

AICRP-FRUITS

Objectives

- i. Augmentation and evaluation of germplasms in fruit crops.
- ii. Varietal evaluation trials.
- iii. Standardization of agro-techniques for fruit production.
- iv. Evaluation of inputs and chemicals for fruit growth and development.
- v. Various aspects for pest management in mandate fruit crops.

1. Significant Achievements:

Crop: Mango

Achievements made from Concluded Trials:



- i. **Release of new varieties in mango:** Two mango varieties namely **Pant Sinduri** (Matures earlier and has red blush on skin) and **Pant Chandra** (Good flavor and more shelf life) have been released in the year 2004 for cultivation. *In totality, 234 germplasms/ accessions (including primary and secondary collection) have been made till date and are being maintained at Pantnagar.*
- ii. **Performance of released mango hybrids:** The mango hybrid 'Mallika' has been recommended for commercial cultivation (as a processing cultivar) in *Tarai* region of Uttarakhand, by considering its better performance w.r.t fruit & pulp weight, size, TSS and shelf life in comparison to local commercial cultivars.
- iii. **Pruning for rejuvenation of over-crowded orchards:** The heading back upto crowded branches and centre opening with standard dose of paclobutrazol application has been recommended for rejuvenation of over-crowded orchard to increase yield (up to 177.12% more yield as compared to control), B:C ratio (up to 1.98) with good fruit quality in mango cv. Chausa.
- iv. **Pruning trial for high density planting in mango:** The annual pruning of mango trees (cv. Dashehari) by heading back of 10 cm terminal shoots, immediately after fruit harvest along with paclobutrazol application (@1ml a.i. per meter canopy spread) has been proved very effective for higher yield (147.0 % more yield as compared to control), B:C ratio (4.04 against 3.53 in control), good fruit quality and for having the dwarfing effect on tree under HDP.
- v. **Effect of different chemicals on regulation of flowering and fruiting in mango:** The spray

of KH_2PO_4 @1% + KNO_3 @1%, just before bud break has been found effective for increasing the flowering shoots (90.2%), hermaphrodite flowers (45.55%), fruit set, yield (37.34% more yield) and quality of mango cv. Dashehari.

- vi. **Pre-harvest treatment for extending the post harvest life of mango:** The pre-harvest application of CaNO_3 @4.0% with mulching or CaCl_2 @2.0% with mulching proved very effective in increasing the shelf life (up to 10-12 days) of Dashehari mango fruit. The treatments containing CaCl_2 @ 4% and 6% had shown the chloride toxicity on leaves.
- vii. **Effect of calcium, boron and sorbitol on pollination and fruit setting in mango:** The treatment of boric acid @ 0.02 % + sorbitol @ 2.0 % was found very effective for increasing the fruit set, yield and quality of mango cv. Dashehari.
- viii. **Planting system cum high density planting in mango:** The double hedge row system of planting (accommodating 222 plants/ha) has been recommended for higher yield (85.37% more yield in comparison to square system) and B:C ratio (2.51 against 1.88 in square system), without any adverse effect on fruit quality in mango cv. Dashehari.
- ix. **Effect of Paclobutrazole on flowering and fruiting in mango cv. Dashehari:** The use of paclobutrazole @ 5ml/tree (*for fully grown-up tree*), 90 days before bud burst has been recommended to increase the flowering and yield in mango.
- x. **High density orcharding in mango:** A success story of high density orcharding in mango has been recommended employing alternate bearer Dashehari and regular bearer Amrapali, without use of dwarfing rootstock. High density Dashehari trees (1333 trees/ha) yielded 238 t/ha fruits (11.38 times more) than that of 24 t/ha in normal density trees (69 trees/ha) during 20 years orchard life (1976-1996). Alternate bearer Dashehari commenced fruiting at an early age. Regular bearing and tree growth were controlled by annual

pruning, soon after harvest and application of paclobutrazol in soil 2.0 to 2.5 months after pruning. Pruning and use of paclobutrazol also decreased floral malformation to a very low level (0.2%). However, use of paclobutrazol was not required for regular bearing in Amrapali. Pruning coupled with paclobutrazol produced higher yield in alternate bearer Dashehari than regular bearer Amrapali.

Ongoing trials:

- i. **Augmentation and evaluation of mango germplasm:** Six new germplasms of mango were planted in field gene bank at HRC, GBPUA&T, Pantnagar in the year 2015 and 3 germplasms in 2016. The observations on various parameters will be recorded when plants of different germplasms will come into bearing.
- ii. **Testing of two superior clones of Dashehari mango:** The mango clone “Dashehari-51” had registered the significantly higher canopy volume, fruit yield (302.86 fruits/plant, 51.82 kg/tree and 5.18 t/ha) and TSS (19.57 °B) compared to Dashehari local. However, maximum fruit weight (183.19 g) was recorded in clone “Dashehari-35” and pulp content (72.87 %) in “Dashehari Local”.
- iii. **Multi Locational Trial of mango hybrids for screening of suitable hybrid for cultivation in relation to commercial cultivars:** Higher yield has been registered with Dashehari mango, whereas higher yield efficiency (2.50 kg/m³) was observed with H-311. The higher TSS (22.27 °B) was observed in H-949. The maximum shelf life was observed in the fruits of H-1084 and H-35 (20.0&18.33 days, respectively). No significant pests and diseases were observed among the hybrids. The hybrids like H-35, H-311, H-360 and H-1084 have shown the dwarfing stature.
- iv. **Effect of micronutrients on yield and quality of mango:** Significantly higher yield/plant (288.33 kg), fruit yield/ha (28.83 t/ha) and percent increase in yield (76.40 %) over control have been observed with the treatment of T₇ [RDF +

100 g Zinc sulphate + 50 g Copper sulphate + 50 g Borax (Soil application) in basin after harvest + Foliar spray of 0.2% Zinc sulphate + 0.1% Copper sulphate + 0.1% Boric acid (2 sprays at just before flowering and marble stage)] in mango cultivar Dashehari.

