of new ornamentals: A futuristic approach

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Most of the present floricultural crops were progenies of the wild relatives that have been popularised and widely commercialised throughout the globe. Harnessing ornamental values of such wild species from the biodiversity rich areas of the country will pave way for creating alternative livelihood as well as revolutionize the floriculture trade to certain extend. Identifying and evaluating useful genetic traits desired by the commercial industries and consumers creates a need to collect and conserve a wide range of species in order to capture greater genetic diversity. Development of cultivation practices to improve adaptability and for increasing aesthetic value is crucial in domestication of wild ornamental plants. Owing to the enormous variations and ecologically highly specific requirements, the wild species often makes their domestication difficult. In order to overcome such biological and ecological barriers, deployment of modern technologies such as gamma irradiation and molecular breeding, would result in the improvement, high adaptability and productivity.

P-104

Development of transgenic papaya and its evaluation in containment facility

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India is the largest producer of papaya contributing 25 per cent of total world production. Papaya cultivation is hampered severely due to prevalence of papaya ring spot virus (PRSV). Transgenic technology has been successfully demonstrated in USA for PRSV resistance. However, the same has not been developed for India. Papaya variety Pusa Delicious was genetically transformed with *hp-tr-cp* gene of PRSV through *Agrobacterium* mediated transformation system. Pre cultured somatic embryos (100 μ M spermidine) were infected with *Agrobacterium* having OD600 = 1.0 for 45 minutes and co-cultivated in CC medium fortified with 100 mg/l L-cysteine, acetosyringone (100 μ M) having pH of 5.2 resulted in 0.413 per cent transformation efficiency. *Agrobacterium* infection of embryos was controlled by keeping them on MS medium fortified with cefotaxime at 100 mg/l. Exposure of embryos to 45 mg/l PEG for one week led to production of 228.32 cotyledonary embryos, maturation of 70 per cent and regeneration of 29.7 per cent plantlets. Two cm long transformed shoots of papaya with at least 4-6 true leaves produced maximum number of primary roots (3.2). A total of 8 T₀ transformants were found to be positive for *cp* gene using gene specific primers in PCR and dot blot hybridization. T₁ transgenic lines were further subjected to real-time PCR using gene specific primers and southern hybridization. Results showed 3 stable transgenic events. Sequencing of all 3 T₁ transgenic lines viz., T_{11.17}, T_{11.21} and T_{11.26}, clearly indicated 99 per cent homology with *cp* sequences. Repeated challenge inoculation under containment facility, clearly revealed that wild type papaya plantlets developed leaf chlorosis and subsequently ring spots on leaf upon sap inoculation of Lucknow strain of papaya ring spot virus. However, the developed transgenic lines did not show any PRSV symptoms so far.

P-105

Impact of front line demonstration of vegetable pea cv. Kashi Uday in central Uttar Pradesh

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Vegetable pea (*Pisum sativum* L.) is an important legume crop grown for its green pod. It is grown throughout the world but India has credit of bagging the highest production. In India, it is grown as winter vegetable in the plains of north India and as summer vegetable in the hills. It is widely grown in the state of U.P., Bihar, M.P., Punjab, Haryana and Himanchal Pradesh. Low productivity and poor returns from market due to non-adoption of improved varieties and recommended package of practices by vegetable pea growers of the district. Krishi Vigyan Kendra, ICAR-Indian Institute of Sugarcane Research, Lucknow, conducted front line demonstrations (FLDs) comprised use of improved variety, recommended spacing, integrated nutrient management system and integrated pest management technologies from 2014-15 to 2018-19. The results revealed that, average yield of demonstrated vegetable pea variety Kashi Uday was recorded 74.4 q/ha which was 19.8 per cent higher than the average yield of farmers practice i.e. 59.6 q/ha. Average net return and benefit cost ratio were recorded Rs. 54780.00 and 1:2.1 from demonstrations as compared to farmer practice Rs. 27292.5 and 1:1.5. The average horizontal spread of vegetable pea variety Kashi Uday was 30.9 ha/year in area was observed during study. The productivity improvement of district 14.67q/ha was recorded over farmer practice.

P-106

Salinity induced biochemical parameters and their expression in polyembryonic mango cultivars

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With the changing climatic scenario, developing salinity stress tolerant rootstocks is one of the important concerns for sustaining mango production systems. Polyembryonic cvs. are best suitable sources for rootstocks owing to their potentials of homogeneity conferred by nucellar seedlings and hence, assessing their potentials for salinity tolerance would facilitate developing elite salt tolerant rootstocks. In this context, the present study was carried out to evaluate the salinity responses (induced by 200Mm NaCl) in important polyembryonic mango cultivars *viz.* Nekkare, 13-1, Kurukkan, Chandrakran, Goa, Olour and Bappakai along with a monoembryonic type Amrapali. Levels of proline started increasing in 13-1, Nekkare, Kurukkan, (29.5, 18.5, 12.8 µg/mg FW) under salt stress upto 15 days of salt imposition, while lowest concentration of proline was estimated in Goa and Amrapali (salt susceptible). Similarly, glycine betaine also showed increasing trend in 13-1, Nekkare and Kurukkan upon salinity stress, moreover, maximum difference in glycine betaine levels was recorded between control and stress. Magnitude of increase in glycine-betaine and proline contents was recorded to be highest in 13-1, Nekkare and Kurukkan, than Amrapali. Amrapali showed relatively high levels of salinity stress symptomatic leaves. Phenol content was higher and reached maximum in cvs. 13-1, Nekkare and Kurukkan under salt stress conditions. Higher levels of sugar were recorded in cvs Kurukkan, Chandrakaran, 13-1 upon salinity stress, where as slightly increase in sugar levels was observed in Nekkare. Based on these biochemical indicators, it is evident that salinity tolerance is more in 13-1, Nekkare and Kurukkan.

P-107

Combining ability and gene action studies for yield and yield contributing traits in tomato (*Solanum lycopersicum* L.) under polyhouse condition

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The present investigation was carried out at Vegetable Research Center of GBPUA&T, Pantnagar, Udham Singh Nagar, Uttarakhand. The experimental material comprised of eight genotypes of tomato and from eight genotypes, 28 crosses were evolved in a diallel mating design (excluding reciprocals), which was evaluated in a Randomized Block Design (RBD) under polyhouse condition. During the research it was found that PBT-5 identified as a best general combiner for maximum number of traits *viz.*, earliness related traits, number of flowers per cluster, number of fruits per cluster, internodal length, fruit yield per plant and fruit yield per hectare followed by PCT-1 (earliness related traits, number of flowers per cluster, number of fruits per cluster, number of fruits per plant and plant height) and PPT-2 (for internodal length, average fruit weight, fruit length, fruit yield per plant and fruit yield per hectare). Thus, these parents could be used for the development of superior varieties suitable for most of the yield related traits. The best specific combiner were PBT-13 x PBT-10 (days to 50 per cent flowering, days to first fruit set, followed by PBT-2 x PBT-13 (days to first fruit ripening, number of fruits per cluster, number of fruits per plant, average fruit weight, fruit yield per plant and fruit yield per hectare), PBT-9 x PBT-5, PBT-5 x PBT-4 (number of flowers per cluster, number of fruits per cluster and number of fruits per plant). Hence, these crosses can be utilized in heterosis breeding for improvement in yield related traits.

P-108

**Stability analysis in coloured capsicum
(*Capsicum annuum* var. *grossum* Sendt.)**

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The present investigation was evaluated to generate information on stability of the genotypes for maturity, yield attributing and quality traits. The experimental materials were evaluated in three diverse environments *viz.*, Experimental Farm of Division of Vegetable Science, SKUAST-K, Shalimar, Krishi Vigyan Kendra, Budgam and Faculty of Agriculture, Wadura during *kharif* 2018. The experiments were laid out in completely randomized block design with three replications at each location. The analysis of variance for individual as well as over environments revealed highly significant differences among genotypes for all the characters under study indicating large amount of variability in the genotypes suggesting that there is an ample scope for improvement. Mean squares due to environments were significant for all traits suggesting the presence of diverse environments. Mean squares due to Genotype × Environment interaction were significant for most of the traits except average fruit weight, seed yield per plant, seed yield per plot, vitamin C and total chlorophyll thereby indicating that the genotypes behaved differently in different environments. For most of the traits under study, wide range of variability was observed, thus, depicting much scope for improvement through selection. Heritability in broad sense was high for all traits except quality traits suggesting that the selection based on phenotype would be effective in these traits. Fruit yield per plot is positively and significantly correlated with plant height (cm), plant spread (cm), number of fruits per plant, average fruit weight (g), fruit length (cm), fruit diameter (cm), flesh thickness (mm), pedicel length (cm), seed weight per fruit (g), number of seeds per fruit and fruit yield per plant (kg).

P-109

Vegetable grafting: a new tool for sustainable farming

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Innovation in agriculture science is necessary to meet the challenges in global endeavor for food and nutritional security. Vegetable production with grafted seedlings was originated in Japan and Korea to avoid the serious crop loss caused by infection of soil-borne diseases aggravated by successive cropping. This practice is now rapidly spreading and expanding over the world. Vegetable grafting has been safely adapted for the production of organic as well as environmentally friendly produce and minimizes uptake of undesirable agrochemical residues. The number and size of commercial vegetable seedling producers has increased markedly reflecting the increase in farmers' preferences for grafted seedlings of high-quality and better performance. In addition to the widely recognized advantages of disease tolerance and high crop yields, grafting technology is also highly effective in ameliorating crop losses caused by adverse environmental conditions such as low soil temperature and high soil salts, especially under protected cultivations where successive cropping or continuous farming is routinely practiced. Active research has been focused to develop efficient rootstocks and handy grafting tools. In addition, researchers are eager to develop grafting machines or robots to reduce the higher price of grafted seedlings. The quality of grafted transplants is extremely important to maximize high quality crop yield. Use of grafted vegetables has increased with the increased use of improved soil mix or substrate, farmer's preferences

for better seedlings, efficient management of nursery systems, lower prices of grafted seedlings, and efficient nationwide delivery and/or transportation system. Improved grafting methods to cut down the labor cost for grafting and subsequent handling of plug-grown grafted transplants will contribute further to the increased use of grafted vegetables worldwide.

P-110

E.M. Technology: A new concept in organic horticulture

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E.M. (Effective Microorganism) is totally organic mixed cultures of beneficial naturally fermentative microorganisms like photosynthetic bacteria (*Rhodospseudomonas* spp.), lactic acid bacteria (*Lactobacillus* spp.) and yeast (*Saccharomyces* spp.) etc. that can be applied to increase the necessary microbial diversity in soil. The application of E.M. technology in horticulture has brought revolution in the field of fruit science, crop husbandry, floriculture, and land reclamation. It is generally available in a form of liquid concentrate. E.M. is completely different from chemical fertilizers or agrochemicals. It does not work when applied in the same manner as chemical fertilizers or agrochemicals. It is important to note that E.M. increases population of beneficial microbes in the soil. E.M. has many significant benefits when used in gardening and horticulture and there are no health and safety issues in using. The continued use of E.M. significantly reduces any dependence on chemical fertilizers and improves plant growth naturally. This is factual, there have been many scientific studies that show E.M. will promote germination, will improve plant growth and will produce bigger and tastier crops. E.M. can be used to inoculate plants, water and soil in various ways to achieve beneficial results. E.M. can be sprayed on soil as a pre-planting treatment, used to inoculate seeds, bulbs or transplants and applied to growing crops as a foliar spray or through irrigation systems. E.M. is beneficial in growing nursery crops, container-grown plants, and even in hydroponics.

P-111

Hydroponics: A recent technique in agriculture

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Hydroponics is the method of growing plants without soil by using a nutrient medium, which is completely liquid. This is used for several different situations. It can be used when a farm has unfertile land and cannot get a good harvest growing in the soil. Growing with hydroponics comes with many advantages, the biggest of which is a greatly increased rate of growth in your plants. With the proper setup, your plants will mature up to 25 per cent faster and produce up to 30 per cent more than the same plants grown in soil. There are many different types of hydroponics systems available. Deep water culture (DWC), in a deep water culture hydroponic system, the roots is suspended in a nutrient solution. Nutrient Film Technique, (NFT), is a type of hydroponic system where a continuous flow of nutrient solution runs over the plants roots. Aeroponics is a hydroponics method by which the roots are misted with a nutrient solution while suspended in the air. Flow hydroponics system, also known as a flood and drain system, is a great system for growing plants with hydroponics. This type of system functions by flooding the growing area with the nutrient solution at specific intervals. A hydroponic drip system is rather simple. A drip system works by providing a slow feed of nutrient solution to the hydroponics medium. We recommend using a slow draining medium, such as Rockwool, coconut coir, or peat moss.

P-112

Hydroponics: A new techniques for growing plants

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Hydroponic cultivation is gaining popularity all over the world because of efficient resources management and quality food production. With the advent of civilization, open field/soil-based agriculture is facing some major challenges; most importantly decrease in per capita land availability. Due to rapid urbanization and industrialization as well as melting of icebergs (as an obvious impact of global warming), arable land under cultivation is further going to decrease. Again, soil fertility status has attained a saturation level, and productivity is not increasing further with increased level of fertilizer application. So, in near future it will become impossible to feed the entire population using open field system of agricultural production only. Naturally, soil-less culture is becoming more relevant in the present scenario, to cope-up with these challenges. Commercially NFT technique has been used throughout the world for successful production of leafy as well as other vegetables with 70 to 90 per cent savings of water. Several benefits of this technique are less growing time of crops, year round production, minimum disease and pest incidence and weeding, spraying, watering etc can be eliminated. In soil-less culture, plants are raised without soil. Improved space and water conserving methods of food production under soil-less culture have shown some promising results all over the World.

THEME 4

CHALLENGES AND MITIGATION OF CLIMATE CHANGE, BIOTIC AND ABIOTIC STRESSES IN HORTICULTURE

ORAL SESSION

O-56

Estimation and analysis of soil nutrients at high altitude area : A comparison between avalanche and non avalanche zone

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Himalayan mountain ranges receives moderate to heavy snowfall and are prone to avalanches. These snow avalanches exert erosive forces, scrape away and entrain soil, which ultimately change the soil properties of the region. The present investigation was undertaken to know the effect on avalanches on the soil properties of selected avalanche sites (34°26' 35.771' N latitude and 74°6' 29.383' E longitude). A total 78 numbers of soil samples were collected and analyzed from non-avalanche site and identified avalanches sites at different altitude (2500-4290 m) of NW Himalaya of India. The analysis of physico-chemical properties of soil were carried out and statistical analysis was done using SPSS statistical tool. Results revealed that, there is a significant increase in sand quantity and pH in avalanche zone soil compared to non-avalanche soil samples under physical properties (sand, silt and clay, Ec, pH, OC). Whereas, a significant increase in N, P, K and S is observed out of nine chemical constituents (N, P, K, Fe, Mn, Zn, B, S and Ni availability) at Avalanche site compared to non-avalanche site. The avalanches in NW Himalaya of India could be attributed for the variation in the micro nutrients concentrations, integration and deposition of the hydrocarbons (in the form of uprooted trees, shrubs, grasses, etc.) that might have led to change in physico-chemical properties of the soils too. Another possibility is that avalanche soil contains higher amount of uprooted stubbles of trees, grasses, shrubs, etc. which enriches OC content compared to non-avalanche soil of NW Himalaya of India.

O-57

Metagenomics : A mining tool for robust PGPR microbiome from hot springs of Indian states

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Microorganisms and plants are known to have a well established symbiotic association where microbes support plant growth by providing a mean to fend harsh conditions of various biotic and abiotic stresses. Microbes have developed various mechanisms to identify their host with which they can establish a beneficial association. In recent years, metagenomics analyses of soil samples from various conditions (saline, drought, alkaline soil and acidic soil) have led to a better understanding of plant microbiome interaction. In our study, we designed a degenerate primer from the literature information for AEC (auxin efflux carrier). Metagenome was isolated from various soil samples of hot springs and PCR amplified using degenerate primers. The only sample of Atri hot spring of Odisha exhibited amplified gene product.

The amplified fragment had a size of 520 bp and sequencing of the fragments revealed it to be an AEC belonging to *Bacillus licheniformis*. In *Bacillus* species, these carriers are used for effluxing of indole acetic acid (auxin) in the rhizosphere which promotes shoot growth as well as wound repair in plants. Using *in silico* analysis, the secondary structure analysis was done and it was found to be majorly trans membrane α -helixes sparse by short stretches of loops. The POREWALKER tool was used for identifying the tunnelling structures and residues lining the pore. PHYRE2 program was used for homology modelling of protein and LIGPLOT was used for interaction studies between AEC pore residues with IAA. Gromacs simulation was run to study how the molecule of IAA is effluxed by the auxin producing microbe. We aim to identify the unknown auxin efflux mechanism utilized by these rhizospheric microbes present in hot-springs.

O-58

Challenges and new strategies in seed potato production

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India is the second largest producer and consumer of potato in the world. In the past ten years, the production has increased more than 60 per cent with both area and yield contributing to the increase. The national average potato yield in 2017 was around 24 tonnes per hectare. However, there are wide variations in yield level within India, ranging from 31.5 tonnes per hectare in Gujarat to 10 tonnes per hectare in Assam. Among different constraining factors for yield growth, the limited availability of quality seed material is considered as the most important factor for lower yield levels in eastern states. Use of high yielding varieties and quality planting materials are two important prerequisites for healthy seed potato production. Low rate of tuber multiplication, high seed (tuber) rate, progressive accumulation of degenerative viruses, perishability and bulkiness are inherent problems in potato seed production. This may result in non-availability of adequate quantities of quality seeds at affordable price and seed cost alone reflects 40-50 per cent to the total costs of cultivation in potato. To circumvent some of these problems, several modifications such as tuber indexing for virus freedom, seed multiplication stages and seed certification standards have been developed and integrated with conventional seed potato production programmes. The advent of tissue culture, in which virus-free plants can be produced through meristem culture has revolutionized seed production in potato world over. Recent developments in automation of minitubers production have further enhanced adaptability of these techniques in potato seed production.

O-59

Challenges and strategies for commercializing citrus cultivation in north western India

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Citrus fruits like sweet orange, grapefruit, mandarin, lemon and lime are important horticultural crops of tropical and sub-tropical regions of the world. The major citrus growing states in the country are Andhra Pradesh, Maharashtra, Madhya Pradesh, Punjab, Gujarat, Rajasthan, Karnataka, Assam, Odisha and Haryana and these states contribute about 71.1 per cent of the total citrus production. Citrus has become a dominant fruit industry of North Western India in term of area and production. It comprises of more than 66 per cent of the total area and 69 per cent of the total production of fruit crops in the Punjab state of this region and is playing a pivotal role in bringing out the state from monoculture of

wheat and paddy rotation. As a result of this high volume of production, knowledge about the different characteristics like yield, fruit quality, plant growth *etc.* of different citrus varieties is of utmost importance in order to screen out most suitable variety or combination of varieties for establishment of an orchard. The area expansion of this fruit crop in the region is also associated with challenges like marketing of the produce, requirement for more suitable commercial varieties for the region, appropriate stoinic combinations, mechanization for efficient cultivation, handling of biotic and abiotic stresses, post-harvest losses, *etc.* The help in regulating the market of this perishable produce through export or consumption in the processing units is the utmost requirement which can make this venture more profitable and thereby bringing larger area under this fruit crop.

O-60

Climate resilient adaptive strategic for sustainable development of viticulture in sub-tropical and temperate regions of India

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Grape is one of the lucrative crop grown in India for its economic importance as well as nutritional value. In India, it was introduced first in temperate climate and there after expanded in subtropical and tropical areas due to its wider adaptability. The effect of climate change on grapevine physiology and fruit quality characteristics are already visible and will very likely continue in the coming decades in all the grape growing areas. The positive effect of climate change is an advance in phenological stages, with a ripening period occurring under warmer climatic conditions. This offers the better prospects of grape growing under sub-tropical climate. Moreover, direct effects of elevated atmospheric CO₂ concentrations are also good under environmental conditions. Beyond establishing whether or not viticulture can even be sustained in an area, the climatic influences of a particular area go a long way in influencing the type of grape varieties grown in a region and the type of viticultural practices that will be used. The presence of adequate sun, heat and water are all vital to the healthy growth and development of grapevines during the growing season. But the, the major problem of grape cultivation under subtropical climate is the use of mid-to-late maturing varieties and occurrence of rainfall during berry ripening results in the rain induced berry cracking and economic loss of crop. This makes most challenging to the growers. Keeping in view the facts, climate resilient strategic planning is urgently required which can fit under prevailing conditions.

O-61

Potential of ecosystem services in orchards in subtropical horticulture: An overview

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There is a pressing demand for the quality of products. The quality standards of fruits, most of which are sold to the fresh market, are very high (Codron et al. 2005). At the same time, on a global scale, the fruit sector is very competitive and yield is of great concern for fruit growers. This has led to the intensification of production techniques, especially of pesticide use in orchards, globally. The objective of this review is to describe ecosystem services and their management in orchards, based on an analysis of agro-ecosystem functioning. This review is based on the CICES classification. The ecosystem services analyzed include

fruit production, climate regulation by mitigation of greenhouse gas emissions, soil nitrogen availability, water regulation in terms of hydrological cycle and water flow maintenance, pest and disease control, and life cycle maintenance through pollination. Efforts have been made to explain how ecological functions modified by agricultural practices provide six ecosystem services - fruit production, climate regulation, soil nitrogen availability, water regulation, pest and disease control, and pollination - and which indicators could describe them. The major points are, first, that orchards have a high potential of multiple services. They can sequester from 2.4 to 12.5 t C/ha/year. Over fertilization enhances nitrogen leaching, which reduces soil nitrogen availability for the plant and deteriorates the quality of drained water. Groundcover increases humidification and reduces de-nitrification and runoff, thus enhancing soil nitrogen availability and water regulation. It also enhances biotic interactions responsible for pest control and pollination. Pruning may increase fruit quality through a better carbon allocation but decreases pest control by fostering the dynamics of aphids. Agricultural practices in orchards have a strong impact on several ecosystem functions and, consequently, on ecosystem service relationships. Groundcover management may increase biotic interactions by offering a habitat to natural enemies or repelling crop pests, but it can also avoid runoff and leaching while increasing soil drainage. Pruning may increase fruit production but may favor some pests as well. Pesticide use remains the most effective pest control method, but its negative impact on ecosystem services such as pollination jeopardizes the sustainability of orchard systems. Irrigation and nitrogen fertilization certainly allow increased fruit production, but they might impact non-marketed ecosystem services since they have a direct effect on functions like leaching and de-nitrification. Developing sophisticated orchard models that address multiple ecosystem services and take the impact of soil, climate and agricultural management into account is still a challenge. Finally, the collective dimension of multi-service management in areas that include a high density of orchards is a new challenge that opens up new research avenues requiring the cooperation of the ecological and social sciences (Lescourret et al. 2015).

POSTER SESSION

P-113

Climate resilient fruit crops : Adaptation and mitigation strategies : A review

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Climate change, a global phenomenon, is a concern for food and nutritional security of growing population and has attracted global, regional and national dialogues for mitigation and adoption strategies. The likely effects stipulated are occurrence of drought and floods, change in rainfall pattern and sudden change in temperatures, which will have impact on the growth pattern of plant, flowering, fruiting and yield and quality of produce, besides increasing vulnerabilities to pest and diseases. Climate change may affect the flowering and fruiting timing, maturity and quality of fruit crops to a great extent. It can also affect the spatial distribution pattern of these crops in order to meet the specific climatic requirement of crops. The temperate crops which possess an optimum thermal range may suffer greatly as compared to tropical crops. Rise in atmospheric temperature may enhance the growing period of tropical crops like mango, jack fruit, banana, etc. in north India especially during winter when growth is generally restricted greatly due to low temperature. This may also help in overcoming the problem of alternate bearing in mango in north India. How to handle the challenges of climate change in terms of adaptation and mitigation strategies made region basis. The potential of perennial fruit and plantation crops for higher carbon sequestration provides an opportunity to be a sink for increased carbon dioxide and additionally, opportunity for soil carbon sequestration.

P-114

Adaption and mitigation on climate change

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Climate change can be defined as the change in the statistical distribution of overall weather pattern when that change lasts for an extended period of time. The heat-trapping greenhouse gas (CO₂), that has driven recent global warming, lingers in the atmosphere for hundreds of years and the earth including oceans takes a while to respond to warming. So, even if it is stopped emitting all greenhouse gases today, global warming and climate change will continue to affect several future generations. To stop the future warming some adaption and mitigation strategies can be adopted. Adaptation strategies involves, adjusting to actual or expected future climate. Ultimate goal is to reduce our vulnerability to the harmful effects of climate change. Whereas, mitigation strategies involve reduction of flow of heat-trapping greenhouse gases into the atmosphere which can be achieved either by reducing sources of these gases or by enhancing the sinks that accumulate and store these toxic gases. It can also be achieved by increasing the greenery or by planting the trees on barrel lands. Horticultural crops have a very important role in countering the negative consequences of climate change by providing a better carbon trade and carbon sink. Planting of some fruit trees can help to improve the micro climate of that particular area. Planting of ornamental plants in house not only compliment interior setting but also bring life to indoor environment. They act as a natural air filters by absorbing various toxic compounds and also by removing other harmful gases.

P-115

Vegetable grafting - Potential technique for overcoming biotic and abiotic stress

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India is the second largest producer of vegetable after china. Vegetable cultivation is one of the commercial enterprises not only in Maharashtra but also in other states of the country. Solanaceous and cucurbitaceous crops are important vegetable families comprising major commercial vegetables like tomato, chilli, brinjal, cucumber, melons, gourds *etc.* These vegetables are cultivated on commercial scale by the farmer due to their high repaying capacity. However, due to its continuous cultivation in the same field, it is infected by many biotic and abiotic stresses. Among the biotic stress, soil borne disease like bacterial wilt, *Fusarium* and *Verticillium* wilt are common causes of yield losses upto 78 per cent. One of the novel way to escape the incidence of such disease is use of grafting techniques. Some of the commercial vegetable growers are now adopting this technology for achieving the yield potential in commercial cultivars. Vegetable grafting although boon for commercial vegetable growers but due lack of knowledge in vegetable grafting with respect to standardization of rootstock, season and methods, the technology is in infantry stage. Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli has initiated work on grafting techniques aspects for brinjal with respect to the age of scion and rootstock. Performance of brinjal grafts under polyhouse and field condition have achieved considerable success.

P-116

Climate change and mitigation strategy for fruit production

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Significant deviation in mean state of the climate in its variability persisting for an extended period (typically decades or longer) is referred as climate change. The amalgamation atmosphere concentration of CO₂, CH₄, N₂O have increased tremendously by about 31, 15, 17 percent respectively due to man made disasters. Hence, without mitigation, the extent and impacts of climate change will be much more severe and future adoption will incur very heavy environment, economic and social costs. Mixing adoption and mitigation strategies can reduce risks to climate change impacts and can be synergised with each other to achieve greater levels of both adaptation and mitigation. In regions, where the prevailing temperature is already high, further increase in temperature will adversely affect the yield and quality of fruits. The consequence of such rapid changes are augmentation of global warming, change of seasonal pattern with excessive rains, melting of ice crop, flood rising sea level and drought occurrence *etc.* The change in land use practices could be attributed as a major factor responsible for climate change and in many areas the land under fruit crops cultivation was replaced for production of coarse grains, seasonal vegetables and other horticulture species. The adjustment can be done by development of low chilling cultivars, crops tolerant to high temperature, resistant to pests and diseases and producing cultivars having good yield under stress conditions. The adoption of hi-tech horticulture and judicious management of land use resources new state of art precision horticulture will be the main strategies and factors to meet these challenges.

P-117

Impact of climate change on horticultural crops

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The effects of changing climate have huge constraints on production and productivity of horticultural crops. Uncertainty in climate patterns, induced by accelerated warming, has started to affect a catchment-specific hydrologic cycle. Higher temperatures lead to a high rate of evaporation and dry conditions. Severe weather events are now more. Which may cause impact in terms of increased temperature, more demand for water and increase in abiotic and biotic stresses. Due to severe cold wind resulting yield loss of 10-100 per cent in horticultural crops in different crops and varieties. The global warming has cause improper growth and development. In mango some times early flowering occur and there is no fruit set due to this early flowering. Abnormal high temperature during winter cause poor flowering, irregular flowering duration, pattern of flowering and poor yield in temperate fruits due to non availability of sufficient chilling hours. The horticulturist will have to play a significant role in the climate change and have to establish proper strategies for protecting various horticultural crops.

P-118

Impact of adverse effect of climate change on global banana yield

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Global warming in about last 60 years had helped in increasing banana yield at annual rate of 0.024 t/ha translating to an average increase of 1.37 t/ha in 27 countries since the 1960s. But with continued warming, the yield gains could slow down or even reverse in some countries leading to a drop in yield 0.59 to 0.19 t/ha by India, which is the world's largest producer and consumer of banana. Nine other countries such as Brazil are facing such type of problems in different ways. India is the world's number one producer of banana. Over 29 per cent of the world's banana production is in India. The average yield of banana in India is around 60 t/ha. During the same period (2010 and 2017) China, produced about one-third of India which is 11 million tones per year. India could experience a major reversal with predicted negative effects of future climate change compared to positive effects in the past. Study finds decline in production due to climate change in the case of India may be mitigated by strong, technology driven measures to increase the yield.

P-119

Population fluctuation of mango fruit fly, *Bactrocera* spp. (Diptera- Tephritidae) in Lucknow region of Uttar Pradesh

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Annual monitoring of the population dynamics of the oriental fruit fly *Bactrocera* spp. (Hendle) Diptera⁶ Tephritidae in Lucknow region of Uttar Pradesh, India was conducted by bottle trap and wooden block trap in 2004 and 2005 and factors including temperature, rainfall and host species with respect to the population fluctuation were analyzed systematically. The results showed that the fruit fly was present all year round in Lucknow region of Uttar Pradesh. The first catch in bottle trap was in the 7th standard week in both year 2004 and 2005 at an average of 10.53 and 9.67 flies/trap/week respectively. However, trap catch were observed in the wooden block traps in the 3rd standard week in 2004 and 2005 (14.50 and 3.67 flies/trap/week, respectively). The peak average population of *Bactrocera* spp. was 420 and 1499 flies/trap/week in 25th standard week in bottle and wooden block traps, respectively in the year 2004. The weather parameters during 25th standard week showed an average maximum and minimum temperature of 37.7°C and 25°C respectively. Maximum and minimum relative humidity was 89% and 73 per cent respectively. The peak average population (399 and 1398 flies/trap/week) during the year 2005 was attained in 26th standard week in bottle trap and wooden block trap respectively. In the corresponding 26th standard week of the second year, maximum and minimum temperature was 42 and 25.7°C maximum and minimum relative humidity was 61 and 41 per cent, respectively, and the total rainfall was 51 mm.

THEME 5

BURSTING THE BARRIERS IN HORTICULTURE AND USING NEXT GENERATION TECHNOLOGICAL TOOLS

ORAL SESSION

O-62

Assessing genetic diversity in Pummelo (*Citrus grandis* L. Osbeck)

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Pummelo, one of the cultivated citrus groups, is mainly consumed for its nutraceutical benefits. Rich antioxidant profile makes it highly suitable for kidney and heart ailments. Though in pummelo both white and red coloured fleshed cultivars are available, the red flesh coloured is more appealing, preferred by consumers and demanded in markets. In the present study five cultivars were evaluated for physico-chemical parameters of fruits along with growth parameters for five years. It was found that the selection NRCC Pummelo - 3 has the highest fruit weight *i.e.* (1120 g) followed by NRCC Pummelo - 5 (813 g), NRCC Pummelo - 5 had highest yield in terms of number of fruits per plant (408 fruits/plant), which were almost double the second largest NRCC Pummelo - 1 (243 fruits/plant). The highest TSS (11.41° Brix) and acidity (0.93%) was observed in NRCC Pummelo - 5. The major pest and diseases were non-significant across the selections. Therefore, NRCC Pummelo-5 was identified as promising cultivar for commercial cultivation and production.

O-63

New era of fruit breeding using CRISPR/Cas technique

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New Breeding Tools (NBTs) in the post genomic era have played a vital role in eliminating obstacles of conventional crop improvement strategies in fruit crops. One such remarkable advanced tool is CRISPR/Cas targeted mutagenesis. CRISPR acronym of Clustered Regularly Interspaced Short Palindromic Repeats system, along with Cas (CRISPR-associated protein) enzyme called CRISPR/Cas genome editing paves precise modification in genome of an organism. Because of easiness, economical, target specific and alternative to transgenic, CRISPR/Cas technology is preferred over other gene editing tools and in fruits citrus was the first crop edited with CRISPR. To date, CRISPR-SpCas9 derived from *Streptococcus pyogenes* has been widely used to modify a targeted trait at specific site in citrus, grape, banana, apple, pear, strawberry and kiwi for proof of efficient editing, functional genomics study, early flowering, plant architecture modification, fruit quality traits improvement and pathogen resistance. Despite the various positive attributes, one of the major limitations with Cas9 endonuclease system is causing off target effect in edited plants. Recently, CRISPR-Cas12a from *Prevotella* and *Francisella* bacteria a class II/type V CRISPR nuclease, has been employed as an alternative system for genome editing, it is reported to have fewer off-targets than Cas9 and which is demonstrated in citrus for Canker resistant. Hence, this paper aims to present how CRISPR/Cas system of gene editing dragged fruit breeding can pave the path for future crop improvement.

O-64

***In vitro* mutagenesis in fruit crops : Opportunities and challenges**

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Achievements through conventional breeding in fruit crops to achieve desired traits has rather been slow due to high heterozygosity, narrow genetic base, polygenic nature of many important traits and long juvenile phase. Tissue culture however, has proved its superiority in terms of production of genetic pure lines (haploids and doubled haploids), virus free plantlets, clonal propagation and faster multiplication rate through different approaches. Mutation breeding on the other hand, acts as a valuable tool by altering only one or a few characters of an already first-rate cultivar, preserving the overall characteristics. Induced mutation in combination with *in vitro* provides extensive opportunities against *in vivo* by allowing a wide choice of plant materials for mutagenic treatment, handling of large populations, increasing mutation induction efficiency, possibility of mutant recovery and speediness of cloning selected variants. Identification and selection of desired mutants however, involves the risk of chimera dissociation for obtaining homohistonts having mutated cells expressing the mutation in the phenotype. Recently developed technologies such as TILLING (Targeting Induced Local Lesions IN Genomes) and S-SAP (sequence-specific amplified polymorphism), come up as a compliment for early mutant identification. Recently *in vitro* mutagenesis has been reported in different fruit crops for disease resistance in mango (anthracnose resistant), citrus (canker tolerant), banana (fusarium wilt and black sigatoka resistant), abiotic stress tolerance like salinity (avocado), drought (grape) induced mutants, quality improvement like seedlessness in grape fruit and tangerine. This paper deals with the opportunities and challenges in breeding of commercial fruit crops through mutation breeding.

O-65

Hybridization and evaluation of F₁ hybrids in guava under semi-arid ecosystem of central Gujarat

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Guava is widely grown in tropical and subtropical regions of India. In Gujarat, guava occupies about 10.81 thousand hectares with production of 140.8 thousand tones and productivity is 13.30 t ha⁻¹ (NHB, 2015). It is mainly grown in semi-arid areas of Bhavnagar, Vadodara, Kheda, Mehsana, Anand, Gandhinagar and Panchmahal districts of Gujarat. Wide variability is found in red fleshed guava due to prevalence of seed propagation in these areas. Therefore, through various surveys, red fleshed guava genotypes were collected from Panchmahal, Bhavanagar, Vadodara, Mahisagar and Gandhinagar districts. The collected red fleshed guava genotypes were used in crossing programme including Lalit at CHES, Godhra during 2016-2019 to develop high yielding, drought hardy varieties with good fruit quality. Nineteen crosses were made using 12 parents adapted to local conditions having diverse fruit and growth characteristics. Controlled cross pollination was done at calyx splitting (pre-anthesis) stage which set fruit in between 75-100 per cent with good number of seeds. All the F₁ hybrid progenies planted in the year August, 2017 came into flowering in 14-22 months after planting. Plant height, canopy spread, growth habit, number of fruits plant⁻¹, yield plant⁻¹, fruit weight, fruit size, flesh thickness, seed core diameter and fruit chemical quality attributes varied significantly within progeny. Based on fruit yield and quality attributes individual F₁ hybrids will be selected.

O-66

Potential genetic advances in grape breeding for sub-tropical climate : Current status and future prospects

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Growing grapes is a challenge under sub-tropical regions of north Indian plains, because of the occurrence of pre-monsoon showers during fruit maturity, shorter period of berry development, dry and hot summers and non-availability of early maturing cultivars. Some of these factors are responsible for decline in the grape acreage under sub-tropical areas of north India. In this regards, systematic grape breeding programme is in progress at ICAR-IARI, New Delhi to develop cultivars, which could combine the characteristics of extra-early maturity along with better berry quality traits in terms of TSS, berry colour, berry size and yield. The basic germplasm used in the crossing programme was *V. vinifera* varieties like Perlette, Pusa Urvashi, Pearl of Csaba, Beauty Seedless, Bharat Early, Banqui Abyad, Cardinal and Hur. Breeding methods adopted includes modern techniques (embryo-rescue), as well as traditional approaches. Breeding efforts resulted into development of dozens of promising hybrids in terms of extra-early maturity as well as berry quality. As a result, six promising hybrids viz., Pusa Aditi, Pusa Trishar, Pusa Swarnika, ER-R₂P₃₆, 16/2A-R1P9 and 16-2A-R₁P₁₄ were found to be promising. Out of these hybrids, ER-R₂P₃₆ was found most promising in terms of extra-early maturity (last week of May), high total soluble solid content (22.2° Brix), mild acidity (0.5%), medium berry weight (2.1 g), medium bunch weight (355.2 g) of seedless black coloured berry. Therefore, outcome from this breeding program is significant for grape growing under subtropical regions of north Indian plains.