- v. **Evaluation of different rootstocks of mango:** This is a new trial and has been started in 2018. The plants are in vegetative phase.
- vi. **Evaluation of different rootstocks of mango for problematic soil:** The trial has been initiated in two mango cultivars namely Dashehari and Langra in the year 2015 and plants are in juvenile phase.

Crop: Guava

Achievements made from concluded trials:

- i. **Release of new varieties in guava:** One guava variety namely Pant Prabhat (Soft seeded and white flesh with distinct aroma) has been released in the year 2004 for cultivation.
- ii. **Evaluation of commercial varieties of guava:** Among twelve evaluated varieties of guava, the Sardar (Lucknow-49) and Pant Prabhat gave higher yield (82.77, 79.33 kg/tree/year, respectively) and the same have been recommended for commercial cultivation.
- iii. **Planting system cum high density planting in guava:** The double hedge row system has been recommended in guava, which gave higher yield (287.15 q/ha) as compared to square system (169.00 q/ha). The yield was increased by 69.88 per cent.
- iv. **Evaluation of substrate dynamics for IPNM in guava:** The treatment comprising ½ dose of recommended fertilizers + 50 kg FYM + 250g *Azospirillum* gave maximum yield (104.87 q/ha). The yield was increased by about 27.69 per cent over control (i.e. 500 g : 200 g : 500 g NPK/tree).

Ongoing trials:

- i. **Testing the performance of new promising**

hybrids/selection of guava: New ongoing trial.

- ii. **Enhancing the input use efficiency in guava under HDP:** New ongoing trial.
- iii. **Evaluation of Arka Microbial Consortium (AMC) for guava:** New ongoing trial.

Crop: Litchi

Achievements made from concluded trials:

- i. **Planting system cum high density planting in litchi:** Double Hedge row system of planting (accommodating 222 plants/ha) has been recommended for higher yield (60.10% more yield as compared to square system) in litchi cv. Rose Scented.
- ii. **Standardization of pruning after harvesting of litchi:** Harvesting of fruits with 50 cm branch and removal of new flushes in Nov.-Dec. could be used for getting higher yield (26.6% more yield) in litchi cv. Rose Scented.
- iii. **Evaluation of substrate dynamics for IPNM in litchi:** Application of ½ RDF + 50 kg FYM + 5 kg Vermi-compost has been recommended to improve fruit yield (50.76% more yield compared to control (i.e. 1000:500:500 g NPK/tree) and quality in litchi cv. Rose Scented.
- iv. **Improving bearing potential of litchi through girdling of branches:** Girdling of 50% of primary branches with 6 mm wide cut performed in month of September has been found effective for increased yield (41.0% more yield as compared to non-girdled tree) with good quality fruits in litchi cv. Late Bedana.
- v. **Extension of harvesting period in litchi:** Use of shed net (30-50%) has extended the harvesting period upto 11-13 days in litchi cv. Rose Scented.
- vi. **Evaluation of PGR and chemicals for early flowering in Litchi:** Spray of K_2HPO_4 (1%) + KNO_3 (1%) was found effective to increase flowering intensity, total no. flowers/panicle, fruits/panicle, fruit weight, yield and TSS in litchi cv. Rose Scented.
- vii. **Method of training in litchi:** The maximum fruit

yield in litchi is obtained from the trees trained on modified leader system.

- viii. **Control of fruit cracking in litchi:** The eco-friendly, convenient and economical technology of at least three (or more) water sprayings on litchi trees starting from 15th April have been recommended for minimizing the extent of fruit cracking and obtaining increased fruit yields of good quality and earning higher profits provided nutritional deficiencies do not exist in the orchard.

Crop: Peach and Pear (up-to the year 1996 - earlier low chill temperate fruits were also in AICRP on Fruits but now mango, guava and litchi are mandate crops)

Achievements made from concluded trials:

- i. **Evaluation of peach varieties:** Based on varietal trials, peach cvs. Flordasun & Saharanpur Prabhat; and plum cv Titron have been found promising from yield, fruit quality and earliness point of view and they have been recommended for commercial cultivation.
- ii. **Evaluation of peach varieties for canning:** For canning, the peach cv Flordasun has been found best. The cv Crawford's Early, a canning type from temperate zone of Kumaon Hills was rated on the sixth position.
- iii. **Nutritional trial in peach:** In peach, 450 g N and 200 g each of P₂O₅ and K₂O per tree to 5 years and above aged trees are recommended as these doses give optimum status of nutrients in leaves. These doses also give best results with regard to tree height, spread, flowers per metre, fruiting shoot, fruit-set and fruit yield.
- iv. **Standardization of planting distance in peach:** Peach tree spread has been observed between 5 to 6 metres. Hence planting distance for standard peach trees is recommended as 6 metre in both ways.
- v. **Standardization of planting distance in plum:** Plum tree spread has been observed around 5 metre. Hence, planting distance for standard plum trees is recommended as 5 metre in both ways.