O-67

In-silico analysis and protein-protein interaction network studies of defense related gene from mango transcriptome of healthy and malformed tissue

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Plant defense is normally induced when plants are attacked by biotic and abiotic stress. The objective of present research was to scrutinize the response of defense genes i.e. resistant genes, enzymes, multi-drug resistant genes and transcription factors in healthy and malformed tissues. Total 77 genes were selected from healthy bud and healthy panicle stage, which were differentially expressed in three different malformed stages. Physico-chemical analysis indicated that among 77 defense related genes, 15 genes were stable in nature. Major GO annotations in defense related genes were metabolic process, cellular process, catalytic activity, cell and cell part. The number of upregulated genes were 22, 23 and 25, while down regulated genes were 27, 6 and 5 at single SSMBS-1, MMBS-2 and MPS-3 respectively. Motif analysis indicated that motif-1 and motif-5 were the most conserved motifs among 77 defense related genes. Protein-protein-interaction network with respect to ortholog genes i.e., *Vitis vinifera* and *Populus trichocarpa* indicated that heat shock protein were more active in all differentially expressed gene followed by other defense gene namely SHMT, SOD, WRKY 33, MAPK, CCR and LHY5. Among CREs, A-box and CAAT-box had maximum (77) frequency followed by TATA-box, ARE, Circadian, Skn-1 motif, G-box, CG-motif, GAG-motif, MBS, Sp1, TC-rich repeats, CGTCA-motif, TGACG-motif, GA-motif, 5UTR Py-rich stretch, TCA-element and GCN4 motif.

O-68

Characterization of *Diplodia* spp. associated with apple canker disease in India using phenotypic and genotypic approaches

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Apple (*Malus × domestica* Borkh) is one of the commercially grown fruit in temperate regions of India. In recent years, the incidence of apple cankers disease is increasing and assuming an epidemic form in most of the apple growing parts of Kashmir. In order to characterize the pathogen and species associated with the disease, 40 infected diseased samples were collected during 2017-18 from different apple growing regions of J&K. The symptoms observed were sunken brown elliptical lesions having series of concentric rings, girdled the affected branch and large tree trunks. Out of 40 samples, 20 isolates representing north, centre and south Kashmir were maintained for morpho-molecular characterization. The cultural characteristics revealed that the colonies were fluffy, irregular margin having dark centre and reached 20-30 mm after 7 days on PDA at 25°C. Based on morphological characters, the fungus was identified as genus *Diplodia*. To confirm the identity of genus and species at the molecular level, internal transcribed spacer region (ITS) and elongation factor (EF1) gene was amplified. Amplicon of 550bp from ITS was amplified from all 20 isolates and sequence analysis showed maximum similarity (97-99%) with two species, *D. bulgarica* and *D. seriata*. To further validate the ITS results, elongation factor (EF1) gene with an amplicon size of 300 bp was amplified from both the isolates of *D. bulgarica* and *D. seriata*. The sequence result further confirmed the species identity and showed sequence similarity 97-98 per cent with *D. bulgarica* and *D. seriata*. In conclusion two species were identified and to the best of our knowledge, among the two species *Diplodia bulgarica* is new report from India.

O-69

Introgression of *Vf* (Rvi6) scab resistance gene in commercially grown cultivars of apple (*Malus x domestica* Borkh.) using marker assisted selection

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The present study was devised to introgress, *Vf* (Rvi6) scab resistance gene in two commercially grown cultivars (Gala Redlum and Fuji Aztec) of apple (*Malus x domestica* Borkh.) using marker assisted selection. Twenty four parental genotypes were screened for scab disease resistance using phenotypic and molecular approaches to find out the highly resistant parental genotype. Phenotypic screening using leaf detach method showed that, in certain genotypes fungus did not proliferate macroscopically and the leaves remained alive, green and also showed hypersensitive response, which gives indication of resistance against apple scab. To validate the results of phenotypic screening, all twenty four genotypes were again evaluated for the presence of *Vf* gene conferring resistance against apple scab disease using nine *Vf* gene specific primers. Certain gene specific markers amplified single fragment in resistant cultivars and confirmed the presence of *Vf* gene in these cultivars. Among 24 parental genotypes 8 genotypes *viz.*, Firdous, Nova Easygro, Gavin, Priscella, Liberty, Selection 5, Selection 1 and Selection 8 were amplified by almost all the primers used. Gene expression studies using Real time PCR also revealed that same 8 genotypes were having highest expression of *Vf* gene. Before hybridization, studies like pollen viability

and pollen germination were also done, which revealed that maximum germination and viability were shown by Priscella (91.31 & 90.60% respectively). For hybridization programme to introgress the resistance in susceptible cultivars Redlum Gala and Fuji Azitec, 8 donor parents were selected as pollen donors based on pheno-molecular screening, gene expression, pollen viability and germination studies. Out of total crosses done, the fruit set percentage was highest in Gala Redlum x Firdous with 91.66%, the seed germination and seedling survival percentage was highest in crosses between Fuji Aztec X Sel. 8 (79.62%) and Gala Redlum x Liberty (79.82%) respectively. Present study confirmed the resistance both by phenotypic and molecular screening among certain genotypes which can be further exploited for future molecular breeding programme.

O-70

Development of stress resistant varieties in garden pea in mitigating climate change risks

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Legumes including garden peas (*Pisum sativum* L.) are an integral part of sustainable agricultural system world-wide. In the context of climate change, the major stresses affecting garden pea productivity are high and low temperature, wilt, powdery mildew, rust and terminal heat. In Northern India, the extra early sowing faces the stress of *Fusarium* wilt due to prevailing high temperature in September or early October, while the late sown crop is much affected by powdery mildew mainly during February-March. The severity of diseases may cause substantial yield losses (30-70%) depending on prevailing weather conditions. Keeping this climate uncertainty in view, breeding programme was initiated at IARI to develop variety of vegetable pea by combining resistance to *Fusarium* wilt as well as heat tolerance so that it can be grown for extra early crop production when high temperature prevails at the time of sowing. Pusa Shree (GP-17) was developed and released by CVRC as early variety having high resistance to wilt, which showed mortality up to 10 per cent as compared to 95 per cent mortality in Arkel under sick plot in 2nd October sowing. The yield may vary from 3.02 t/ha to 7.51 t/ha in 2nd October and 30th October sowing, respectively. However, it produced an average pod yield of 99.2 q/ha on all India basis AICRP trials under normal sown conditions. Another new climate resilient variety Pusa Prabal is developed, released and notified by CVRC. Its average pod yield is 100-130 q/ha with 7-9 seed/pod and 52 per cent shelling. It is the first of its kind having multiple resistances to *Fusarium* wilt and powdery mildew disease, which can be grown in early as well as late sown conditions for realizing higher productivity and farmers can earn more profit with less risk in changing climate scenario.

O-71

Precocity induction : a fast track fruit breeding approach

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The complex reproductive biology and long juvenile period are the most important impairment for fruit breeding programmes and genetic studies. Fruit breeding programs using diverse genetic material from both wild species as well as different cultivars may require several generations of backcrosses and can therefore last for several decades. A biotechnology tool has been developed to promote transition from the vegetative to the reproductive phase in juvenile citrus plants by expression of the *Arabidopsis thaliana*

or citrus *FLOWERING LOCUS T* (*FT*) genes using a *Citrus leaf blotch virus*-based vector (*clbvINpr-AtFT* and *lbvINpr-CiFT*, respectively). Citrus plants of different genotypes graft, inoculated with either of these vectors started flowering within 4–6 months, with no alteration of the plant architecture in comparison with non-inoculated adult plants. Similarly, when apple cotyledons were inoculated with ALSV-AtFT/MdTFL1 immediately after germination, more than 90% of infected seedlings started flowering within 1.5–3 months, and almost all early-flowering seedlings continuously produced flower buds on the lateral and axillary shoots. A transgenic line of ‘Spadona’ (*P. communis*), named Early Flowering-Spadona (EF-Spa), was produced using a *MdTFL1* RNAi cassette targeting the native pear genes *PcTFL1-1* and *PcTFL1-2*. Thus, the early flowering transgenic line EF-Spa obtained by *PcTFL1* silencing provided an interesting tool to accelerate pear breeding. CRISPR/Cas9-mediated mutagenesis of *AcCEN4* and *AcCEN* may be a valuable means to engineer *Actinidia* amenable for accelerated breeding. There have been numerous reports demonstrating that a number of different microRNA (miRNA) families play important roles in the regulation of flowering time and floral development, which they do by targeting and down-regulating transcription factors involved in these processes.

O-72

Microsatellites presented high level of species level variation in *Psidium* for utilization in rootstock breeding

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Guava (*Psidium guajava* L.), acclaimed as poor man’s apple, is a fruit crop for both tropical and subtropical regions. Enormous amount of diversity has been reported in *Psidium* species which is spread widely across the globe. Generally, cpDNA based markers are extensively used for species discrimination in many crops. In the present study, we report the usefulness of SSR markers for the species discrimination among 9 *Psidium* species viz., *P. chinensis*, *P. cujavalis*, *P. molle* x *P. guajava* interspecific hybrid, *P. cattleianum*, *P. guineense*, *P. friedrichsthalianum*, *P. acutangulum*, *P. araca*, including the most common guava, *Psidium guajava*. About 19 SSR markers were surveyed on 9 *Psidium* species, among which 8 markers amplified 2-7 alleles per marker with a total of 77 alleles cumulatively. Heterozygosity index (Hi) was found highest for *mPgCIR22* (0.48) and lowest (0.224) in *mPgCIR 05*. Polymorphic Information Content (PIC) ranged from 0.198975 to 0.3648 and was found to be highest in *mPgCIR22*. Effective multiplex ratio (E) ranged between 0.5 and 1.0, with maximum values in *mPgCIR 13*, *mPgCIR16*, *mPgCIR21* and *mPgCIR94*. *mPgCIR 22* scored the highest arithmetic mean of H/ Average heterozygosity i.e. 0.024, while *mPgCIR 05* scored minimum (0.003201166). Marker Index ranged between 0.0029 and 0.019. *mPgCIR05* had the highest discriminating power with score 0.99 while *mPgCIR22* scored lowest i.e. 0.85. Resolving power was found highest (2) for markers viz., *mPgCIR13*, *mPgCIR16*, *mPgCIR21*, and *mPgCIR94* and lowest (1) for *mPgCIR23*. These results suggest that the SSR markers could be efficiently used in selection of interspecific pre-breeding stocks and resistance rootstock breeding in guava.

O-73

Standardization of surface sterilization exposure duration for *in-vitro* cloning of *Anthurium andraeanum* Lind. cv. Candy

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Anthurium is traditionally propagated by stem cuttings and suckers to obtain homogenous planting materials but being a very slow process it becomes tedious and not practical to carry out on a large scale. However, *in-vitro* propagation is the most suitable method for production of large number of pathogen free true-to-type plantlets at a quicker pace. A study was taken up for standardizing the exposure duration for surface sterilization of leaf and petiole explants in Anthurium cv. Candy, during 2013-17 in the Department of Floriculture at Biotechnology-cum-Tissue culture Centre, OUAT, Bhubaneswar. The experiment was conducted with washing of the explants in Tween-20 solution followed by fungicide and then treatment with Mercury chloride (HgCl_2) at varying exposure time. The surface sterilized explants were cultured on MS media. The leaf explants surface sterilized with 0.1% HgCl_2 for 4 minutes recorded no fungal or bacterial contamination (0.00%) with 96.89 per cent survival and 100 per cent aseptic condition at 45 days after inoculation (DAI) and 100 per cent aseptic condition with 89.8 per cent survival of leaf tissues at 60 DAI. The petiole explants of cv. Candy sterilized with 0.1% HgCl_2 for 8 minutes were free from any fungal or bacterial contamination (0.00 %) with 96.74 per cent survival of tissue at 45 DAI and 99.93 per cent aseptic condition with 96.13 per cent survival of tissue at 60 DAI. The obtained sterilization time was taken into consideration for further sterilization explants and *in-vitro* culture in the MS basal media supplemented with of bio-regulators.

POSTER SESSION

P-120

Characterisation of ERFs during fruit development and ripening in mango

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Dashehari is one of the leading mango cultivars of north India and area under this cultivar is also increasing in other parts of the country owing to its pleasant taste, aroma and high pulp content. In recent years, during fruit ripening jelly seed development has been experienced as one of the major disorder in some of the pockets, where the crop is commercially grown. Understanding the genetic basis for this malady is important, therefore efforts were made to understand role of ethylene responsive TFs in fruit development and ripening. Ethylene and ethylene responsive transcription factors (ERFs) play major role in the fruit ripening. ERF super family is defined by the AP2/ERF domain, consists of about 60 to 70 amino acids and is involved in DNA binding. ERF family genes are implicated in many diverse functions such as biotic and abiotic stresses, metabolism regulation during developmental processes. In the present study we have mined 17 CDS of AP2/ERF genes in transcriptome data of mango jelly seed tissue. Expression analysis of some genes carried out during fruit development and ripening stages showed expression of ERF21 and ERF39 to be up-regulated during fruit development, ripening and jelly seed as compared to 0 dpa, which suggests that ERF21 and ERF39 play an important role during fruit development as well as ripening and jelly seed formation.

P-121

Standardization of *in vitro* regeneration protocol for kinnow mandarin through nodal segments

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Standardization of *in vitro* regeneration protocol for kinnow mandarin through nodal segments from field grown mature mother plant was attempted. Present study concluded that, among the surface sterilization treatments Carbendazim 0.1% along with 2 drops Tween 20[®] for 30 minutes followed by 0.1% Streptocycline[®] along with 200 ppm HQC for 30 minutes under open condition, subsequently under laminar air flow chamber 0.1% NaOCl for 5 minutes resulted in maximum (75.00%) contamination free cultures. Pre-treatment (spraying) of mother plant before explant collection with Carbendazim 0.1% and Streptocycline 0.1% alternatively for 5 days controlled contamination up to 93.00% during sunny days. Among the basal media (MS, MT and DKW) and plant growth regulators (BAP, Kinetin and GA₃ of 0.0 to 2.5 mg/l) tested in different combinations for primary shoot emergence, MS medium supplemented with BAP 1.5 mg gave a healthy shoot of 1.50 cm length with 5.00 leaves within 30 days and further increases in BAP concentration resulted multiple shoot emergence (2 to 5 buds/explant) with reduced shoot length and leaf width compared to other treatments. In variable of growth regulators bud break was absorbed from explants within 8.0 days after inoculation. Premature abscission of primary shoots was the major problem encountered in this present study. In order to control abscission, the effect of different growth regulator combinations (BAP, Kinetin, GA₃, NAA) alone or together with activated charcoal (100-500 mg) and organic additives (malt extract, casein hydrolysate, adenine sulphate and L-Glutamine (25-500 mg/l) were tested.

P-122

Molecular breeding in vegetable crops

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The application of marker-assisted selection has proven capacity to make plant breeding more efficient. Using molecular markers for selection in breeding makes the production of new crop varieties faster and more cost-effective. Breeding virus-resistant tomato or flood-tolerant rice can be achieved more efficiently by using molecular markers for selection instead of relying on phenotypic selection alone. During the last 15 years, the private sector has strongly benefitted from this technique, but adoption of molecular breeding in the public sector is still limited and in most developing countries it is hardly used. Vegetable crops provide high quantities of food and represent a rich source of nutrients, vitamins, and minerals for the human diet. Recently, many advances have taken place to facilitate the development of genomic resources for several vegetable crops, including tomato, pepper, cucumber, and watermelon. These genomic resources have facilitated the development of genome-wide markers and high-throughput genotyping platforms. In addition, several mapping approaches have been applied to dissect complex quantitative traits with higher accuracy relative to linkage analysis. These genomic resources and tools are highly valuable for the research community and they will benefit breeders aiming to develop superior vegetable cultivars with improved traits by increasing the selection efficiency through marker-assisted selection and/ or genomic selection. Moreover, current and future genomic advances will lead to the next green revolution and will facilitate sustainable agriculture.

P-123

Morphological and molecular characterization of guava (*Psidium guajava*) hybrids

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An experiment was conducted to characterize 20 different guava varieties and hybrids, based on morphological and molecular markers. The guava genotypes showed significant variation for different traits. The maximum leaf length was recorded in Lalit (14.87 cm) and hybrid GH-2018-10 (13.93 cm), whereas, minimum was in Purple Guava (8.13 cm). Similar type of results were also recorded for leaf length : breadth ratio. Molecular characterization of guava genotypes using 25 SSR markers was done out of which 9 primers showed polymorphism. The allelic size ranged from 160 to 420 bp among the 9 SSR loci and a total of 30 alleles were amplified with an average of 3.33 alleles per SSR locus. The maximum expected heterozygosity (0.20) was noted for SSR locus mpgCIR19, while minimum (0.05) for SSR locus mpgCIR14 with mean value of 0.03 among the 9 SSRs. The average PIC value was 0.49 of 9 SSR loci and the highest PIC (0.73) was recorded for locus, mpgCIR13, while minimum (0.34) for SSR mpgCIR16. The SSR loci, *viz.*, mpgCIR14, mpgCIR13, mpgCIR05 and mpgCIR249 had PIC values greater than 0.50, thus, representing high discriminating power among the studied SSRs. Based on phylogenetic relationship Hisar Surkha, which was stretching outside and remains separated from other clusters. Whereas, remaining genotypes grouped in two different sub-clusters. Morphological and molecular analysis showed a high degree of variation among the guava genotypes, indicating them as important source of genetic diversity that can be used in the guava improvement programme.

P-124

Molecular markers and its role in vegetable improvement

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Marker is a piece of genetic material that bears or produces distinctive feature that consist of specific molecules that show easily detectable differences among different strains of a species or different species. They are of different types such as morphological, biochemical and molecular markers. Based on Polymerase Chain Reaction they are of three types like Non-PCR based approaches, PCR-based approaches and Targeted PCR and sequencing. In marker assisted selection (MAS) technique, linkages are sought between DNA markers and agronomically important traits such as resistance to pathogens, insects and nematodes, tolerance to abiotic stresses, quality parameters, and quantitative traits. Most molecular marker techniques are employed in the evaluation of genetic diversity and construction of genetic and physical maps. Greater and greater amounts of sequence data, genomic and cDNA libraries, and isolated chromosomes will be increasingly available with time. This information and material will be of major importance in the future due to the present rate of extinction and diversity reduction.

P-125

Morphogenetic diversity among exotic clonal rootstocks of apple

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The morphogenetic identification of clonal rootstocks of apple (M9-T337, M9-T339, M9-Pajam, MM-106 and MM-111) collected from 5 different locations were carried out at Ambri Apple Research Centre, Pahnoo, Shopian during two consecutive years 2016 and 2017. International Union for the Protection of New Varieties of Plants criteria were used for morphological evaluation of these rootstocks. A wide variation was observed among clonal rootstocks of apple for various morphological traits. Non-hierarchical analysis was also performed to identify clonal rootstocks of apple in terms of inter cluster distances and mean performance of clusters for various characters. For this purpose, intra and inter cluster distances and mean performance of each cluster for different traits were studied. The intra cluster distances ranged from 0.00 to 0.31. The members of cluster I and III exhibited maximum divergence (3.28) followed by cluster I and II (1.29). The members of cluster II and III were least divergent (1.24). Genetic divergence among rootstocks was estimated by eight SSR markers and DNA amplification was carried out in 20 µl reaction in PCR. Then the products were analysed by electrophoresis in 3.5% agarose gel. On the basis of SSR data dendrogram grouped the genotypes into two clusters. The PIC value varied from 0.5 to 1.0 with an average of 0.63 across 17 clonal rootstocks (pooled sets) of apple. The seventeen clonal rootstocks (pooled sets) of apple showed different two-way similarity coefficient values ranging from 0.00 to 0.32.

P-126

Role of nano technology in Floriculture

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Nanotechnology, a new emerging field is being exploited in horticulture as well as floriculture. The technology includes nano-fertilizers, nano iron and nano silicon particles. It contains microorganisms, specially phosphate solubilizing bacteria, plant growth promoters, nitrogen biological fixative, Fe and Zn improves nutrient efficiency within the crop, enhances the plant growth as well as it improves germination percentage in some of the ornamental crops. Not only fertilizers, nanotechnology play a crucial role in vase life of cut flowers. In recent years, nano silver (NS) was tested as a pulse and vase solution treatment for cut flowers. Nano material includes nano sizes silver (Ag⁺) particle was attributed to inhibition of bacterial growth in vase solution at the end of the cut stems, highly effective as germicide and ethylene inhibitor. The nano silver particles have properties to prevent decrease water stress and increased vase life, reduce stem bacteria and reduce less fresh weight of cut flowers. Therefore, the silver nano particles as appropriate compound, low cost and without adverse effects on the environment can be exploited to increase the survival and succulence of cut flowers.

P-127

Biotechnological approaches in fruit breeding

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Vegetable and fruit production suffers from several biotic stresses. Transgenic papaya cultivars carrying the coat-protein gene provide effective protection against *Papaya ring spot virus*. The transgenic Honey Sweet plum cultivar provides an interesting germplasm source for *Plum pox virus* control. Enhanced host plant resistance to *Xanthomonas campestris* pv. *musacearum*, which causes the devastating banana *Xanthomonas* wilt was achieved by plant genetic engineering. Transgenic fruit crops can make important contributions in enhancing production and productivity of fruit crops.

P-128

Begomovirus infecting *Bhut Jolokia* (*Capsicum assamicum*) in Tezpur region of Assam harbours chimeric genome

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Bhut Jolokia (*Capsicum assamicum*) is a chilli species endemic to North East region of India and is widely cultivated in the states of Assam, Nagaland and Manipur. It is one of the top ten hottest chillies in the world. This is the most ideal chilli species for extraction of capsaicin due to its high capsaicin content of 3-5 per cent unlike other Indian chillies. The demand for this chilli has increased in recent times, both in domestic as well as in international market, and its cultivation is being done on a massive scale in NE India. This chilli is reported to be infected by an isolate of Tomato leaf curl Bangladesh virus in Tezpur region and the present study was undertaken for its complete molecular characterization. Infected leaves were collected, genomic DNA extracted and subjected to RCA-PCR amplification using specific as well as degenerate primers. Presence of DNA-B component was tested using specific primer pair DNABF5/DNABR5 which yielded an amplification product of ~1.3 kbp that corresponded to DNA-B component of *Tomato Leaf Curl New Delhi virus*. Further characterization with degenerate primer for amplification of betasatellite genome gave positive amplicon of size ~1.45 kbp corresponding to betasatellite of *Tomato leaf curl virus*. The *Begomovirus* infecting *Bhut Jolokia* in the Tezpur region of Assam was thus found to be a mono-bipartite type having a chimeric genome.

P-129

Effect of different gelling agents on micropropagation of strawberry (*Fragaria* × *ananassa* DUCH.)

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Strawberry (*Fragaria* × *ananassa* Duch.) is a natural hybrid of *Fragaria chiloensis* L.P. Mill. and *Fragaria virginiana* Duch and belongs to the family *Rosaceae*. It is conventionally propagated through vegetative means. But, this approach of propagation is not feasible for commercial scale plantlet production and has the chance of yield reduction due to the infestation of insect-pests. Therefore, the availability of

quality planting material is of urgent need. Recently, tissue culture has been a promising approach for strawberry multiplication at large scales because it generates a large number of contamination free plantlets in a minimum space and time. Use of mercuric chloride and ethanol were found to be the best instead of their alone for higher explant survival with low contamination percentage in established cultures. The minimum time of callus induction (26.00 days) with the treatment of MS medium + Sago@20 g l^{-1} + 2-4 D @ 4.0 mg l^{-1} , while maximum (40.50 days) was noted under MS Media + Corn flour 5 g l^{-1} + 2-4 D @ 5.0 mg l^{-1} . The earliest shoot initiation (14.21 days) was noted under BAP 4.00 mg l^{-1} + Sago@20 g l^{-1} . The minimum days taken for shoot development (24.28 days) was noted under Half MS Media + Tapioca (sago) 10 g l^{-1} + BAP @ 2.0 mg l^{-1} . After, 40 and 60 days Maximum number of shoots obtained (5.78) were noted under the same treatment of Half MS medium BAP 4.00 mg l^{-1} + Sago@20 g l^{-1} . Maximum percentage of developed shoots obtained (83.16%) was noted under the same treatment of BAP and Sago.

P-130

Morphological and biochemical characterization of guava (*Psidium guajava* L.) germplasm

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Morphological and biochemical characterization of guava (*Psidium guajava* L.) germplasm was done with the aim to characterize the germplasm at morphological and biochemical level. Observations were recorded for different traits *viz.* leaf characters and tree characters during winter season. The investigation was also done on characterization of fruits on the basis of morphological characters. The experiment was conducted in Randomized Block Design with 8 treatments and 5 replications. Results of the investigation revealed that significant variations were present with reference to various morphological and biochemical characteristics among the different genotypes. The treatment consisted of 8 genotypes *viz.*, MPUAT Sel-1, MPUAT Sel-2, Arka Kiran, CISH-G-35, RCGH-7, RCGH-1, RCGH-11 and RCGH-4. The results showed significant variation in tree height, tree spread, stem girth, cross sectional trunk area, leaf characters *viz.*, length of leaf, width of leaf, petiole length, number of veins, surface area of leaf, shape of leaf, shape of leaf apex and base, colour of leaves, number of fruits per tree, yield, average fruit weight, average fruit length, fruit diameter, fruit volume, number of seeds per fruit, average weight of 100 seeds, total soluble solids, acidity, ascorbic acid, total sugars, TSS : acid ratio, sugar : acid ratio and seed hardness among the guava cultivars. However, petiole length did not differ significantly. On the basis of morphological and chemical description the germplasm Arka Kiran was all together different from other.

P-131

Crop protection through non transformative RNA interference (RNAi) techniques

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Now a day, use of pesticide has become fundamental to modern crop protection technology. The scientist with their great intellectual thoughts has developed more refined strategies to reduce crop losses such as transgenic crop development and gene silencing through RNA interference. RNA interference (RNAi) is a method of blocking gene function by inserting short sequences of ribonucleic acid (RNA) that match part of the target gene's sequence, thus no proteins are produced. RNAi in crop protection can be achieved not only by plant-incorporated protectants through plant transformation (transgenic) but also by non transformative strategies such as formulations of sprayable dsRNAs in the form of sprayable products, stem injection, root drenching, seed treatment, or powder/granule can be used as direct control agents or developmental disruptors for crop protection. The most critical step of non transformative strategy is the uptake of dsRNA into the plant cell. Nevertheless, one of the biggest challenges for the RNAi technology is to make possible that target organisms (*i.e.*, pest insects, plant pathogens, nematodes, viruses) uptake intact and active molecules that will trigger an RNAi pathway. Delivery of dsRNA to a target organism is the easiest through transformative RNAi approach (*i.e.*, transgenic plants) but it is not practical to every target and crop. Therefore, the development of nontransformative approach (*i.e.*, sprayable dsRNA) for RNAi delivery will boost up its use in the field. Therefore, dsRNA delivery as a nontransgenic approach was already published as a proof-of-concept work, so it is time to point out some directions on how the real potential for agriculture and crop protection is.

P-132

FasTrack breeding approaches in fruit crops

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Conventional fruit breeding remains a slow, arduous process that has changed little over the centuries. Limitations include long juvenility periods, significant field costs, and yearly limitations on flowering and fruiting related to chill and heat requirements. FasTrack utilizes genetic engineering strategies, but the product released for commercial use is not a genetically modified plant. Thus, this technology has the potential to integrate into existing breeding programs. Preliminary work on the development of the FasTrack breeding system with California plum varieties has been undertaken at the USDA-ARS research facility in Kearneysville, WV, and Dr. Scorza's team has made significant progress. Utilizing the **Early Continuous Flowering (ECF)** is critical to the project, as it induces the tree to bear flowers and fruit with the first year of growth, thus shortening the multi-year juvenile period typical of perennial fruit trees. This trait has been successfully incorporated into plants. **Flachowsky *et al.* (2011) reported that** early flowering transgenic apple lines overexpressing the BpMADS4 gene of silver birch with regard to tree morphology in glasshouse conditions. Based on the results obtained, line T1190 was selected for further analysis and application to fast breeding. A crossbred breeding programme has been initiated by crossing T1190 with the fire blight resistant wild species *Malus fusca*. Schlatholter *et al.* (2018) has obtained 18 advanced selections of the fifth generation in the greenhouse within 7 years by using the early flowering line T1190 and 'Evereste' as source of the fire blight resistance (*Fb_E* locus).

P-133

Genetic relatedness and variation for morphological traits in pomegranate germplasm accessions

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Pomegranate (*Punica granatum* L.) is important commercially cultivated crop grown from ancient times for its economic, ornamental and medicinal properties. Genetic relatedness and variation inferred using morphological markers in pomegranate. In India it has high economic value and yields huge returns to pomegranate orchardist. It has a vast diversity of pomegranate genetic resources for various morphological traits. In this context the genetic diversity was accessed among 60 pomegranate accessions which include 20 indigenous and 40 exotic types for 12 morphological traits. Phylogenetic tree constructed on the basis of phenotypic characteristics by applying squared Euclidean distance and group average clustering method showed two diverse groups but partially divided the genotypes on the basis of their type into two groups. Principal component analysis (PCA) showed that first principal component (PC1), explained 21.6 % of the total variance that mainly consisted of fruit breath, fruit length, fruit weight, aril color, and fruit cracking predominantly, PC2 explained 15.7 % variability that mainly included plant height and number of stem and fruit length upto some extent further PC3 and PC 4 showed remaining 13.9% and 10.38%.The bivariate correlation coefficients among twelve phenotypic attributes measured showed significantly positive correlation and negative correlation. Per se performance was measured for traits like plant height (1.5-3.6), number of stem (2.0-6.0), thorn length (4.0-11.0), rind thickness (1.8-4.5), fruit weight, fruit length and fruit breadth. Based on the result frequency distribution curve showed high phenotypic diversity among the 60 genotypes and this information could be used for selecting parents for breeding programs.

THEME 6

DOUBLING INCOME THROUGH INNOVATIVE TECHNOLOGIES OF POST HARVEST, WASTE AND SUPPLY MANAGEMENT

ORAL SESSION

O-74

Contrivance of an operative supply chain for mango: Appraisalment of cost economics to imply swift trade

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The paper pertains to study on cost bore and incurred by farmers of northern India by highlighting the supply chain procedure followed for mango fruit with marketing techniques adopted by farmers and traders to sell their produce to the end consumers. Attempts have also been made to identify the causes and give possible recommendations applicable to the individual subsectors. The study was carried out in a phased manner employing four different approaches *i.e.* (i) Post harvest handling (ii) Survey (iii) Cost economics and (iv) Market with transportation provision available at distinct stages. During the visit among the farming community, they revealed that most of them watch Krishi Darshan an agricultural infotainment series broadcasted by Doordarshan. This paper focuses on the present marketing system prevalent in north India, draw conclusions and develop recommendations for obtaining higher value for the produce so as to equally benefit farmers, traders and making cost effective to consumers.

O-75

Mechanization and sensor based technologies for postharvest handling of fruits

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Postharvest handling is the stage of crop production, begins with identification of correct maturity index till the packaging and storage of fruits for extending its shelf life. Numbers of effort have been made by various faculties and research unit for harvesting, sorting, grading and handling of fruits and vegetables using various sensors, AI and MLA. Following researches have been done at Navsari Agricultural University, Navsari in area of mechanization and sensor based technology for fruit handling. Surface reflectance and quality parameters analytical base studied of Kesar mango at various stage of maturity near harvesting indices using hunter color lab instrument indicated the significant difference in the L, a and b value of colour scale with respect to maturity stage of fruit. Photo image based analysis was carried out for development of database for sorting and grading machine for fruits like papaya. Circulatory motion electronic load cell bases weight grader was developed in collaboration with M/s. Lele Pvt. Ltd., Pune. The machine could grade the fruits with the minimum weight difference of 50g in five grades. It was found effective for various fruits. Continuous conveyor type mango desapping unit was developed in collaboration with M/s. Shanti Agro, Valsad for effective discharge of sap from unripe freshly harvested

mango. Automatic box or carte filling platform was developed in collaboration with M/s. Hitesh Automation, Vadodara, which could be fixed between two conveyors and on and off the motion to avoid under as well as over filling. The automation and sensor based technology could be useful for maintaining the post harvest quality of fresh fruits.

O-76

Effect of pre harvest fruit bagging on litchi bunches cv. Rose Scented

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The present investigation was undertaken at Horticulture Research Centre, Pattharchatta of GBPUAT, Pantnagar, U.S. Nagar Uttarakhand to evaluate the effect of different bagging materials (white polypropylene and pink polypropylene bags) with varied bagging dates. T₁=Polypropylene white + 25th April (15 days after fruit set) T₂= Polypropylene white + 5th may (25 day after fruit set). T₃= Polypropylene white + 10th may (30 days after fruit set). T₄= Polypropylene pink + 25th April (15 days after fruit set) T₅=Polypropylene pink + 5th may (25 day after fruit set). T₆= Polypropylene pink + 10th may (30 days after fruit set) T₇= control during the year 2019. The highest significant fruit weight (23.07 g), fruit diameter (3.73 cm) and fruit yield (59.02 kg/tree) were observed in treatment T₆=polypropylene pink + 10th may 30 days after fruit set. Fruit cracking and sun burn on litchi were observed minimum as compared to control. The borer infestation was nil in all the bagged treatments. However, 11.02% of borer infestation was seen in control. The data showed that the maximum TSS (19.33°B) and the minimum acidity (0.21%) were found in T₆ followed by T₃ and T₅. The anthocyanin content in T₆ was reported highest with 26.24 mg/100g followed by T₃, which has 25.88 mg/100g. On the perusal of the above data it can be concluded that the litchi bunch bagged with polypropylene pink on 30 days after fruit set respond significant results.

O-77

Improving efficiency and drudgery reduction in harvesting through CISH mango harvester

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ICAR-CISH developed a light weight mango harvester for reduction of drudgery in mango harvesting operation. The main components of the harvester are cutting blades, frame, fruit collection net and aluminum pipe. The leaf shaped frame made from high density polyethylene (HDPE) is 390 mm long, 12 mm thick and 210 mm wide at the center. Two sharp cutting blades (surgical grade) are mounted in the shape of inverted 'V' with screws on the external edge of the frame. In the main frame, a provision was made to attach an aluminum pole of 25 mm diameter and 12 feet long with fruit collection net made of nylon is tied on the periphery of the main frame. About 650-900 fruits can be harvested with this tool per hour. The blades used in this tool are sharper and heavy duty and can be replaced when wear out. This harvester was demonstrated in randomly selected 20 orchards. Traditionally, laborers were using heave harvester (1-1.5 kg) locally known as 'Khauncha' in standing and bending position which decreases the work efficiency of labourers. In case of CISH harvester it was observed that the same amount of fruits could be harvested in almost half of the time and work efficiency was increased by 57.43 per cent and drudgery involves in harvesting operation was reduced by 33.62 per cent. CISH harvester assisted in avoiding hand and shoulder stiffness due to light weight.

O-78

Cold chain management: A way forward to curtail post-harvest losses and enhance farmers' income

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India over the years witnessed a marked increase in production of perishable high nutrition products like fruits, vegetables, meat and poultry products *etc.* but development of cold-chain infrastructure was not strategically directed, for safe handling and to transport of these perishable products to markets, except in the dairy sector. A resultant demand supply mismatch emerged across these commodities, contributing to wide spread price fluctuations and inflation. Cold-chain development efforts in India were earlier mainly focused on building storage capacity for single commodity bulk storages, at production end as for potato and dried chilies whereas the larger basket of perishable horticulture requires other infrastructure components to avail of cold-chain as a market linked intervention. It is apparent that post-harvest losses can be reduced through efficient cold chain system from the point of harvest to the point of consumption. Even if the country is able to reduce 50 per cent of the losses/ wastage from the current levels, the farmer's income will be sustainably enhanced. During last decade tremendous progress has been witnessed in handling practices at farmer's level but still it is not supported by infrastructure facilities. A simple solution to bring the entire country into cold chain network will be creating a central pack house facility with reefer vans for transport by connecting 2-3 districts and handling capacity of 1000 MT/day with associated farm collection centers, which would also create employment for about 5000-6000 persons directly and many more indirectly. These pack houses with facilities for washing, sorting, grading, storage and other preliminary operation depending on the commodity can help in curtailing post-harvest losses and enhance the income of the farmers.