- vi. **Evaluation of pear varieties:** Based on germplasm and varietal trails, the pear cv Gola has been found promising and hence it has been recommended for commercial cultivation in the Trial region of Uttarakhand.

A. Fruit Entomology:

1. Significant Achievements:

- i. **Survey and surveillance of insect pests and their natural enemies in Mango:** A total of 57 insects species were recorded in the mango orchards in Tarai and plains of Uttarakhand. Among them 23 species were considered as pests attacking at various stages of mango, 11 species as natural enemies on different pest and 27 insects as insect pollinators. Mango hopper (*Amritodus atkinsoni*, *Idioscopus* spp.), mealy bug (*Drosicha mangifera*) mango shoot gall (*Apsylla cistellata*) and fruit fly (*Bactrocera dorsalis*) were observed as major pest on mango. Mango fruit borer, *Citripestis eutrapphera* (Meyrick) (Lepidoptera: Pyralidae) was recorded as new emerging pest on mango and causing extensive damage to immature fruits at Pantnagar. Beside these pests, various defoliating beetles, weevils, lepidopterous larvae, borers and scales were also recorded as minor pests in various orchards of different regions of the state. Various natural enemies like spiders, coccinellids and *Chrysoperla*, Reduviidae & Cantheconidae predatory bugs, damselflies, dragonflies, praying mantis and different insect parasitoids were also found to be associated with mango ecosystem.
- ii. **Management of mango hoppers:** Recommendations were made in form of



technology for the effective management of mango hoppers. Two to three sprays of Imidacloprid (at panicle initiation stage) Thiamethoxam (at pea stage) and NSKE (need based spray) gave significant result in reducing the hopper population as well as gave high yield.

- iii. **Monitoring and management of fruit flies in mango and guava:** Capturing the males of adult fruit flies through methyl eugenol traps with hanging of wooden block (5x5x1 cm) in plastic bottle soaked in solution in ratio of 6:4:1 (alcohol: methyl eugenol: DDVP) used @ 10 traps/ha) were found most effective monitoring and management practice for fruits flies in mango and guava without any foliar sprays on fruits.
- iv. **Management of mango shoot gall:** Three sprays of pesticide along with sticker viz. Quinolphos, Monocrotophos and Dimethoate in the month of August –September at 15 days interval with pruning of galls bearing braches in the month of October were recommended as effective management practices.
- v. **Management of mango mealy bugs:** IPM package with application of 400 gauge and 25 cm. wide alkathene/polythene sheet wrapped around the basal portion of tree trunk is recommended as best technology for the management of mango mealy bugs eithout any pesticide application.
- vi. **Documentation of insect pollinators in mango:** The activity of pollinators was started in the mid month of the February to first week of March with initiation of flowering in tarai of Uttarakhand. The major insect pollinators observed on mango flowers belonged to the orders-Diptera and Hymenoptera. Among the dipterans, syrphids flies were most dominating as they represented by highest number of species included *Episyrphus balteatus* DeGeer, *Melanostoma orientale* Weid, *Syrphus corollae* Fab. and *Eristalis tenax* L. Among hymenopterans, *Apis* species: *Apis dorsata*, *A. cerana* and non *Apis* species *Tetragonula iridipennis* Smith and *Xylocopa aestuans* L. were recorded on mango flowers. However, pesticide sprays applied on flowering stage cause harmful effect on insect pollinators with about 50 per cent reduction in the pollinator's population.
- vii. **Survey and surveillance of insect pests and their natural enemies in litchi:** Fruit borers, *Conopomorpha cramerella* (Snellen), *C. litchiella* (Bradley), leaf curl mite, *Eriophyes (Aceria) litchi* (Keifer) and leaf roller, *Tortrix epicyrta* (Meyrick) and *Platypeplus aprobola* (Meyrick) were recorded as major insect pests in litchi.
- viii. **Management of litchi fruit borer:** Two sprays with flubendiamide 39.35 SC (0.008%) or spinosad 45 SC (0.014%) at weekly interval during marble and colour break stage provide significant results as compared to conventional pesticides in terms of low infestation and higher yield.
- ix. **Management of litchi leaf curl mite:** Pruning of infested litchi leaves, shoots and destruction by burning after harvesting of fruits in the month of June with spraying Dicofol at the time of new flush gave best result in reducing mite infestation (62.84%) and higher yield 34.33 Kg/tree yield over control(1.67kg/tree)
- x. **Surveillance of insect pollinators in litchi:** The activity of pollinators started in the mid of March with initiation of the flowers. The hymenopterans constituted major group of insects visiting on litchi flowers of these, the bees of the family Apidae and dipterans (syrphids) were the major visitors. The hymenopterans constituted major group of insects visiting on litchi flowers of these, the bees of the family Apidae and subfamily Melliponinae and Xylocopinae were the key visitors. The Apinae was represented by three main species of the *Apis* viz., *A. dorsata* Fab., *A. mellifera* L., and *A. cerana indica* Fab. Among the non apis bees subfamily melliponinae (*Trigona* spp.) and Xylocopinae (*Xylocopa aestuans* L.) were also observed. The syrphids species included *Episyrphus balteatus* DeGeer, *Melanostoma orientale* Weid, *Syrphus corollae*

Fab. and *Eristalis tenax* L.