O-79

Mango varieties responses to exogenous ethylene for ripening

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Artificial ripening of mango is an ancient practice and many traditional methods of ripening are still prevalent which are cumbersome, unhygienic and do not provide uniform fruit ripening. Therefore, traders/growers shifted towards use of calcium carbide (CaC₂). Lately, ethylene is commercially used for safe ripening of mango fruits worldwide, but its gainful potential can be achieved only with proper understanding of the varietal responses to ethylene concentration and exposure time. Therefore, there arose a need to standardize ethylene doses for mango varieties. In a two seasons study, fruits from three different varieties (Dashehari, Chausa and Langra) were harvested at the commercial maturity stage. A total of 400 fruits were selected and were randomly divided into 4 lots of 100 each. Thereafter, fruits were placed in plastic crates and kept for ripening in ethylene chamber. The ripening chamber was maintained at 24 ± 2°C temperature, 95 per cent RH and 100 ppm ethylene dose for 24 hours. After 48 hours of holding in chamber, fruits were taken out from the chamber and stored at ambient conditions (25 ± 2°C, 85 ± 5% RH) for 8 days. At two days interval, fruits of each variety were sampled randomly and were subjected to analysis of physico-chemical attributes. Dashehari reached to optimum soft-eating stage on the 4th day after ethylene treatment. Chausa and Langra reached at optimum ripening stage on

6th day, while Dashehari was spoiled by this time. Ethylene evolution peak was maximum (1.81 $\mu\text{l C}_2\text{H}_4/\text{kg/h}$) in Dushehari and it was lowest (0.40 $\mu\text{l C}_2\text{H}_4/\text{kg/h}$) in Langra on the 4th day of storage. Earlier studies on inter-varietal differences in surface morphology and anatomical features of mango-fruits highlighted cell configuration and compartmentalization which may be the reason for easy entry and uniform distribution of exogenously applied ethylene in Dushehari fruits compared to Langra and Chausa.

O-80

Profiling of ascorbic acid, phenolic compounds and organic acids in guava varieties by HPLC-PDA

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Guava, poor man's apple, is a good source of ascorbic acid, phenolic compounds and organic acids. Both ascorbic acid and polyphenols are powerful antioxidants, whereas organic acids are responsible for flavour in fruits. High performance liquid chromatography with photodiode array detector was employed to identify and quantify all these nutraceuticals. Gallic acid, chlorogenic acid, catechin, epicatechin, caffeic acid and ellagic acid as phenolic compounds and oxalic acid, tartaric acid, citric acid and mallic acid as organic acids were identified in ripe fruit of six guava cultivars (Allahabad Safeda, Sardar, Lalit, Shweta, Dhawal and Lalima). Maximum amount of ascorbic acid (226 mg/100g) was recorded in Dhawal followed by Allahabad Safeda (200 mg/100g). Among the phenolic compounds, gallic acid was the major one and found maximum in Allahabad Safeda (125 mg/100g) followed by Shweta (77 mg/100g) and Dhawal (61 mg/100g), while catechin (59.6 mg/100g), ellagic acid (5.92 mg/100g) and *p*-coumaric acid (0.89 mg/100g) were found maximum in Lalit variety. In case of organic acids, citric acid was the major one and recorded maximum in Sardar (460 mg/100g) and minimum in Allahabad Safeda (202 mg/100g). Tartaric acid was found maximum in Sardar (66 mg/100g) and minimum in Lalima (57 mg/100g). In terms of ascorbic acid Dhawal and Allahabad Safeda were the best varieties for consumption, while Lalit and Allahabad Safeda were the best varieties to consume for the presence of anti-cancer antioxidant phenolic compounds.

O-81

Value addition in fruits resulted wine industry development in India – A success story

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Grape is highly remunerative crop to farmers as per acre returns are the highest from this crop. Grapes export is also good in demand from last more than 30 years from western India and very remunerative to growers. However, many times in the past it has been experienced that due to poor climatic conditions during production phase this crop suffers a lot in absence of any processing demand. Though raisins are processed but they need very high brix, so harvested late and then dried, however impact of bad weather comes in the middle of grape maturity and with lower brix level there is no option with the farmers but to loose the whole crop. In view of this, idea came to introduce wine making thinking that only 2-3 per cent of total grapes produced are used for processing and 95per cent are consumed as fresh in India and that processing is only for raisin making. Whereas, in rest of the world 95 per cent grapes are used for

processing and mainly for wine making. Now new initiation has started in HP, other hilly states and Maharashtra to make fruits wine, which is in line similar to other wine countries where fruit wines are introduced and people are accepting with a product which is something different. Now Wine Lovers in Maharashtra will soon have a wider range of options, with the state government announcing excise duty exemptions for fruit-based and mead (honey) wines.

O-82

Nutrient rich cookies from composite flour to curb problem of anaemia

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Access and affordability of quality diet to every citizen is a worldwide concern with highest prevalence in developing countries which has resulted in nutritional deficiencies such as anemia, goitre, rickets, night blindness, scurvy etc. Among these, the problem of nutritional anemia is severe in women of child bearing age and during pregnancy and lactation as well as young children. This is mainly due to iron deficiency, which arise either due to inadequate intake or poor bioavailability of dietary iron or due to excess losses of iron from the body. Keeping in view the problem, an investigation was carried out to develop the composite flour and preparation of quality cookies. In this investigation, the ingredients like wheat (*Triticum aestivum*), moth bean (*Vigna aconitifolia*), little millet (*Panicum sumatrense*) and mango ginger (*Curcuma amanda*) were used both in processed and unprocessed form. The proximate analysis of both processed and unprocessed flour for various parameters such as moisture, ash, fibre, phytic acid total protein, carbohydrates and lipids was done by standard method. Based on quality characteristics, only processed composite flour was considered for preparation of cookies. Further, two different formulations of composite flour were prepared as batch I (in the ratio of 50:20:20:10) and batch II (in the ratio of 30:30:30:10) of wheat, moth bean, little millet and mango ginger, respectively. The study reveals that the composite flour prepared after processing has enhanced the nutritional values especially iron content but decreased phytate levels which will otherwise decrease the bioavailability of nutrients. These cookies are also recommended for anganwadi and mid-day meals by integrating with National Nutrition Programme.

O-83

Change in photoperiodism and its effect on quality of spices crops

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Colours shade nets that manipulate light for benefit of the plants grows which is under net is not science fiction. It is a new agro technological concept that is boosting the post-harvest quality of spices crops was carried out at Soil and Water Management Research Unit Farm, Navsari Agricultural University, Navsari, Gujarat during summer season to study the effect of different colour shade nets on biomass yield and quality of fenugreek, coriander and garlic. The total sugar content in plant parts of garlic crops grown under white colour shade net (7.67%) recorded significantly the highest value as compared to other growing conditions (6.02%). Starch content was the highest in plants grown under white colour shade net (2.4%) which was at par with red (2.45%) and green (2.34%) colour shade net. Under net house, higher nitrate content was observed in crop grown in yellow colour shade net (0.14%). Lower

nitrate was observed in red, blue and green colour shade net. The highest chlorophyll content was observed from the plant grown under red colour shade net (18.07 mg/g) followed by green colour shade net (18.07 mg/g). Garlic plants recorded the highest chlorophyll content (26.95 mg/g). On the other hand, lower chlorophyll content was observed under the crop grown in open field condition as well as yellow colour shade net.

O-84

Development and evaluation of raw mango candy prepared from some commercial varieties

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India is the largest producer and consumer of mango fruit and it is available for a longer period of time from February to September in different parts of the country. Mango is a rich source of antioxidants, Vitamin A, Vitamin C, Vitamin E, and fair amounts of iron and nicotinic acid. Raw mango fruits contained higher amount of polyphenols including flavonoids and thereby showing higher antioxidant properties. With the purpose of raw mango product diversification, raw mango candy of commercial varieties (Totapuri, Mallika and Dashehari) was developed during the mango season and evaluated for nutraceutical properties at three months and six months interval. Organoleptic evaluation of the product was assessed by using nine point hedonic scales. The total soluble solids, acidity, and reducing sugar increased, while ascorbic acid and antioxidant decreased during six months storage. Organoleptically Dashehari candy got highest score (8.5 out of 9) and Mallika lowest with score (7.8 out of 9). Highest TSS was recorded in Dashehari candy (73.5^o B) and Lowee in Mallika (66.5^o B). Vitamin C was at par in Dashehari and Mallika *i.e.* 98.0 mg/100gm and lowest in Totapuri 70.0 mg/100gm. Acidity was highest in Mallika (0.81%) and lowest in Totapuri (0.33%). No microbial growth was found in any sample during the storage period. Storage study is still continuing, for further quality checking. This mango candy is a perfect diversification for utilization of raw mango as small scale enterprise for farm women. It will also give solution to mango dropping during wind storm during the month of April-May.

O-85

Developing entrepreneurial skill among women through post harvest handling and value addition

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Indian women play an active role in the farm and home system and contribute substantially in the physical aspect of farming, livestock management, postharvest and allied activities, but they are socially suppressed and have less right in the decision-making process due to lack of independent income source in hand. Entrepreneurship development among rural women cannot only enhance national productivity and generate employment but also help to develop economic independence and personal and social capabilities. Among different areas of agriculture, post harvest technology is one of the most suitable areas, which can be undertaken to develop entrepreneurial skills among rural women. Suitable, cost effective and appropriate location specific post harvest technologies like processing and minimal processing can be disseminated among rural women in order to develop entrepreneurial skills in them. Dissemination

of integrated post harvest technologies may help in achieving (i) reduced post harvest losses (ii) better nutritional security (iii) employment generation and (iv) economic transformation of rural women thereby making them self-sufficient and independent. Women can do wonders by their effectual and competent involvement in entrepreneurial activities if they are supported and motivated by skill development and financial assistance. Skill development initiative in appropriate post harvest technologies focusing on specific needs and challenges faced by growing entrepreneurs is the key to promote self-employment among the Indian women in this area. Therefore, entrepreneurship should not be developed by the dissemination of new technologies only but by transformed new technologies.

O-86

Utilization of bamboo shoot as food in Meghalaya

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Bamboo is a precious gift of nature to the peoples of Meghalaya. It is a multi-use plant which has become interwoven with the daily life and culture of the region. Meghalaya is endowed with affluence of natural resources and bamboo is one such resource. The region is rich in diversity as well as stock of bamboo. One extensive use of bamboo in this region is the usage of young shoots as food. Young bamboo shoots are eaten in various forms in this region and people developed their own techniques and methods of preserving and processing of bamboo shoots for long term as well. In Meghalaya the consumption and uses of bamboo is very common, which causing a huge loss to the natural resource and as well as in the bamboo production. Some varieties which are common in this region are becoming extinct by the too much consumption. As bamboo is a monocarpic plant, so the huge amount of collection and consumption of bamboo shoots decreasing its production value. The production and the stock of bamboo is decreasing day by day only for this cultural method of consumption. The selling of bamboo shoots is getting very popular among the sellers which are minimizing the full grown bamboo plants. So, there is a need to increase the bamboo production and development of such varieties which are only for shoot consumption.

O-87

Post harvest application of melatonin reduced browning in minimally processed lettuce (*Lactuca sativa* L.) during low temperature storage

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In recent years, demand for minimally-processed (MP) vegetables is increasing particularly in metro cities in India. Lettuce an important leafy vegetable consumed as salads highly perishable and susceptible to enzymatic browning. Minimally processed produce deteriorates more rapidly than whole produce because internal and outer tissues are exposed to external environment. Melatonin acts as an antioxidant in postharvest technology and augments the postharvest life of fruits and vegetables. Lettuce var. Grishma grown under aeroponic conditions at vegetable hydroponic facility of ICAR-CISH, Lucknow was procured for experiment. Cut lettuce heads were treated with aqueous solution of melatonin (10, 100 and 1000 $\mu\text{mol/litre}$) by immersing them for 5 minutes and air dried to evaporate surface water then packed in zip-n-lock polypropylene bags with sample size of 200 g. Packed samples were stored at $6\pm 2^\circ\text{C}$ temperature and $85\pm 5\%$ relative humidity for 9 days and sampling was carried out on 0, 2, 4, 6 and 9 days of storage for physical parameters analysis. Melatonin treatments @ 100 and 1000 μmol were notably prevented emergence of browning spots on lettuce heads. The browning index value was also observed significantly

lower (2.45, 2.51) in melatonin treated samples as compared to control. Visual quality index of the lettuce heads was remarkably retained high 5.02 and 4.98 in 100 and 1000 melatonin treated samples, respectively at the end of storage period. Electrolyte leakage of lettuce heads was increased during storage. Heads treated with melatonin (100 & 1000) had lower electrolyte leakage value 44.56 and 47.67 per cent compared to control (63%). In conclusion, the quality of minimally processed lettuce was remarkably maintained for 9 days at 6±2°C temperature by post harvest melatonin dip treatment.

O-88

Antioxidant potential of some underutilized leafy vegetables upon different cooking methods

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Among the plant food, leafy vegetables are rich source of antioxidants apart from energy, protein and micro nutrients and play a major role in nutritional security of human. Rural common man especially tribal mainly consume underutilized vegetables, which constitute an integral part of their diet. These plants have local or regional importance, but generally lack of national recognition and appreciation. However, these species have under-exploited potential to ensure food and nutrition security to urban dwellers. It is also important to understand the effect of different type of cooking methods on possible variation in antioxidant potential of underutilized vegetables. In this present study, 15 different leafy vegetables generally consumed by tribal community were selected to understand the antioxidant potential in fresh & cooked conditions for promotion among urban dwellers. Four different cooking methods were followed to cook vegetables which are used in modern kitchen namely by steam methods, microwave oven based, boiled in normal utility and refluxed methods. Among them, highest phenol and flavonoids were recorded in reflux (at 25°C under tightly covered by lid) followed by normal boiling (at 100°C without lid), steam (in rice-cooker) and microwave based cooking methods. Lowest IC₅₀ values means high antioxidant capacity were recorded in *Marsilea* sp., followed by *Centella asiatica*, *Hygrophila spinose*, *Amaranthus viridis* and rest of the other showed similar antioxidant trends. Therefore, present study suggests the promotion of these potential underutilised leafy vegetables among the urban dwellers for nutritional security and healthiness. It is also advised to consume cooked vegetables through reflux followed by normal boiling and also cautioned to avoid microwave oven based cooking method.

POSTER SESSION

P-134

Use of irradiation for prolonging shelf life of garden pea (*Pisum sativum* L. var. Hortense)

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Garden pea (*Pisum sativum* L. var. Hortense) belongs to family leguminosae and ranks third in the worldwide production amongst grain legumes. It is highly nutritive having high percentage of digestible protein along with carbohydrates and vitamins with rich source of minerals. The produce, which is marketed locally face problems of spoilage losses as well as loss of quality of produce due to its perishable

nature. Now, Irradiation Technology has opened a new avenue to increase shelf life of vegetables specially garden pea because irradiation processing slows down the rate of metabolism, delay the senescence and inactivate the enzymes responsible for spoilage. Irradiation also eliminates pathogenic organisms through surface pasteurization without appreciable raising the temperature of the produce. Low dose of gamma irradiation upto 1 kGy is used to delay physiological processes, sprouting of fresh vegetables like garden pea and to control insects and parasites in it. The Food and Drug Administration has approved cobalt - 60 as source of gamma rays for irradiation treatment of foods. Tenderness and high sugar content are associated with pea quality, which tends to reduce and higher decay losses during storage after harvesting. The enormous potentialities of gamma radiation have been emphasized, which not only improves shelf life of perishables without appreciable change in their bio-chemical and organoleptic attributes but also reduce the decay losses by elimination of pathogenic microorganisms.

P-135

Bioethanol production from fruit wastes

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Diminishing supplies of petroleum and growing environmental concerns over its use has led to increasing interest in developing biomass as an alternative to fossil fuels. A very huge amount of fruit wastes are available as sugar laden wastes world over. In fact, there is a need to recover value added products from these wastes. Fruit wastes are rich in sugars and carbohydrates which can be recovered and utilized for the production of bioethanol. In particular, bioethanol produced from biomass represents a promising alternative fuel or gasoline extender. Bioethanol is used in vehicles either as a sole fuel or blended with gasoline. As an oxygenated compound, ethanol provides additional oxygen during combustion and hence obtains better combustion efficiency. The main environmental advantages of fuel ethanol are its sustainability in using a renewable resource as a feedstock, thus reducing the dependence upon fossil fuel and maintaining the level of greenhouse gas. Bioethanol can be produced from carbohydrate containing substrates by the process of fermentation. Many microorganisms like bacteria, fungi and yeast involved in bioethanol production. Bioethanol can be produced from rotten fruits with inoculation of bacteria. Rotten fruits serve as potential feedstock for bioethanol production due to high sugar content and cost effective substrate. Bioethanol can solve the problem of pollution and considered as fuel for future.

P-136

Surface coating of Thompson Seedless grapes with guar gum-green tea extract for quality

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Grape growing in India is mainly concentrated under tropical conditions and more than 90 per cent of total production is obtained from hot areas where grape bunches face high temperature coupled with low humidity at harvesting. Prevailing weather conditions are responsible for short shelf life, higher post-harvest losses and availability of inferior quality grapes to consumers. Improper handling and poor supply chain results in higher post-harvest losses. It is well proven that extended shelf life is observed

when coating is applied on fruits and vegetables. Combinations of guar gum (0.5%) and green tea extract with concentration of 0.125, 0.5 and 1 per cent were applied as surface coating on bunches of Thompson Seedless grapes, while no application was given to control. Coated bunches of grapes were stored at 10°C with 60-65 per cent RH for a duration of 28 days. To record data on physico-chemical and microbial aspects, samples were collected at 7 days interval. Present study revealed that the coating helped in improving physico-chemical and microbial properties of grapes. Overall appearance of coated berries was better in comparison to control. Changes in total soluble solids and titratable acidity were delayed in coated berries. A combination guar gum and green tea extract with concentration of 0.5 and 1 per cent, respectively was found better than other combinations. Green tea extract proved to be an antioxidant and antimicrobial agent by increasing total phenols, antioxidant activities and by reducing microbial load on berries.

P-137

Studies on ready to serve beverage of date palm (*Phoenix dactylifera*) fruits

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Studies on Ready to Serve Beverage of date palm fruits was carried out at Faculty of Agricultural Science, Madhav University, Pindawara, Rajasthan and the Post-Harvest laboratory, Department of Horticulture, College of Agriculture, Junagadh Agriculture University, Junagadh (Gujarat) during the year 2018-19. The main objectives of the present investigation were, to standardized the recipe for preparation of date palm RTS and to evaluate the sensory parameters and various treatments for date palm RTS beverages. Among the treatments, two pulp concentration 20 & 25 per cent pulp and 3 levels of TSS *i.e.* (16, 17 and 18 per cent of RTS) were used for preparation of the RTS. The 20 per cent pulp content rated best in combinations with 16 per cent TSS of RTS for organoleptic parameters, which are based on overall acceptability characters, whereas, the aroma rating values were found best with the treatment 1st and 5th (20% pulp + 16% TSS + 0.3% acidity of RTS & 25% pulp + 17% TSS + 0.3% acidity of RTS) for taste also the rating of the treatment 1st was found best as compare to other treatment and for the colour was rated better with the treatment 1st (13% pulp + 16% TSS + 0.3% acidity of RTS).

P-138

Biotransformation of citrus solid waste into value added products

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Citrus fruits include oranges, mandarins, lime, lemon, pumello are among the most widely cultivated fruits around the globe. Its production is increasing every year due to rising consumer demand. Citrus-processing industries generate huge amounts of wastes every year, and citrus peel alone accounts for 50 per cent of the wet fruit mass. Citrus waste is of immense economic value where high potential by-products can be produced through processing technology. Citrus by-products are the processed solid wastes generated after citrus juice extraction. The solid waste of citrus consists of peel (flavedo and albedo), pulp (juice sac residue), rag (membranes and cores), and seeds. These citrus fruit residues which are discarded as waste in the environment, can act as a potential nutraceutical resources. The utilization of these bioactive rich citrus residues can provide an efficient, in expensive and environment friendly platform for the production of novel compounds such as essential oils, pectin, enzymes, single cell proteins, natural antioxidants, ethanol, organic acids as well as considerable amount of trace elements.

P-139

Effect of edible coatings treatment on quality retention of peach (*Prunus persica* L. Batsch) cv. Early Grande

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Effect of edible coating treatments on quality retention of peach (*Prunus persica* L. Batsch) cv. Early Grande" was studied at postharvest laboratory in the Department of Horticulture, College of Agriculture, G.B. Pant University of Agriculture and Technology, Pantnagar. The study was conducted to see the effects of xanthan gum and guar gum edible coatings along with incorporation of some functional constituents viz., calcium gluconate as texture enhancer and ascorbic acid as an anti-oxidant at varying concentration on physico chemical attributes, functional attributes and shelf life of peach fruits. The trial was conducted in two factorial completely randomized design with 17 treatments and 3 replications under low temperature conditions at 10°C and 75 per cent relative humidity in April, 2019. The changes in fruit weight, diameter, firmness, physiological loss in fruit weight, shrinkage, decay, TSS, pH, acidity, ascorbic acid, total sugars, carotenoids content, phenolic content and antioxidant capacity were recorded under each treatment over a storage period of 20 days. Functional edible coating formulations of 1.0% Xanthan gum + 1.5% Calcium gluconate + 1.0% Ascorbic acid were found most effective in reducing weight loss, shrinkage, decay and in maintaining higher firmness, ascorbic acid, carotenoid content, phenolic content and antioxidants quality attributes. Uncoated control fruits showed a shelf life of 10 days, while it was extended up to 20 days for coated fruits under low temperature conditions.

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Flower drying: An art to preserve blossoms

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With the increasing awareness for natural ecofriendly products, dried flowers have attained prime importance in the floriculture industry. Future prospects of the dry flower industry are expected to contribute a lot to the country's economy in comparison to the fresh cut flowers and other live plants. Huge stock of fresh flowers is also wasted due to lack of proper marketing and some unavoidable circumstances during blooming season. So, now a days attention is shifted towards the storage practices for increasing shelf life of cut flower. In this review the scattered information and data on drying of flowers and other ornamental plant parts are being tried to put together. The storage life of loose chrysanthemum flowers after drying by embedding in self-indicating silica gel at 45±2°C with 80 per cent humidity. Stage of harvesting the flower was taken at 80-100 per cent mature of the same size. Dried flowers were stored in different packaging materials i.e. without packaging, polyethylene pouch, vacuum packing, air tight plastic box with silica gel and air tight plastic box. The study revealed that the shelf life of the flowers stored in air tight plastic box with silica gel was extended for 3 month with acceptable and marketable quality which was followed by vacuum packaging. On the other hand, flowers which were stored in polyethylene pouch deteriorated early. Therefore, chrysanthemum flowers after drying could be used even after its season get over thus, making the flowers available when its demand rises.

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Dehydration of pre-treated green bitter gourd : Enhance food safety and quality

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Bitter gourd (*Momordica charantia* L.) a member of the family cucurbitaceae is popular vegetable known for its unique medicinal and nutritional properties. It has a very high content of folate and vitamin C. The medicinal value of bitter gourd in the treatment of infectious diseases and diabetes is attracting the attention of scientists worldwide. In India, the peak harvesting season of bitter gourd is from April-August. During the later phases of harvesting (July-August), market glut is commonly observed forcing the grower to sell their produce at a very lower rate because of its perishable nature. Since this valuable medicinal vegetable can't be stored for a long time under ambient condition, it is apparent that if methods are developed to preserve it for longer duration, the off-season availability of the produce can be increased both for diabetic population and general public. Dehydration is the most popular method of preservation as due to reduced mass it can be easily transported with minimal production and packaging cost. Thereby, adding value to the product along with addressing the new challenges of food safety and food security. Bitter gourd slices treated with guar gum (1%) gave better results for retention of nutritional properties and food quality attributes.

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Integrated protocol for development of value added products from peach

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Peach (*Prunus persica*) is a soft, juicy and fleshy stone fruit that contains good amount of carbohydrates and proteins besides anthocyanins in red skin varieties. The fruit bears attractive color ranging from red and white to purple, pleasant aroma and tangy taste. An integrated protocol was standardized for production of diversified products from peach. Whole fresh fruits were first subjected to lactic acid fermentation using *Lactobacillus* sp. It led to production of probiotic drink with 1.37×10^5 CFU/ml living population of *Lactobacillus* sp. The fruits left were utilized in the preparation of sweet candy by incubating the fruit slices in subsequently increasing concentrations of sugar syrup and then drying to intermediate moisture level of around 12 per cent. The excessive softened slices were used for preparation of chutney using spice ingredients. The sugar syrup, thus left was utilized in the preparation of squash, wine and vinegar. Peach probiotic drink had 0.63 per cent lactic acid and 31.5 mg/100 ml phenolics. The wine prepared from Sarbati variety contained 9.73 per cent ethanol, 10.2°B TSS, 1.38 per cent acidity and 143.5 mg/100 ml phenolics. Peach vinegar possessed 5.41 per cent acetic acid and 96.8 mg/100 ml phenolics. Peach chutney had 78.4 mg/100 g phenolics. All peach products were found to have good organoleptic acceptability scoring above 7.0 out of total 9.0. Thus, it may be inferred that diversified processed products could be prepared from peach using same raw material and adopting integrated protocol that leaves no waste. The seeds were used for sowing purpose.

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Integrated protocol for development of value added products from strawberry

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Strawberry (*Fragaria x ananassa*) is a soft and fleshy fruit that contains ample amounts of carbohydrates, vitamin-C, phenolics and anthocyanins. The fruit bears attractive deep red color, pleasant aroma and delicious taste. An integrated protocol was standardized for production of diversified products from strawberry. The fresh fruits were first washed and subjected to lactic acid fermentation using *Lactobacillus* culture preserved in the Microbiology lab. The prepared probiotic drink was collected and left over fruits were utilized for preparation of other products, viz. candy, squash, jelly and wine. Candy was prepared by incubating whole fruits in subsequently increasing concentrations of sugar syrup and then drying at 60°C temperature in electric dehydrator to an intermediate moisture level of around 12 per cent. The sugar syrup thus left was attractive red in color due to anthocyanins extracted from the fruits. It was used for preparation of squash, jelly and wine. The strawberry probiotic drink contained 2.2°B TSS, 0.17 per cent acidity, 2.1 mg/100ml vitamin-C, 37.1 mg/100 ml phenolics and 2.36 mg/100 ml anthocyanins. Quality analysis of strawberry wine revealed that it had 11.7 per cent ethanol, 8.6°B TSS, 0.49 per cent acidity, 1.6 mg/100 ml vitamin-C and 22.5 mg/100 ml phenolics. All the strawberry products were highly acceptable during sensory evaluation scoring above 7.0 out of total 9.0. It may be concluded that a variety of processed products could be prepared from same raw material by using integrated protocol for strawberry products. The protocol has potential for complete utilization of fruit materials.

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Influence of pre harvest fruit bagging on the physico-chemical properties of litchi (*Litchi chinensis* Sonn.) cv. Rose Scented

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The present investigation was undertaken at Horticulture Research Centre, Pattharchatta of GBPUAT, Pantnagar, Uttarakhand to evaluate the effect of different bagging materials (white polypropylene and pink polypropylene bags) with varied perforations (0, 5 and 10%) and bagging dates (45 days before harvest, 35 days before harvest and 30 days before harvest) on the physico-chemical properties of litchi during the year 2018. Among the various bagging materials of different perforations used, white polypropylene bag with five per cent perforation had most effectively improved the physical as well as the chemical attributes of litchi viz. fruit retention, fruit cracking, fruit weight, fruit volume, pulp weight, pulp to seed ratio, TSS, total sugars, reducing sugars, non-reducing sugars, ascorbic acid and fruit peel anthocyanin content. However, higher fruit diameter and TSS : Acidity ratio with lower sun burn were obtained in fruits bagged with white polypropylene bags without any perforation. On the other hand, fruits bagged 30 days prior to harvest gave significant results for all the parameters. The economics calculated for all the treatments showed that bagging of fruits 30 days before harvest with white polypropylene bags having five per cent perforation showed feasibility in litchi cultivation as the net return per rupee was Rs. 2.88.

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Recent advances in storage of horticultural crops

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Storage is one of the important post-harvest aspects which facilitate the regulated distribution and extending the duration of the horticultural produce availability. Storage increase the period of consumption, check losses, reduce glut, regulate supply and helps to obtain better price of the produce to increase the storability of produce needed advances in the storage technique horticultural crops are high value commercial crops and play a unique role in countries economy, nutritional security, poverty alleviation and employment generation most of the horticultural commodities are seasonal in nature and prices go down considerably during the glut period and production becomes uneconomical due to distress sale. The wastage or losses can be checked by adoption of the advances methods of storage. Principles of storage to control the rate of transpiration and reduces the rate of respirations also lows down the ripening process avoid undesirable biochemical changes and disease infection.

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Recent advances in fruit processing

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The modern technologies are the results of continuing modern scientific advances and decades of development. The processing industry is closely linked to the agriculture and domestic household activities *i.e.* pickling, preserve making, wine making *etc.* Processing can always fetch an additional income to the growers and help in stabilizing the prices with economic return. Processing units are a boon for the welfare of the growers as they can save their crop from huge wastage and at the same time their produce becomes more valuable, price fetching commodity with suitable post harvest treatments, packaging and by processing into different products. Horticultural crops are very high value commercial crops and in our country play an important role in national economy. In India, the losses of fruits and vegetables are about 36 per cent and in India only 2 per cent of total production of horticultural crops is processed in to different value added products. So, to enhance the capacity of horticultural processing sector in India using many approaches such as to increase the number of processing industries, production of osmo dehydrated products, production of frozen products, production of beverages of fruits, natural fermented beverage and minimal processing. By these advances of processing we can improve the processing of fruit by developing quality value added products.

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Recent techniques to prolong storage life of mango

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India is the largest producer of mango in the world and share above 57 per cent of total production. It is a climacteric fruit and unless the fruits are stored properly, one can not be sure about the condition in which the fruits will reach market. The processing units are not having the capacity to utilize the entire produce at a time, so proper storage conditions become vital. In general mature green fruits have better storage life in comparison to those harvested ripen from the plants. Storage temperature for various varieties ranges from 6.5°C to 11°C with RH of 85-90 per cent. Another method advocated for enhancing storage life and for delaying ripening is that of wax coating. Treatment with wax emulsion help to reduce transportation losses in mango. Wax coated fruits also reduce the fungal diseases, respiration, transpiration and other infection after harvesting of mango in storage condition and can prolong self-life of mango resulting in increased availability for long time for consumption. For this paraffin wax and bee wax can be used commercially. Fruits are stored at temperature of 29°C to 35°C and treated with 6 per cent Waxol-w-emulsion and pre-packaging (1 kg lots in 200 gauge polythene bags with 0.6% ventilation) or waxed and stored at 5.5°C to 7.2°C resulted in reduction of weight loss and spoilage with prolonged self-life. Various attempts have also been made by scientists to prolong the self-life through the controlled atmospheric storage (CAS), irradiation, freezing, modified atmospheric storage (MAS) but presently these are more of an academic interest as compared to waxing treatment.

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Biodegradable packaging materials to beat plastic pollution

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The world is facing a huge hazard related to non-biodegradable usage of plastic and its packaging materials all around the globe. Plastic packaging made up of high density polyethylene which contributes about 1.1 to 8.8 million metric tons of plastic waste entering the ocean from costal communities every year. Recently government has launched ban on single use plastic which will lead to packaging problems in the market. In this scenario horticulture can help a lot. Coconut husk that are discarded can easily be molded with an organic adhesive to become custom cartons for fruits and vegetables, it also provides cushioning effect to protect fresh fruits. Banana leaf can also be used for making plates, cups and boxes. In traditional manner food can also be served in fresh banana leaf. Tamil Nadu is already giving influential support to banana leaf packaging. Jack fruit and lotus leaf are also be considered as a good option for bio-degradable material. U.S. Department of Agriculture (USDA) has proved that jack fruit contains diet rich phytonutrients which seems to be “effective strategy” for lowering risk of cancer and heart diseases. The alkaloids preset in lotus leaves are a natural cure for diarrhea, also help in improving heart function and blood circulation. The above plant packaging material will also enhance employment rate as it requires plucking, cleaning, drying and shaping of leaves into desirable shapes. Bio-degradable materials are the future of sustainable development goals.

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Enhancement of quality and storage life of aonla (*Emblica officinalis* G.) products

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Aonla fruit is rich source of antioxidants, vitamins and minerals and to employ these properties a study was conducted to prepare fruit preserve and candy by using different alum concentration. The fruit is found to have a good amount of total soluble solids (9.5°Brix), total sugar (3.42%), reducing sugar (2.63%), acidity (2.16%) as well as ascorbic acid (526 mg/100g). The fruits were pre-treated with alum solution for two hours and blanched (28 min at 7 kg/cm²) prior to convert into preserve and candy. The prepared products was kept for storage and evaluated after every one month. There were small changes observed in physico-chemical and organoleptic analysis with advancement of storage period. Out of different alum concentrations, the best recipes of aonla preserve and candy was found 2 per cent alum concentration with a 8.90 and 8.30 organoleptic value (at 9 point hedonic scale), respectively. The present study shows that both the product has commercial value as they are rich in various physico-chemical and sensory properties.

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Horticultural crops value addition for nutritional security

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Nutritional well-being is a sustainable force for health and development of people and maximization of human genetic potential. From the beginning of human history, food has been considered as the major factor in maintaining well-being and health of individuals. Active ingredients in food which are effective in promoting human health include amino acids, fats dietary fiber, antioxidants, pigments, vitamins and minerals which are present in different food groups such as pulses, cereals, legumes, oilseeds, fruits and vegetables. Among all these food groups, fruits and vegetables play a significant role in human nutrition, especially as a source of vitamins, minerals and dietary fiber. The different fruits and vegetables like carrots, tomatoes potatoes, ginger, green leafy vegetables and the like are important protective foods because of their nutritional value and antioxidant properties. Value addition of such fruits and vegetables by formulation of different value-added products are an important source of nutritional security.

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Season-independent vegetable cultivation under protected condition

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Vegetables are a rich source of dietary fibers, vitamins, minerals, antioxidants, phytochemicals and are important for our food and nutritional security. Though the vegetable requirement is 300g/day/person as recommended by dietician, we are able to meet only around 1/9th of that requirement. Therefore, there is need to increase the area and production of vegetables in our country. A model playhouse with

misting and cooling facilities has been developed on 250m² 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 land in the peri-urban areas can substantially increase their income by protected cultivation of vegetables in the off-season.

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Hydroponically grown spinach (*Spinacia oleracea*): Comparison of performance over soil and soil-less grown system

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Shrinking land resources, increasing residual toxicity load and depleting levels of safe water for drinking and agriculture have made it really challenging to ensure availability of safe food to ever growing population. Maintaining production and productivity through traditional agriculture system have been tough. Globally one technology has been accepted as sustainable technology to tackle all these issues is Hydroponics (soil-less cultivation) which not only offers safe food but also ensures vertical utilization of space with higher water utilization efficiency. This experiment was conducted at DIBER, DRDO, Haldwani, Nainital (Uttarakhand) to study the effect of three growing conditions *i.e.* hydroponics, soil less and field condition on yield and quality of spinach. Experimental findings have revealed that crop productivity under hydroponics system was more than 2 times over soil and soil-less system with better quality produce. Spinach crop under hydroponics system developed profuse root system with average root length more than 15.0 cm almost 60 per cent superior over soil grown system. This paper deals with comparative performance of spinach under various growing systems.

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Studies on the incorporation of rose petal in jaggery

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The rose petal contains 86.12 g/100g dw of carbohydrates, 7.58 g/100 g dw of proteins, 4.29 g/100g dw of ash and 392.87 kcal /100g dw of energy. The flower contains phenolics which are believed to be anti inflammotory. The extract of rose plant act as an anti depressant, antibacterial, antifungal, antiseptic, anti-inflammotory, digestive stimulant, kidney tonic and menstrual regulator. Sugarcane jaggery is a traditional unrefined non-centrifugal sugar consumed in Asia, Africa, Latin America and the Caribbean. Apart from being a sweetener, jaggery is a food material as well and is liked for its medicinal properties. It is cooling, diuretic, aperients, refreshing, aphrodisiac, lactogenic and acts as cardiac tonic. The nutritional

and medicinal value of jaggery can be enhanced by fortification and supplementation with wide variety of protein, vitamin and mineral sources. This work was designed to enhance the consumer acceptance of traditional jaggery by adding rose petals. The incorporation of rose petals into the jaggery was found highly acceptable on the organoleptic evaluation.

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Studies on physico-chemical composition 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 SO₂. 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 to evaluate seven germsplasm. The experiments was laid out in CRD with five replication and seven treatment/genotyps (G₁, G₂, G₃, G₄, G₅, G₆, G₇) were collected from different locations 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 41.33⁰ Brix, acidity from 1.52 to 1.77 per cent, ascorbic acid from 4.76 to 7.13 mg (per 100 g), TSS acid ratio from 18:41:1 to 26:57:1 reducing sugar from 3.76 to 5.16 per cent non reducing sugar from 6.73 to 11.26 per cent and total sugar from 10.56 to 16.43 per cent.

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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 cultivars of aonla were screened for their suitability into different products and accordingly the fruits of cultivar Chakaiya were used for preparation of fruit beverages (RTS and squash) and NA-7 for making preserve, pickle and sauce. Observations on vitamin C (ascorbic acid), total soluble solids, acidity, browning and organoleptic quality of these products were recorded during storage at monthly interval. The vitamin C content of these products decreased continuously with the storage period. 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 except pickle where it declined after three months of storage. 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.