- xi. Monitoring of insect pest in Guava:** The major insect pests recorded in guava ecosystem were Fruit borer, *Dichocrosis punctiferalis*; fruit fly, *Bactrocera dorsalis*; Mango mealy bug, *Drosicha mangiferae* (Green); Aphid, *Myzus persicae*; Coccids, *Chloropulvinaria psidii*; Semilooper; Anar butterfly, *Deudorix (Virachola) isocrates*; Leaf cutter bee *Mechachile* sp., *Spodoptera litura* and Defoliating beetles.

2. Research Publications:

- Chauhan, D. and Srivastava, P. (2017). Feeding inhibitory activity of different medicinal plant oils against *Papilio demoleus* L. *Journal of Entomology and Zoology Studies*, 5(1): 631-635.
- Chauhan, D. and Srivastava, P. (2017). Growth and development inhibitory activities of medicinal plant oils against lemon butterfly. *Journal of Experimental Biology and Agricultural Sciences*, 5 (2): 258-263.
- Chauhan, D. and Srivastava, P. (2018). Evaluation of effectiveness of various insecticides for the management of Citrus psylla, *Diaphorina citri* Kuwayama. *International Journal of Chemical Studies*, 6(2): 1043-1051.
- Chauhan, D.; Srivastava, P. and Mishra, V.K. (2018). Impact of Abiotic Factors on Population Dynamics of Citrus Psylla, *Diaphorina citri* Kuwayama. *J. Exp. Zool. India*. 21 (1) 221-226.
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- Managanvi, K.; Khan, M.S. and Srivastava, P. (2012). Foraging activity of Stingless Bee (*Trigona laeviceps*). *Indian J. Agric. Res.*, 3(1): 168-171.
- Rai, V.L. and Srivastava, P. (2012). Studies on the impact of bee pollination on yield and quality of litchi (*Litchi chinensis* Sonn.). *Progressive Horticulture*, 44(2): 262-264.
- Rai, V.L.; Srivastava, P.; Bisht, K. and Mishra, V.K. (2017). Diversity and relative abundance of pollinating insects visiting litchi (*Litchi chinensis* Sonn.) Inflorescence under Tarai agro-climatic condition. *J. Exp. Zool. India*, 20(1): 221-227.
- Usha and Srivastava, P. (2018). Foraging Reward and Foraging Behavior of Insect Visitors on Mango Flowers during Blooming Period. *Int. J. Pure App. Biosci.*, 6 (3): 437-440.
- Usha; Srivastava, P. and Goswami, V. (2014). Diversity of floral insect visitors of mango during blooming period at Pantnagar. *Indian Journal of Agriculture Science*, 84(3): 363-364.

3. Thesis Research:

- Jyoti Raina (2018). Bio-Intensive Pest Management Strategies for Mango Shoot Gall Psylla, *Apsylla cistellata* Buckton. (Ph.D.), submitted to GBPUAT under guidance of Dr. Poonam Srivastava.
- Usha (2008). Studies on Diversity Of Insect Pollinators And Their Impact On Fruit Setting In Major Fruit Crops At Pantnagar. (M.Sc.), submitted to GBPUAT under guidance of Dr. Poonam Srivastava.
- Usha (2013). Studies on insect pollinators in mango and potential of repellents to reduce pesticidal hazards to domesticated bee pollinators. (Ph.D.), submitted to GBPUAT under guidance of Dr. Poonam Srivastava.

B. Fruit crops –Pathology:

1. Significant Achievements:

- Orchard surveys were made on the status of major diseases in the mango growing districts of Udam Singh Nagar. Powdery mildew, malformation, anthracnose, bacterial black spot and sudden

decline are important diseases and widely distributed in most of the mango growing areas of Udam Singh Nagar. All the diseases which inflict heavy losses in the orchards (8 to 75%) of Udam Singh Nagar. We provide 5 keys for the assessment of important mango diseases. All of which have been prepared from the disease (symptom) appearance to development on different part of mango trees. Twenty mango cultivars were investigated during 2013 and 2014 for their susceptibility level to PM, MA, MM, and BBS in HRC, Patharchatta of Udam Singh Nagar. Development of powdery mildew is favoured by T max range of 20-26°C, T min of 16°C, RH <70% and dry weather especially during February-March. For anthracnose of T max up to 28°C and T min of 16-20°C and RH >70% with intermittent rains proved most effective for disease development. Rasgulla and Redtotapari were resulted in minimum apparent infection rate (0.038 and 0.048 per unit per day), AUDPC (37.41 and 35.05) and also screened out to be resistant against Anthracnose of mango. Similarly, for floral malformation, a T range of 18-30°C with high RH was considered optimal for its progress. Bacterial black spot is favoured by a T range of 24-30°C with high RH. A reduced period of sunshine with rainfall up to 120 mm during fruit development favours the bacterial black spot. Minimum r and AUDPC was found in only one cultivar 'chausa' against floral malformation (0.026 per unit per day and 39.39) and bacterial black spot (0.032 per unit per day and 34.92) in the both respective years. The coefficient of multiple determination R² value of twenty cultivars showed that variation of disease incidence in the development of disease can be explained up to 94% (max) in powdery mildew, 98% (max) in Anthracnose, 99% (max) in floral malformation as well as 95% (maximum) in bacterial black spot with combined effect of the weather variables. A regression equation of twenty cultivars were also derived which will be useful in the prediction of above four important disease of mango in Uttarakhand.

➤ Progression of anthracnose (*Glomerella*

cingulata (Stoneman) Spauld and H. Schrenk (anamorph: *Colletotrichum gloeosporioides* (Penz) Penz & Sacc) was studied in twenty popular varieties of mango for two years revealed that generally disease progress slowly during the month of March – April. The disease development is comparatively more during May-July. Out of these, none of the variety was found resistant to mango anthracnose. However, three varieties namely, Kesar Basti, Amrapali and Romani were moderately resistant to *C. gloeosporioides*. Rest of the varieties were either susceptible or highly susceptible of these leaf spot diseases. Pant Sinduri, Kesar, Mallila and Dushree were found to be highly susceptible (> 75%) and are not suitable for the region. The disease incidence were found to be higher in both year i.e. 88.0 (Pant Sinduri), 82 (Dushree) and 78.3 percent (Mallika) when the rainfall was 420, 413 and 415 mm respectively. Multiple regression equation between disease incidence and environmental factors explain hundred percent roles in progression of disease incidence to be due to above mentioned environmental factors in all the cultivars at the Horticulture Research Centre, GBPUAT, Pantnagar.

➤ One pre-harvest spray of Azoxystrobin or antagonist, *Trichoderma harzianum* + *Pseudomonas fluorescens* at 10 days before harvest to reduce the incidence of post harvest diseases of cv. Langra, Chausa and Amrapali fruits. In post harvest dip treatment of fruits with Azoxystrobin, or *Trichoderma harzianum*+*Pseudomonas fluorescens* found promising against the anthracnose during storage and proved most effective in reducing anthracnose severity in cv. Langra, Chausa and Amrapali. The residue of Azoxystrobin was below the minimum permissible residue limit. Therefore, it is safe to be used as post harvest mango treatment. Reduced post harvest anthracnose losses in cv. Langra, Chausa and Amrapali fruits treated with one spray of Salicylic acid and oxalic acid during storage. Hot water treatment practices for 15 minutes at 52°C was most effective and very important to effectively manage post harvest diseases in cv.

Langra, Chausa and Amrapali.

- Guava wilt is soil borne disease involve *Fusarium oxysporum* and *F. Solani*. Wilt disease in guava was effectively controlled by the application of *Bacillus amyloliquefaciens*, Compost and Pant bioagent-3 (*Trichoderma harzianum* + *Pseudomonas fluorescens*) in place of systemic fungicides like Carbendazim + Mancozeb, Propiconazole and Propiconazole + Carbendazim.

2. Research Publications:

- Arvind, S.; Lal, S.; Singh, C. P.; Guru, S. K. and Kumar, R. (2018). Effect of leaf to fruit ratios on the physico-chemical quality of guava (*Psidium guajava* L.) cv. Pant Prabhat planted under high density. *International Journal of Chemical Studies*, 6(2): 2332-2335.
- Bhatt, A.; Mishra, N.K.; Mishra, D.S. and Singh, C.P. (2012). Foliar application of potassium, calcium, zinc and boron enhanced yield, quality and shelf life of mango. *HortFlora Research Spectrum*. 1(4): 300-305.
- Bora, L., Singh, A.K., Kumar, A. and Metwal, M. (2018). Morphological and microsatellite marker based polymorphic assessment of genetic diversity and relationship of mango (*Mangifera indica* L.). *Indian Journal of Biotechnology*, 17: 91-100.
- Chand, S.; Bhatt, A.; Chandola, J. C.; Srivastava, R.; Kumar, R. and Nirgude, V. (2017). Effect of chemicals and cincturing on flowering, fruiting and yield of litchi cv. Rose Scented. *International Journal of Chemical Studies*, 5(6): 244-247.
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- Chandra, D.; Kumar, R. and Misra, K.K. (2011). Effect of low cost wrapping and cushioning materials on physico-chemical properties of guava (*Psidium guajava* L.) fruits. *Progressive Horticulture*, 43(1): 130-133.
- Dimri, D.C.; Rao, V.K.; Singh, A.K.; Pandey, Y. and Pandey, K.K. (2017). Efficacy of Blossom Thinners on Flowering, Fruit Retention and Yield Attributes in Plum (*Prunus Saliciana* L.) cv. 'Kala Amritsari'. *Chemical Science Review Letters*, 6(21): 64-68.
- Dubey, M.; Chandra; Kumar, R.; Kumar, A. and Kohli, K. (2016). Evaluation of different guava (*Psidium guajava* L.) genotypes under Tarai condition of Uttarakhand. *The Bioscan*. 11(3):1765-1770.
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- Joshi, R.; Singh, C.P. and Dharmi, V. (2013). Morpho-phenological characteristics of mango cultivars under Tarai conditions. *Pantnagar Journal of Research*. 11(3):373-377.
- Joshi, P.; Lal, S.; Nautiyal, P. and Mahesh, P. (2016). Effect of plant spacing and pruning intensity on yield and fruit quality of guava (*Psidium guajava* L.) cv. Pant Prabhat. *International Journal of Basic and Applied Agricultural Research*, 14(2): 192-196.
- Kumar, J.; Kumar, R.; Rai, R. and Mishra, D.S. (2015). Response of Pant Prabhat guava trees to foliar sprays of zinc, boron, calcium; and potassium at different plant growth stages. *The*