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Studies on physico-chemical attributes on bael (*Aegle marmelos* Correa) fruits in sodic soil condition

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The present investigation was carried out at the Main Experiment Station, Department of Horticulture, ND University of Agriculture & Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during the years 2016-2017. The experiment was conducted in RBD with twelve genotypes and replicated three times, considering one plant as a unit. On the basis of Physico-chemical attributes of bael fruit *viz.* maximum fruit length (27.35cm), pulp weight (2.094 kg), Specific gravity (1.01 g/cc) and Minimum acidity(0.29 %) found in ND/AH-25, fruit width(25.57 cm) and total soluble solids(39.00) in ND/AH-10, fruit yield (224.06 Q/ha), fruit weight(2.51 kg) are found is best in ND/AH-8. The maximum (415.67 g) shell weight was recorded in the genotype ND/AH-11 followed by (412.67 g) shell weight was recorded with the genotype ND/AH-25. The minimum (344.67 g) shell weight was recorded in the genotype ND/AH-21 followed by (356.33 g) shell weight was recorded as the genotype ND/AH-27. Maximum (3.21 mm) shell thickness was noted in genotype NB-21 followed by (2.94 mm) in genotype ND/AH-12 where as Shell thickness was found minimum (2.19 mm) in genotype ND/AH-26. Maximum (39.00⁰ Brix) total soluble solid was noted in genotype ND/AH-10 followed by genotype ND/AH-8 (38.67⁰ Brix). The minimum total soluble solid (35.00⁰ Brix) was noted with genotype ND/AH-26. The minimum number of cavity (11.0) and maximum total sugars (16.02 %) is recorded best in ND/AH-27. The highest reducing sugar (7.07 %) is recorded best in ND/AH-9. The maximum (48.16 mg/100g pulp) ascorbic acid was recorded with genotype ND/AH-17, whereas minimum (30.96 mg/ 100g pulp) ascorbic acid content was recorded in genotype ND/AH-26. The maximum (0.46 %) acidity was recorded as the genotype ND/AH-10 & ND/AH-17. The minimum (0.29 %) acidity was recorded in genotype ND/AH-25.

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Pre-harvest stresses which influence the post-harvest abiotic stress in fruits

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Providing food to the rapidly expanding population is a major global issue and ensuring food security is main aim of sustainable fruit production. India ranks second in the production of fruit, but still it's unable to fulfill the daily requirements of a large number of its people. Harvested fruits can be potentially exposed to numerous abiotic stresses during production, handling, storage and distribution. Abiotic stresses such as drought, temperature extremes, salinity, light and plant nutrition occurring during pre-harvest can either be the primary cause for disorders that exhibit themselves during post-harvest handling and storage practices or they can influence the susceptibility of fruits to post-harvest conditions that cause abiotic stresses resulting in disorders. Lot of efforts has been made in the direction to increase the yield, but comparatively a meager attention is paid to the management of post-harvest losses, which result into loss of nutrients which can be otherwise used to nourish people. It is important to understand the relationship between pre-harvest abiotic stresses occurring during production and post-harvest abiotic stresses that the fruit crops are exposed after harvest, during storage and distribution, since the solution to these different problems will be best resolved by focusing on pre-harvest or post-harvest abiotic stress

amelioration, respectively. The management of various pre-harvest stress factors may prove helpful in the better option for the reduction of post-harvest losses.

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Extending storability of pear *cv.* Patharnakh in response to sodium nitroprusside treatment

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Patharnakh is a most important variety of pear grown in Punjab. But, its harvesting period coincides with the hot and humid season of the year that leading to decline in self-life of fruits. Keeping in view, an experiment was conducted to extend the post-harvest storage life of Patharnakh pear fruits under cold storage (0-10°C) with post-harvest application of sodium nitroprusside (SNP 0mM, 1mM, 2mM, and 3mM). Fruit samples were analysed for various physico-chemical changes after 30, 45, 60, 70 days of storage. Results revealed that during storage a significant weight loss was recorded in all the treatments but lowest weight loss was recorded in SNP 2mM treated fruits followed by SNP 3mM treated fruits and maximum in controls. No fruit spoilage and internal browning was recorded up to 45days and most of the fruit spoilage occurred after 60 days of storage. Sensory quality and palatability reading of fruits increased during initial storage periods but later on decreased and highest sensory quality was retained by SNP 2mM at the end of storage period. Highest retention of total phenols and acidity was also observed in SNP 2mM treated fruits. Other parameters like TSS, total sugars, reducing and non-reducing sugars were slowly increased in treated fruits up to 60 days of storage, afterward a decline was recorded. It can be concluded that SNP 2mM and SNP 3mM treatment extended the storage life of pear fruits as compared to control.

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Comparitive assessment of edible coatings on physicochemical characteristics of kiwifruit (*Actinidia deliciosa cv. monty*)

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The study was undertaken to assess the impact of different edible coatings on physicochemical characteristics of kiwifruits (*Actinidia deliciosa cv. Monty*) harvested at commercial maturity stage. The fruits were immersed in two different concentrations of Calcium nitrate (1.5 and 3%), Chitosan (1.5 and 3%) and Aloe Vera gel (25 and 50%) for 5 minutes and stored at 10°C with relative humidity of 90-95 per cent for 90 days. Physico-chemical properties of fruits including weight loss, firmness, total soluble solids (TSS), ascorbic acid, reducing sugar and organoleptic properties were monitored regularly during 90 days of storage period. It was recorded that kiwifruits treated with aloe vera gel 50 per cent showed the best result in terms of fruit quality. It showed least physiological loss in weight with excellent firmness, texture and biochemical properties in comparison to the control. Lower reduction in TSS, reducing sugars and ascorbic acid was recorded in same during the period of the experiment. The second-best treatment was aloe vera gel 25 per cent, which also resulted in retaining the fruit quality followed by Calcium nitrate 3 per cent but these treatments were significantly different from each other. The results also revealed that Chitosan treatment was not as much effective as aloe vera gel and Calcium nitrate treatments in extending the shelf life and maintaining quality of kiwifruits.

P-160

Influence of boron, potassium and prohexadione-calcium on productivity of apple cv. Red Delicious

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To determine the influence of boron, potassium sulphate and prohexadione-calcium on productivity of Red Delicious apple, eighteen year old plants with uniform growth and vigour were selected in a private orchard of district Ganderbal, Jammu and Kashmir during 2016. The experiment comprised of six treatments *viz.* T₁: control (no spray), T₂: boric acid @1.5 g/l, T₃: potassium sulphate @7 g/l, T₄: boric acid @ 1.5 g/l + potassium sulphate @ 7 g/l, T₅: prohexadione- Ca @100 ppm, T₆: Prohexadione-Ca @150 ppm, was laid out in a complete randomized block design with four replication. The results obtained revealed significant effect of the treatments on all the studied characters. Foliar application of boric acid @ 1.5 g/l + potassium sulphate @ 7 g/l (T₄) resulted in maximum increment in trunk girth (2.34cm), tree volume (3.30 m³), shoot extension growth (52.53 cm), fruit set (48.50%), fruit yield (115.90 kg/tree), fruit length (7.97cm), fruit diameter (8.34 cm), fruit weight (207.71 g), fruit colour (8.26), TSS (15.62⁰B), reducing sugar (10.88 %) and total sugars (13.89 %). Trees sprayed with Prohexadione-Ca @ 150 ppm (T₆) resulted in maximum fruit retention (33.67 %), yield efficiency (0.37 kg/cm²), TSS/acidity ratio (81.01), fruit firmness (8.91 kg/cm²) and calcium content (0.049 %). Thus it can be concluded that the treatment T₃ *i.e.* boric acid @ 1.5 g/l + potassium sulphate @ 7 g/l resulted in better yield of quality Red Delicious apples.

P-161

Standardization of floral preservatives for enhancement of storage and vase life of *Gladiolus grandiflorus* var. Nova Lux

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The present investigation was carried out during 2018-19 at Model Floriculture Centre and Department of Horticulture at G.B. Pant University of Agriculture and Technology, Pantnagar Uttarakhand. The experimental material adopted for the purpose of vase life study was cut spikes of *Gladiolus grandiflorus* var. Nova Lux which followed a complete randomized design under laboratory conditions. The experiment had thirteen treatment combinations of sucrose, 8-Hydroxy quinoline citrate (8-HQC) and AgNO₃ replicated thrice. The influence of floral preservatives showed statistically significant results for various floral characters such as floret diameter, longevity, spike length, preservative uptake, floret opening percentage, blooming period *etc.* over the control. For storage life, the optimum treatment combination recorded as per the data analyzed was found to be of sucrose (3 %) [15.44 days] over the control exhibiting 10.29 days. For storage life, the optimum treatment combination recorded as per the data analyzed is found to be of 8-HQC (300 ppm) + sucrose (6 %) [11.11 days] over the control showing vase life duration of 8.46 days.

THEME 7

INDIGENOUS TECHNOLOGIES AND HORTICULTURE FOR HEALTH, HEALING, HAPPINESS AND ENVIRONMENT

ORAL SESSION

O-89

Floriculture for employment and happiness

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Floriculture is a fast emerging sector and the demand for floriculture produce is increasing over a period of time. Floriculture is becoming important for domestic and export markets and the demand is ever increasing. Opportunities for floriculture and landscape gardening are increasing due to urbanization and enhanced expendable income. In the fast changing global context, managing the change on a time scale, by converting weakness into opportunities to become internationally competitive is considered important. India is endowed with wide range of climatic conditions with varied range of soils, man power along with variety of agro climatic conditions which thereby enable us to grow different types of flower crops almost throughout the year. The increasing demand for both cut flowers and potted plants in Western countries will result in the production gain from our country. The scope expands further by increasing the production of exiting product as well as expanding the product range. There has been an appreciable increase in floriculture, but potentialities, which exist in the sector, have not been harnessed. The sector has lot of potential to address social and economic issues including employment generation, private sector investment, entrepreneurship, job for unemployed educated youths and women empowerment. Need for trained personnel have been realized in this sector that has led to various courses being offered by ASCI, government and private institutions. Therefore, it is advised to grow many of the cut flowers under protected conditions for making it available all the year round, thus protecting them from fluctuations in temperature and providing higher remunerative to the growers which is thereby not possible in the open field.

O-90

Peri urban vegetable cultivation : A boon to the small farmers

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Peri urban agriculture is recognized for its potential in increasing food security employment and income generation poverty alleviation community resource development waste management and environmental sustainability. The rich social and economic variability of Peri-urban areas offers opportunities for innovative science, living condition to promote harmony both between societies and between group of people. It will be helpful for taking up vegetable cultivation in peri-urban areas in an organized way. A huge quantity of solid waste generated during handling and marketing of fresh vegetable produce. Recycled to produce vermicompost, etc. for use in organic vegetable production peri-urban vegetable cultivation can provide farmers the possibility to cultivate a small piece of land, and obtain an income to meet their essential and basic needs. In recent years, around big cities, belts are being developed which

can proved a very intensive and profitable network of small farms specialized in production of perishable vegetables for consumption by the urban consumers. This is likely to result in a social symbiosis between farmers and city dwellers with mutual benefits and advantages. This will require involvement of large number of institution to address many issues related to the peri-urban vegetable cultivation in viable participation approaches to make an impact and deliver anticipated results to peri-urban population.

O-91

Enhancing livelihood security of tribal farmers through TSP on onion and garlic

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The tribal belt of Nandurbar in Maharashtra has congenial climatic conditions for production of onion and garlic. But cultivation of these crops was limited to the kitchen garden before the initiation of Tribal Sub-Plan (TSP) in this area by ICAR-DOGR, Pune. Under TSP, systematic effort was undertaken to improve the area and production of onion and garlic by careful application of improved technologies. About 750 tribal farmers were selected in a form of 75 groups under TSP. Each group undertook demonstrations on onion and garlic cultivation in one acre of land in Navapur, Akalkua and Dhadgaon Talukas of Nandurbar. In total, 275 demonstrations on newly improved varieties of onion and garlic and improved production technologies were undertaken. As a result onion and garlic are giving more profit than traditionally grown crops in these areas. Farmers have earned a net income of Rs. 0.70-0.80 lakh per acre by production of about 120 q bulbs of onion variety Bhima Shakti/ Bhima Kiran/ Bhima Light Red during *rabi* whereas earned same net income by production of about 85 q bulbs of Bhima Super/ Bhima Dark Red in *kharif*. Farmers have earned 0.60-0.80 lakh per acre net income by production of about 2 q seeds per acre of Bhima Kiran/ Bhima Shakti/ Bhima Light Red/ Bhima Super/ Bhima Dark Red. From garlic cultivation, Rs. 0.80-1.00 lakh per acre net income is earned by production of about 35 q bulbs per acre of Bhima Purple/ Bhima Purple. The production and productivity of onion in Nandurbar has been increased to 191% and 138%, respectively after initiation of TSP.

O-92

Cactus & succulent cultivation : a potential and commercially viable lucrative business

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Cactus and succulent come in different forms, sizes and sometime very colourful. They are hardy and easy to maintain. Recently, the craze of succulents have increased manifold due to availability of new varieties with attractive and colourful succulents in market. Low maintenance and adaptability make them favourite for urban landscapes both outdoor as well as indoor. *Furcraea*, *Agave*, *Kalanchoe*, *Adenium* and *Sansevieria* are widely used in landscaping and different varieties of *Sempervivum*, *Crassula*, *Dudleya* are used as indoor plants. Several succulents also have medicinal and nutritional values and can be easily cultivated in pots or in field for mass production of plant materials for pharmaceuticals and health care business. *Aloe vera*, *Bryophyllum pinnatum*, *Euphorbia neriifolia* and *Cissus quadrangularis* are some of the popular medicinal succulents. *Hylocereus undatus* (dragon fruit), is a fruit bearing cactus which has a big scope in India especially the Indo-Gangetic plains. With little investment and land, cultivation of this plant group can become a very successful business in horticultural and pharmaceutical markets.

POSTER SESSION

P-162

Horti-tourism : An eco-friendly enterprise

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The mushrooming population has created the problem of unemployment very badly enforcing the rural people to migrate to urban and city areas in search of job and better life. But the cities are at saturated state with artificial adornments, crowded population, hectic life and unhealthy environment. The people in cities are always in search of peaceful, healthy, natural environment with good food so that they can forget all the tension and busy life and enjoy with their family. Thus, horti-tourism could be a best option. Horti-tourism is the interrelationship between tourism, horticulture and gardening. It is the act of visiting a natural and beautiful place with flora and fauna for the purpose of enjoyment, recreation and entertainment. The different vegetables, fruits, condiments, animal products *etc.* for the cuisine purpose are made available by the flora and fauna present in the area. Horticulture tourism satisfies the curiosity of urban people about sources of food, plants, animals, rural handicrafts, languages, culture, traditions, dresses and life style of the people. Healthy and peaceful environment, employment opportunity, increase in socio-economic level, education, promotion of culture and tradition *etc.* are the major benefits of horti-tourism. However, lack of knowledge about horti-tourism and commercial approaches of small farmers are the major constraints. Some of the important destinations under horti-tourism in India are Kalahasti Falls, Honnanma Falls, Jagara pass and valley, mango orchards in Maharastra *etc.*

P-163

Pink guava : A nutrient power house

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Guava (*Psidium guajava*) is one of the important nutritional fruit among the myrtaceae family. It is commonly known as poor man's fruit because of its rich nutritional value and availability at moderate prices compared to other fruits. Guava fruits generally have white and pink pulp colour. Pink guavas are rich in bioactive components than white pulp guavas. Lycopene is one of the major carotenoids, known as lipophilic antioxidant recently, has gained attention among nutritionists due to its effectiveness against prostate cancer and its demand is also increasing in the global market. Hence, the Pink pulp guavas are the major alternative source for lycopene (2.0 to 4.5 mg/100g) content among fruits, it has gained an important role in research programme. Along with lycopene they are also the important source of total phenols (200 to 350 mg/100 GAE), total flavonoids (80 to 200 mg/100 QE), total antioxidant activity (2 to 3.5 μ mol Trolox/100g), total carotenoids (1.0 to 10 mg/100g) and vitamin C (150 to 215 mg/100g). As pink pulp guava are having multiple health benefits loaded with many of the important bioactive components, they have gained an important role in crop improvement programme for developing nutritionally rich cultivars.

P-164

Kitchen gardening : Approach to enhance rural household food security of Lucknow district

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India has achieved food security, however nutritional security is still a major concern among farm families. In Lucknow, about 93 per cent farmers have small and marginal land holdings, unable to meet out the daily recommended requirement of fruit and vegetables. Hence, most of them are victims of malnutrition. Kitchen gardening contributes to household food security by providing direct access to food that can be harvested, prepared and fed to family members, often on a daily basis. Kitchen garden is a realistic solution as in rural area to solve the nutritional insecurity. Increase availability of pesticide free food and better nutrition through food diversity and enhanced rural employment through additional or off-season production in rural areas of Lucknow district. The present study was conducted from 2011-12 to 2018-19 in selected villages and farm families of Lucknow district to popularize the nutritional kitchen gardening. During study conducted training programmes and demonstration for creating awareness and capacity building of farm families of rural population. The result revealed that the 150 m² area of kitchen garden fulfill the average requirement of vegetables of farm family in daily routine diet was 70.3 per cent from for medium size family (7 person/ farm family). It is also observed that after introduction of kitchen garden rural population save money in buying vegetables and use fresh and pesticide free vegetables as well as enhanced food security of rural household.

P-165

Plant polyphenols : Sources, synthesis and their nutraceutical potential

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Polyphenols are a large family of natural compounds widely distributed in plant foods and contribute to the beneficial health effects of vegetables and fruits. The main source of polyphenols is dietary, since they are found in a wide array of phyto-chemical bearing foods. Green tea polyphenols are those from wine and have attracted a great deal of media attention. While dietary anti-oxidants, such as vitamins E and C, have received considerable attention, less is known about a similar anti-oxidant role for plant-derived flavonoids and phenolic acids. Natural polyphenols help in the management of major depression. Natural polyphenols, the non-essential micronutrients, found in array of plant products, are known to affect various physiological and biochemical functions in the body. Studies have shown the protective effect in different neurological and mental disorders. They modulate monoaminergic neurotransmission in the brain and thus possess antidepressant-like activity at least in animal models of depression. From about 500 million years ago, freshwater and terrestrial plants slowly optimized the production of new endogenous antioxidants, such as ascorbic acid (vitamin C), natural phenols (including flavonoids) and polyphenols, tocopherols, etc. A few of these appeared more recently, in the last 50–200 million years, in fruits and flowers of angiosperm plants. Their contribution to the antioxidant capacity of the human diet is much larger than that of vitamins. The total intake in a person's diet could amount to 1 gram a day, whereas combined intakes of beta-carotene, vitamin C, and vitamin E from food most often is about 100 mg a day. There are a couple of biosynthetic pathways that form polyphenols.