- Bioscan*, 10(2):495-498.
- Kumar, R.; Lal, S. and Kumar, M. (2011). Effect of post harvest packaging material and calcium treatment on the quality of guava during Storage. *Annals of Horticulture*, 4(2): 165-170.
- Kumar, J.; Kumar, R.; Tripathi, S. and Singh, V.J. (2017). Physico-chemical and morphological evaluation of guava (*Psidium guajava* L.) genotypes under Tarai condition. *HortFlora Research Spectrum*, 6 (1): 97-101.
- Kumar, P, Singh, A.K. and Shankhdhar (2017). Efficacy of soil and foliar application of macro and micro nutrients on yield and quality of mango cv. Dashehari. *Journal of Applied and Natural science*, 9(4):2199-2204.
- Kumar, P. and Singh, A.K. (2018). Effect of soil and foliar application of macro and micronutrient concentration in soil and leaves of mango (*Mangifera indica* L.) cv. Dashehari. *International Journal of Chemical Studies*, 6(2):3446-3451.
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3. Thesis Research:

- A.K. Goswami (2008). Effect of integrated plant nutrient management on growth, yield and quality of guava (*Psidium guajava* L.) cv. Pant Prabhat. (Ph.D.), submitted to GBPUAT under guidance of Dr. Shant Lal.
- Amit Bhatt (2016). Effect of chemicals and cinturing on flowering, fruit yield and quality of Litchi cv. Rose Scanted. ((M.Sc.), submitted to GBPUAT under guidance of Dr. Satish Chand.
- Amit Narain Singh (2008). Effect of planting system-cum-high density planting on quantitative and qualitative characters of mango (*Mangifera indica* L.) cv. Dashehari. (M.Sc.), submitted to GBPUAT under guidance of Dr. C.P. Singh.
- Anju (2009). Response of nutrients spray on yield and quality attributes of mango. (M.Sc.), submitted to GBPUAT under guidance of Dr. C.P. Singh.

- Aradhana Singh (2014). Studies on morphological and physio-chemical characteristics of mango (*Mangifera indica* L.) varieties. (Ph.D.), submitted to GBPUAT under guidance of Dr. C.P. Singh.
- Arun Kumar Tiwari (2011). Effect of paraffin liquid and packaging materials on shelf life and quality of mango fruits Cv. Dashehari. (Ph.D.), submitted to GBPUAT under guidance of Dr. C.P. Singh.
- Deena Wilson (2016). Studies on efficacy of coating materials and chemicals on the shelf-life and quality of mango cv. Langra. (Ph.D.), submitted to GBPUAT under guidance of Dr. Ashok Kumar Singh.
- Deepak Ravel (2012). Effect of post harvest treatment of organic acid and polysaccharide for enhancing shelf life of litchi cv. Rose scented. (M.Sc.), submitted to GBPUAT under guidance of Dr. N.K. Mishra.
- Deepika Chauhan (2016). Studies on population dynamics of citrus psylla and biological attributes of lemon butterfly alongwith their management. (Ph.D.), submitted to GBPUAT under guidance of Dr. Poonam Srivastava.
- Gaya Prasad (2008). Effect of pre harvest foliar spray of nutrients on fruit quality and shelf life of mango cv. Dashehari. (M.Sc.), submitted to GBPUAT under guidance of Dr. Ashok Kumar Singh.
- Hitesh Agarwal (2017). Impact of girdling on flowering, fruiting and yield attributes in litchi cv. Late Bedana. (M.Sc.), submitted to GBPUAT under guidance of Dr. Satish Chand.
- Jitendra Chandola (2012). Morphological and biochemical characterization of litchi cultivars (*Litchi chinensis* Sonn.). (M.Sc.), submitted to GBPUAT under guidance of Dr. D.S. Mishra.
- Jitendra Chandola (2018) Evaluation of promising chemicals to enhance flowering, fruiting and shelf life of litchi (*Litchi Chinensis* Sonn.). (Ph.D.), submitted to GBPUAT under guidance of Dr. Satish Chand.
- Jitendra Kumar (2014). Effect of foliar spray of different nutrients on physico-chemical properties of guava (*Psidium guajava* L.) cv. Pant Prabhat. (M.Sc.), submitted to GBPUAT under the guidance of Dr. Rajesh Kumar.
- Kamlesh Kumar (2011). Response of paclobutrazol on growth, flowering and yield attributes of mango (*Mangifera indica* L.) cv. Dashehari. (M.Sc.), submitted to GBPUAT under guidance of Dr. C.P. Singh.
- Khushbu Kholiya (2012). Effect of modified microclimate on quality of litchi fruits. (Ph.D.), submitted to GBPUAT under guidance of Dr. N.K. Mishra.
- Krishna Kant Dangi (2015). Studies on floral biology, fruit set and yield in different cultivars of mango (*Mangifera indica* L.). (M.Sc.), submitted to GBPUAT under guidance of Dr. Ashok Kumar Singh.
- Krishna Madhav (2014). Studies on intergrated nutrient management in mango (*Mangifera indica* L.) cv. Dashehari. (Ph. D.), submitted to GBPUAT under guidance of Dr. Ashok Kumar Singh.
- Lokesh Bora (2014). Agro-morphological, biochemical and molecular characterization of promising hybrids and selection of mango. (M.Sc.), submitted to GBPUAT under guidance of Dr. Ashok Kumar Singh.
- Mahesh Pal (2015). Response of different high density spacings on growth, yield and quality of guava (*Psidium guajava* L.) cv. Pant Prabhat. (Ph.D.), submitted to GBPUAT under guidance of Dr. Shant Lal.
- Meenakshi Joshi (2006). Effect of micronutrients on yield and quality of mango (*Mangifera indica* L.) cv. Dashehari. (M.Sc.), submitted to GBPUAT under guidance of Dr. C.P. Singh.
- Mohit Kumar (2010). Response of organic manures on growth, yield, quality and shelf life of mango

- (*Mangifera indica* L.) cv. Dashehari. (Ph.D.), submitted to GBPUAT under guidance of Dr. C.P. Singh.
- Mukesh Chandra Dubey (2015). Morphological and biochemical characterization of guava (*Psidium guajava* L.) germplasm Prabhat. (M. Sc.), to submitted to GBPUAT under the guidance of Dr Rajesh Kumar.
- Mukunzi Baseke Thierry (2017). Effect of post-harvest treatments on quality and shelf life of mango *Mangifera indica* L.) cv.Langra. (M.Sc.), submitted to GBPUAT under guidance of Dr. C.P. Singh.
- Naganagouda Patil (2012). Effect of pre-harvest treatment on yield, quality and shelf life of (*Litchi chinensis* Sonnn) cv. Rose scented. (Ph.D.), submitted to GBPUAT under guidance of Dr. N.K Mishra.
- Namita Bora (2003). Standardization of air layering in litchi cultivars. (M.Sc.), submitted to GBPUAT under guidance of Dr. R.L. Lal.
- Neha Kunjwal (2016). Studies on biological parameters and domiciliation of native Megachilid bee pollinators. (Ph.D.), submitted to GBPUAT under guidance of Dr. Poonam Srivastava.
- Nidhi Rathore (2006). Effect of foliar application of micronutrients on yield and quality of litchi (*Litchi chinensis* Sonnn.) cv. Rose scented. (M.Sc.), submitted to GBPUAT under guidance of Dr. N.K Mishra.
- Pankaj Kumar (2017). Studies on soil and foliar application of macro and micronutrients on yield and quality of mango (*Mangifera indica* L.) cv. Dashehari. (M.Sc.), submitted to GBPUAT under guidance of Dr. Ashok Kumar Singh.
- Pooja Devi (2018). Effect of fertigation on vegetative growth, yield and quality of mango cv. Pant Sinduri. (M.Sc.), submitted to GBPUAT under guidance of Dr. C.P. Singh.
- Pooja Pant (2013). Enhancement of efficacy in extending shelf life and quality of mango cv. Dashehari by pre and post harvest chemicals applications. (Ph.D.), submitted to GBPUAT under guidance of Dr. C.P. Singh.
- Pradeep Sagar Kushwaha (2010). Effect of post harvest treatments on shelf life and fruit quality of mango cv. Dashehari. (M.Sc.), submitted to GBPUAT under guidance of Dr. Ashok Kumar Singh.
- Pradyot Nalini (2016). Response of inorganic and organic fertilizers on soil nutrient status, yield and quality of litchi (*Litchi chinensis* Sonn.) cv. Rose Scanted. (M.Sc.), submitted to GBPUAT under guidance of Dr. Satish Chand.
- Pratibha (2005). Studies on morphological and reproductive traits of guava cultivars. (M.Sc.), submitted to GBPUAT under guidance of Dr. Shant Lal.
- Pratibha (2008). Response of planting systems and pruning on growth, yield and quality of guava (*Psidium guajava* L.). (Ph.D.), submitted to GBPUAT under guidance of Dr. Shant Lal.
- Priyamvada Pandey (2013). Characterization of *Psidium* spp. using morphological and molecular markers. (M. Sc.) submitted to GBPUAT under the guidance of Dr Rajesh Kumar
- Sanjay Kumar Singh (2004). Effect of fertigation and plastic mulch on growth, yield and fruit quality of mango cv. Dashehari. (M.Sc.), submitted to GBPUAT under guidance of Dr. C.P. Singh.
- Satyendra Singh Narvariya (2014). Efficacy of cultar from new source on growth, flowering and yield behaviour of mango (*Mangifera indica* L.) cv. Dashehari. (M.Sc.), submitted to GBPUAT under guidance of Dr. C.P. Singh.
- Satyendra Singh Narvariya (2016). Classification of different varieties and new accessions of mango (*Mangifera indica* L.) based on qualitative traits and assessment of genetic diversity. (Ph.D.), submitted to GBPUAT under guidance of Dr. Ashok Kumar Singh.

Satyendra Singh Negi (2009). Effect of nutrients on yield and quality of mango cv. Dashehari. (M.Sc.), submitted to GBPUAT under guidance of Dr. Ashok Kumar Singh.

Shailendra Kumar Verma (2008). Effect of pre-harvest spray of mineral nutrients and fungicide on shelf life of litchi (*Litchi chinensis* Sonn.) cv. Rose scented. (M.Sc.), submitted to GBPUAT under guidance of Dr. N.K Mishra.

Sneha Pawar (2011). Studies on flowering and qualitative traits of mango varieties. (M.Sc.), submitted to GBPUAT under guidance of Dr. Ashok Kumar Singh.

Sonali (2013). Response of IBA concentrations and application dates on the performance of air layering in litchi cultivars. (M.Sc.), submitted to GBPUAT under guidance of Dr. Satish Chand.

Tanuja phartiyal (2010). Studies on various insect-pest fauna associated with citrus eco system at Pantnagar. (M.Sc.), submitted to GBPUAT under guidance of Dr. Poonam Srivastava.