P-166

Aromatherapy : A pseudoscience in ornamental plants for holistic healing of human body

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Aromatherapy is the therapeutic application or the medicinal use of aromatic substances (essential oils) for holistic healing. Named by the French chemist Rene-Maurice Gattefosse in 1910, it is a form of alternative medicine that uses volatile plant materials, known as essential oils, and other aromatic compounds for the purpose of altering a person's mind, mood, cognitive function or health. Aromatherapy is the practice of using the natural oils extracted from flowers, bark, stems, leaves, roots or other parts of a plant to enhance psychological and physical well-being. It came into existence after the scientists deciphered the antiseptic and skin permeability properties of essential oils. The inhaled aroma from these "essential" oils is widely believed to stimulate brain function. Essential oils can also be absorbed through the skin, where they travel through the blood stream and can promote whole-body healing. This type of therapy utilizes various permutation and combination to get relief from numerous ailments. A form of alternative medicine, aromatherapy is gaining momentum. There are wide number of essential oils available, each with its own healing properties. Lavender (*Lavender augustifolia*) oil consists of camphor, terpinen - 4 - ol, betaocimene and 1, 8-cineole and is excellent to treat insomnia and improves the sleep quality. After 12 weeks of lavender aromatherapy, midlife women with insomnia have improvement in the quality of their sleep and increased heart rate variability for a short term. The aromatherapy effectively reduced the anxiety level and increased the sleep quality in the Percutaneous coronary infraction (PCI) patients admitted to the ICU. Inhalation aromatherapy using the Damask rose (2% from a piece of cloth smeared with 3 drops of oil) decreased depression, anxiety and stress in patients under hemodialysis. Rosemary oil, consisting of α -pinene, camphor, and 1,8-cineole has been shown to possess excellent brain stimulating properties, memory improvement and mood improvement too. The results of aromatherapy *via* inhalation of Jasmine oil showed that the beta wave power (13-30 Hz) was increased in the anterior center as well as the left posterior region of the brain. On one hand, the positive emotions including the feeling of well-being, active, fresh and romantic have been increased by jasmine oil. An improvement to a greater extent is also seen in the communication skills of autistic children. The involvement and collaboration of therapists, patients and referring health professionals in the design of such studies is challenging but an effective way of developing new methodologies for holistic healing of human body *via* use of essential oils.

P-167

Isolation and characterization of nitrogen fixing bacteria to promote organic farming in low temperature zone

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Nitrogen is a major soil nutrient for proper growth of plants. Nitrogen fixing bacteria is an important group of bio-fertilizer essential for maintenance of soil health. Bio-fertilizers confer a property alternate to chemical fertilizers through their plant growth promoting activities and contribute considerably in enhancement of soil fertility and crop yield. With an aim to isolate nitrogen fixing bacteria from high altitudes region of Arunachal Pradesh, soils samples were collected from agricultural fields in Tawang. The samples were cultured under low temperature using specific medium. The isolates were characterized using biochemical tests and molecular techniques. Biochemical tests revealed presence of nitrogen fixers, which were subjected to PCR amplification of 16s rDNA and *nif* genes. Positive samples were sequenced to study their homology with nitrogen fixing bacterial groups. The *nif* gene is most widely sequenced marker gene used to identify nitrogen fixing bacteria belonging to the genus *Azotobacter* and *Azospirillum*. The current study identifies seven distinct microbial strains isolated from different soil samples from high altitude regions of Tawang possessing nitrogen fixing capability. Consequently, the isolates were identified as strains of *Azotobacter* and *Azospirillum*.

THEME 8, 9, 10, 11

SUCCESS STORIES IN HORTICULTURE AND ORGANIC PRODUCTION, EXTENSION, HORTI-BUSINESS AND ENTREPRENEURSHIP, FUTURE STRATEGIES, GOVT. SUPPORT AND POLICIES AND WOMEN EMPOWERMENT

ORAL SESSION

O-93

High yield in chilli through adoption of mulching and drip fertigation : A success story

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Chilli (*Capsicum annum* L.), the most widely used and universal spice of India. Among horticultural crops, chilli plays a very important role in economy of the Burhanpur district. Fertigation is a new concept recently practiced in several parts of the world. The use of organic and inorganic mulch as a soil cover is effective in improving growth and yield of chilli (*Capsicum annum* L.). It minimizes the requirement of nitrogen fertilizer, warms the soil and suppresses weed growth and therefore, increases yield. In recent years, changing climate is expected to be harsher and detrimental on crop production. Pest and disease management is the serious issue which intern reduce the income per unit area. Keeping above concern in view KVK demonstrated different technologies through mandatory activities among the chilli growing farmers of the district in 2015-17 and number of the farmers adopted the technology. Mr. Subhash Mahajan of Khatala village adopted the technology and laid the path to other chilli growers of the district. Maximum yield of 465.12 q ha⁻¹ was observed under the black plastic mulch of 25 micron thickness and fertigation with 125 per cent RDF. The data on economic parameters reveals that Rs.335000/- was earned though chilli cultivation with full POP whereas, Rs 2,25000/- per ha from traditionally cultivation. The B : C ratio was 3.91 in chilli cultivation with full POP, whereas it was 3.25 under traditional cultivation. The technology demonstrated among the farmers to create awareness about benefits of poly mulch to save water, fertilizer and low incidence of sucking insect pest.

O-94

Horticulture Mission for north east & Himalayan states : A centrally sponsored scheme for holistic development of horticulture sector in Uttarakhand

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The centrally sponsored scheme (CSS) of HMNEH is being implemented in the State since 2003-04 for the holistic development of horticulture sector duly ensuring forward and backward linkages by adopting cluster approach, covering production, post-harvest management, processing and marketing with the active participation of all the stake-holders. Under this scheme supply chain (forward and backward linkages) is being strengthened through adopting cluster approach with innovative technologies for the bulk production, establishment of nurseries under public & private sector to ensure availability of quality

planting material, area expansion of fruits, vegetables, spices & flowers, creation of water source to enhance the irrigation facility, protected cultivation (polyhouse, shade net house, anti hail net, plastic mulching), mechanization to reduce the drudgery, mushroom cultivation and bee keeping, post-harvest management (establishment of pack houses on farmers field, cold storage, CA storage, refrigerated transport vehicle, ripening chamber *etc.*), processing, marketing and human resource development. Adoption of best practices under HMNEH. Obviously, a strong supply chain management is supplementary to food security with each other which deals with strong backward and forward linkages through innovative technological interventions in the state. This may play a vital role to increase production and productivity of crops, development of cool chain, handling, transportation, storage *etc.* to increase availability of quality product to consumers with minimizing post harvest losses and development of markets and marketing infrastructure including e-marketing, assessment of trading performance. This will help to generate the employment, encourage reverse migration, ensure food security and finally will help to achieve the objective of doubling farmers' income in horticulture sector.

O-95

Self-employment generation through value addition of aonla fruit in Bundelkhand

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This Vocational Training Programme was carried out at the Krishi Vigyan Kendra, Panna of the JNKVV, Jabalpur, Madhya Pradesh to generate the self-employment among the rural youth. In district Panna, aonla is a major fruit but no regular orchard is found. Villagers harvested the aonla fruit from the forest. Fruit size is medium. They generally sold these fruits fresh. They used to get less price for fresh fruit. No processing industry was there. So, in this situation KVK take lead and came forward with two objectives like reduction of exploitation of minor forest products as aonla and engagement of unemployed rural youth in self-employment generation. We suggested improved varieties of aonla through trainings. We also trained the people through VTPs. Through one VTP on aonla murabba preparation, 30 participants were trained. After training they motivated and started their own Self Help Group (SHG) named Maa Durga Self Help Group. Initially, they prepare aonla murabba but later aonla juice, supari and pickle *etc.* They prepare 50-60 q aonla murrabba, 2 q aonla supari, 5-6 q pickle, 200 lit. aonla juice, 4 q auwargathi (dry aonla). They earned net income of Rs. 2 lac./annum @ Rs. 3000/qtl (sale price @ Rs. 80/kg). Cost of production was @ Rs. 5000.00 (aonla Rs. 2000/qtl, ingredients Rs. 2000, labour/packing charges Rs.1000). This success leads to checked the deforestation of aonla plants and now the farmers are very much aware about the importance of M.F.Ps. Prepared produce have been sold through outlets at Panna city and through demonstration in various farmers fare, exhibition *etc.*

O-96

Indian farming with green technology : Insight to the regulation of bio-pesticides and organic farming - Indian perspectives

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India is the 4th largest producer of chemical insecticides and as many as 300 pesticides have been registered. Insecticides Act, 1968, Destructive Insects and Pests Act, 1914 supported by Plant Quarantine Order (Regulation of Import into India), 2003 enacted in the government regulation to control the biopesticides

and organic farming. The concept of bio-pesticides is too young and the market share is only to the tune of about 2.5 to 3 per cent in India as compared to global share which is about 5.5 per cent. As many microbial pesticides including antagonist fungi and bacteria, entomopathogenic fungi, nuclear polyhedrosis virus, plant origin-pyrethrum, karanjin, neem-based pesticides are registered under section 9(3) or 9 3 (B) and without the registration of Central Insecticides Board and Registration Committee (CIBRC) no one can sell and commercialize the pesticides. Contrasting the regulation of organic food is quite different and has ambiguity. Interestingly National Programme for Organic Production (NPOP), which is the authority of organic farming is not included in the registered bio-pesticides and not recommended. The question always persists the fate of bio-pesticides if it is not included in organic farming. Further, the absence of limit trans-boundary between the Agricultural and Processed Food Products Export Development Authority (APEDA), Food Safety and Standards Authority of India (FSSAI), Participatory Guarantee Systems by National Centre of Organic Farming (NCOF) are encroaching each other and such individual certification making harm the organic food. Therefore, understanding of its legality is required for a uniform policy organic food certification.

O-97

Development and dissemination of vegetable production technology in border villages of district Pithoragarh (Uttarakhand)

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The state Uttarakhand is comprised of 13 districts, of these 13 districts, four districts (Nainital, Haridwar, Dehradun and Udham Singh Nagar) have large areas in the plains, whereas, the other nine districts comprise the hill region of the state. The hill region districts are less developed in terms of infrastructure, *i.e.*, electricity, roads and irrigation. More than three-fourths of Uttarakhand total population depends on agriculture for their livelihood and the economy is predominantly dependent on mountain agriculture. Keeping the above points in mind, an effort was made by Defence Institute of Bio Energy Research (DIBER) (DRDO) through development and dissemination of vegetable production technology developed by the institute in the border villages of Pithoragarh to fulfill the demand of troops and local inhabitants. This will in turn change the socio-economic conditions of farmers and generate more opportunities for self employment and entrepreneurship too. Besides this, Trainings are being organized for 2-3 days duration on nursery management, planting of vegetables, crop protection, protected cultivation *etc.* for farmers, women farmers and ex servicemen. Apart from this, farmers from various villages and students from schools and army personnel also come to the institute on an exposure visit for learning the technologies by seeing and believing. Knowledge Exchange Workshops on 'Challenges and Prospects of Agriculture and Village Development' are being organized at border villages. By adopting the improved technologies regarding vegetable production, farmers are getting very good remuneration and their economic status is also increasing.

O-98

Backyard nutritional kitchen garden for combating the malnutrition and to raise additional income

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Malnutrition and poor health condition is one of the common problems in rural areas of our country. For poor households, vegetables and fruits are often the only sources of micronutrients in the family diet. Vegetables help combat malnutrition and diversify diets. Mostly rural people depend on grains for food. Less consumption of vegetables, green vegetables, fruits and milk are the reasons for malnutrition. Kitchen gardening is one of the world's most ancient food production practices and is practiced throughout the world. Homestead production of fruits and vegetables provides the households with direct access to important nutrients that may not be readily available or within their economic reach. Improved vegetable nutrition garden is better than traditional homestead vegetable garden. The improved model involves many crops that can be repeatedly harvested to meet a family's vegetable needs throughout the year. Therefore, present study was conducted to see the impact of kitchen gardening in improving the nutritional security and economic status of households in rural areas. The demonstration was conducted among 20 farm women's in Nutri Smart Village of Morghira and Bijauri of Burhanpur district of M.P. The total population of village Morghira and Bijauri was 4961, out of which 13 were found malnourished, which has decreased to 03. Farmers were producing sufficient food but consumption was not up to the mark. After interventions, there was a significant increase in availability and consumption. Observation recorded that production of vegetables on beneficiaries field increased 76 per cent, which resulted in increased profit up to 69 per cent worth Rs. 2700/- only. The cost benefit ratio was 1:2:4.

O-99

Impact and adoption status of various agro practices under -protected cultivation of vegetables for productivity and quality enhancement in Uttarakhand, India

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India has a wide range of diverse agro-climatic conditions but vegetable cultivation has generally been restricted to seasonal and regional need of the local area. Although the production has increased to a level of 162.19 million MT from an area of 7.2 million hectare, still the technology used and practices followed are predominantly traditional resulting in low productivity and inconstant quality and quantity of produce. It is also observed that cultivation practices used by farmers are poor and substandard. Taking in view the study was conducted to know the adoption status of various recommended sowing practices under protected cultivation of vegetable crops in two districts of Uttarakhand viz. Pauri Garhwal and Bageshwar. Total 100 farmers were selected for the study by probability proportion of number of farmers practicing protected vegetable cultivation and the data were collected by personally interviewing the farmers of protected cultivation. The result revealed that maximum number of farmers (65.5%) grown capsicum in protected structure followed by 59.75% for tomato and 25.80% for cucumber crop in the protected structure. Majority of farmers preferred poly house structure for cultivation of these crops followed by shade net house. Vermi compost, Tricho derma and Neem cake were mostly used by farmers under protected structure. This study also revealed that majority of farmers adopted soil testing practices to get the real micro nutrient status of soil, shallow soil ploughing and applied organic formulation

before sowing of crops under protected structure. majority of tomato growers followed soil solarization practice under protected cultivation to reduce the soil born infection. Data Revealed that majority of capsicum and tomato farmers prepared their own nursery and used seed treatment practice before sowing under protected structure. In capsicum crop maximum number of farmers adopted recommended spacing practices and not adopted transplanting time practices where as in tomato crop farmers did not adopt recommended spacing practices but they adopted recommended transplanting time practices. The cucumber crop, majority of farmers did not adopt recommended seed rate and spacing practices used pre treated seed and adopt recommended sowing time practices. The study reveals that regular awareness programmer and training courses, goshties kisan chowpals, seminars and workshops should be organized to train the farmers for better results of vegetable crops under protected cultivation and adoption of these technologies at large scale for increasing the better productivity and economic security. This is also revealed that the demand of poly house increased by double in number. Therefore the area under protected cultivation increased from 50% to 100% in every year.

POSTER SESSION

P-168

Horticulture: way of women employment

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Telling women's stories to the world will change the way that the world treats women-Moira Donegan, The New Yorker. From the beginning of civilization women play an important role in gathering of seeds and cultivating important crops for feed, food, fodder, fuel and fiber when men engaged themselves in hunting, tillage process. They have protected the soil health through organic cycling and also promoted crop security through the maintenance of varietal diversity and genetic pool. In agriculture and allied sectors the employment is approximately 89.5 per cent of women. Women are employed in all activities in horticulture starting from transplanting to value addition. Maximum employment is there in the field of Horticulture. Women play highly important and significant role in horticulture as decision maker, manager, entrepreneurs, scientist, researcher, highly skilled labourer to unskilled labourer. The scope of horticulture is very broad including women friendly. The love for family, nature attracts women towards horticulture, which broaden the scope of employment generation which improves the quality of life *i.e.* mainly health of family and built their asset base. Horticulture is pursuit of natural science in which all sexes and degrees of education and refinement unite." -Daniel Webster, September 1845.

P-169

Seed biopriming of French bean with plant growth promoting Rhizobacteria, *Rhizobia* and *Trichoderma* spp. for seed yield and disease resistance

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Seed priming is a quality enhancement technique for rapid uniform germination of seeds and optimum plant stand in the field. In this prospective, Biopriming is a new technique of seed treatment that integrates biological physiological aspects of disease control. It is recently used as an alternative method for

controlling many seed and soil borne pathogens. The present investigation was conducted in Research farm of Department of Seed Science and Technology, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh in *kharif* 2017. Data revealed that all the treatments of PGPR, Rhizobia and *Trichoderma* spp. resulted increase in yield parameters and reduction in the incidence of diseases as compared to treated and untreated control. The maximum field emergence (95.55 %), plant height at 30 days after sowing (34.80 cm), plant height at final harvest (59.39 cm), days to pod harvest (50.67), pod size (17.27 cm), number of pods per plant (21.00), number of seeds per pod (7.33), seed yield per plant (22.01 g) and 100 seed weight (35.43 g) were recorded in PGPR-1 + *Rhizobium* strain B₁ (T₄). Incidence of *Rhizoctonia* root rot (2.22 %), Angular leaf spot (2.22 %) and Fusarium wilt (0.74 %) was also recorded minimum in PGPR-1 + *Rhizobium* strain B₁ (T₄). The overall experiment concluded that seed biopriming with consortium of PGPR and *Rhizobium* strain B₁ found to be best for seed yield parameters and disease incidences. Hence, bioprimed seed showed better growth as compared to non primed seed and combined application of microbes enhanced seed germination, plant growth and disease resistance better than their individual application.

P-170 (Theme-5)

Isolation of induced flower colour mutants through physical mutagenesis in *Chrysanthemum* cultivar "Little Pink"

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Rooted cuttings of *Chrysanthemum* (*Dendranthema grandiflora* T.) cv. Little Pink were treated with different doses of gamma rays viz., 0, 100, 150, 200, 250, 300, 350, 400 and 450 for induction of mutation. Cuttings were planted in randomized beds just after radiation. Foliage and flowers abnormalities in plants were recorded upon gamma irradiation, which increased with increasing exposure to gamma rays. Anatomical and chromosomal aberrations were also observed after physical mutagenesis with gamma radiation. Early flowering (5-8 days) and increased flowering duration (approximately 10 days) were observed in lower doses of 100 and 200 grays. Induction of flower color mutation and flower head shape were observed in chimeric form after irradiation in M₁ generation. Plants with induced flower colour mutations were multiplied and planted in same research field in M₂ generation. In M₂ generation two types (only 4%) of pure mutants were observed and multiplied for third generation (M₃ generation). In M₃ generation two pure flower colour mutants were isolated. For evaluating their distinctiveness or novelty from their parent plants, morphological screening of vegetative and floral characters, anatomical study to observe stomatal behaviour and cytogenetic study for determine chromosomal aberration in mutants had done.

P-171

Advanced production management strategies for organic Saffron and Kalazeera in India

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Saffron and Kalazeera are the important spice crops grown under temperate conditions of the world. In India saffron is cultivated in Jammu and Kashmir and Kalazeera is mostly found wild in Northern Himalayas of the country. Both of these crops are principally used as food additive in vegetarian and culinary dishes and give pleasant flavour, distinctive colour and delicate aroma and are irreplaceable spices. Besides, these spices are reported to have noteworthy antioxidative, antibacterial and antifungal activities. Owing to incredible utilization of saffron and kalazeera, the world production is not sufficient enough to meet the growing global demand because most of the countries have abandoned the saffron cultivation due to high cost of production and as such chances of its horizontal expansion are very slow. However, in India there is a tremendous human resource base as such saffron and kalazeera industry has an ample scope to expand provided these crops are cultivated on scientific lines and the traditional practices of cultivation are replaced by the latest technologies developed by SKUAST-Kashmir, India. Adoption of latest post-harvest technologies have potential to bring about improvement over strenuous traditional practices and returns to the growers from the superior quality product.

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