Tanuja phartiyal (2014). Role of some plant extracts and insecticides against major insect pests of citrus with special reference to dissipation study of Imidacloprid. (Ph.D.), submitted to GBPUAT under guidance of Dr. Poonam Srivastava.

Vijay Laxmi Rai (2011). Studies on integrated approaches for enhancing litchi (*Litchi chinensis* Sonn.) fruit production. (M.Sc.), submitted to GBPUAT under guidance of Dr. Poonam Srivastava.

Yamuna Pandey (2013). Evaluation of hybrids and selections of mango (*Mangifera indica* L.) under tarai region of Uttarakhand. (M.Sc.), submitted to GBPUAT under guidance of Dr. Ashok Kumar Singh.

4. Awards/Honours

1. Bagged **five prices** (03 First + 01 Second + 01 Third) for GBPUA&T, Pantnagar in “All India

Mango Show” during “Global Conference held at Lucknow in June, 2011, organized by Central Institute for Sub Tropical Horticulture, Lucknow.

2. Bagged **six prices** (05 First + 01 Second) for GBPUA&T, Pantnagar in “Uttarakhand Mango Festival” held at Dehradun in July, 2017, organized by Horticulture and Food Processing Department, Uttarakhand.

3. Bagged six prizes (**02 first + 04 Second**) for GBPUAT, Pantnagar in “**National Mango Festival 2018**” held at Dehradun w.e.f. 16th - 17th July, 2018, organized by Horticulture and Food Processing Department, Uttarakhand.

Awards to Dr.A.K.Singh:

4. **Best Poster Paper Presentation award** on mango in the “Global Conference on Augmenting Production and Utilization of Mango”, at Lucknow in June, 2011.

5. **Appreciation award for significant research work** under “All India Coordinated Research Project on STF”, Periyakulam, Tamilnadu in 2011.

6. **Best Oral Paper Presentation award** on mango in the “International Symposium on New-Dimension” in Agrometrology at Pantnagar in 2014.

7. **Best Teaching Practices Award –2014** conferred by Dean College of Agriculture, GBPUA&T, Pantnagar on January 01, 2015.

8. **Best Oral Paper Presentation Award** on mango in the “National Symposium on Innovations in Horticulture: Production to Consumption at Pantnagar in 2017.

9. **Best lead presenter award** during VI- Group Discussion of ICAR-All India Coordinator Research Project on Fruits at AAU, Jorhat, Assam in 2019.

Awards to Dr. Poonam Srivastava

10. **Best Teaching Practice Award - 2016** conferred by Dean College of Agriculture,

GBPUA&T, Pantnagar on January 01, 2017.

11. **Best Lead Presenter Award- 2015** by DDG Horticulture, ICAR during the 2nd group discussion of AICRP on Fruits at MPUA&T, Udaipur on March 01, 2015.
12. **Best Abstract Award 2018** in “2nd International online Conference on Biological Sciences” for excellent contribution in the article entitled: Relationship of shoot gall psylla (*Apsylla cistellata* Buckton) oviposition with gall formation, panicle initiation and adult emergence in mango.

Awards to **Dr. Satish Chand:**

12. **Best Poster Paper Presentation award** on litchi in the “National Symposium on Innovation in Horticulture: Production to Consumption”, at Pantnagar in 2017.

Awards to **Dr. C.P. Singh**

13. **Indian Society of Horticultural Research & Development, Uttarakhand** conferred ISHRD Fellowship for outstanding contribution in the field of Horticulture in September, 2004.
14. **G.B.P.U.A & T, Pantnagar** recognized the significant contribution in the field of Mango Improvement as an outstanding staff member in November, 2004.
15. **The Society for Development of Subtropical Horticulture (SDSH)** conferred SDSH Fellowship on occasion of Global Conference on Augmenting Production and Utilization of Mango: Biotic and Abiotic Stresses at CISH, Lucknow, June 21-24, 2011.
16. **The Society for Scientific Development in Agriculture and Technology** conferred Life Time Achievement Award on the occasion of international conference on GRISAAS-2017 at MPUAT- RCA, Udaipur (Raj), 02-04 December, 2017.

4. Future Thrusts:

The following will be future plan of work under

AICRP on fruits to increase the farmer’s income and strengthen the knowledge.

- i. Distribution of superior hybrids/clones of fruits among the farmers.
- ii. Promotion of high density planting.
- iii. Canopy management and training systems.
- iv. Nutrient management through fertigation and fertilizer scheduling.
- v. Rejuvenation of old and senile orchards.
- vi. Promotion of organic farming.
- vii. Promotion of mulching in fruit crops.
- viii. Control of blackening in late maturing varieties of mango.
- ix. Promotion of low chill cultivars of peach and plum as filler crops and intercropping.
- x. Crop regulation.
- xi. Girdling of litchi (cv. Late Bedana) branches to improve the bearing.
- xii. Control of litchi browning and cracking through micro sprinkler
- xiii. Bagging of fruits to improve the fruit quality.
- xiv. Conservation and utilization of beneficial insects for sustainable and eco-friendly pest management program by reducing the number of pesticide sprays.
- xv. By keeping honey bee boxes in the orchards to enhance the pollination and to generate extra income through production and marketing of bee products.
- xvi. By avoiding pesticide application at flowering stage to improve the quality and quantity of fruit yield through good pollination service.
- xvii. By following cluster based crop wise pest management program instead of single pest management to reduce the input cost.