Annual Report

2018 – 19

ICAR-Central Institute of Temperate Horticulture
Old Air Field, PO-Rangreth, Srinagar 191132
Jammu and Kashmir, India

Published by:
Dr. Desh Beer Singh
Director

Compiled & Edited by:
Dr Desh Beer Singh
Dr. O.C. Sharma
Dr. J.I. Mir
Dr. Anil Sharma
Dr Raj Narayan
Dr Arun Kishore
Dr. Geetika Malik
Dr K L Kumawat
Dr W H Raja
Dr Selvakumar R.
Mr. S.U. Nabi

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ICAR-Central Institute of Temperate Horticulture
Old Air Field, P.O.-Rangreth-191132, Srinagar (J&K)
Phone: 91-194-2305044, 2305045
E-mail: dircithsgr@icar.org.in

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Mobile: +91 9811622258

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Executive Summary

The ICAR-Central Institute of Temperate Horticulture is focusing on conservation, evaluation, improvement, production, protection and commercialization of temperate horticultural crops in temperate region of the country. Institute has emerged as an apex centre for generation of farmer friendly technologies during last few decades in various temperate horticultural crops. The Institute along with its two Regional Stations is continuously carrying out need based research on temperate horticultural crops to boost the productivity and quality of temperate horticultural crops. The number of technologies generated at ICAR-CITH is increasing year after year. Presently farmers have adopted many technologies to boost the productivity of their farms. To cater the need of farmers associated with temperate horticultural crops, the research work carried out by the Institute and its Regional Stations during 2018-19 are briefly summarized below:

Crop Improvement

The germplasm is the main wealth of any Institute which can be used to breed the new cultivars or to tackle the problems in future. The collection, evaluation and characterization of germplasm of horticultural crops are the major objectives of the Institute. The Institute has added 120 new germplasm in its field gene bank and its number has reached to 2742 at main centre Srinagar, J&K while Regional Station Mukteshwar is maintaining more than 350 germplasm lines of various fruit, vegetable and flower crops.

In apple, sixty genotypes were analyzed for their phenolic content and antioxidant activity which revealed significant variability in catechin concentration which ranged from 109.98 to 5290.47 µg/g, and the rutin concentration ranged from 12.136 to 483.89 µg/g of apple fruit. Antioxidative and free radical scavenging potential was also deciphered across the sixty apple genotypes. The level of DPPH activity ranged from 9.04% to 77.57%, and almost half of the 15 genotypes showed below 30–40% DPPH activity. For estimating the stability of the fruit quality traits of the columnar cultivars four columnar apple cultivars viz Redlane, Goldlane, Sunlight and Moonlight, maximum number of fruits (180) were set in cultivar Redlane followed by Goldlane with 95 fruits and highest fruit weight (160 g) was observed in Goldlane followed by Sunlight (150 g) and Moonlight (110 g). Columnar apple cultivars showed very good anti-oxidative and free radical scavenging potential as revealed by DPPH assay but these cultivars are acidic in taste. Apple selections representing scab resistant, cultivars with variable fruit quality and selections from *Malus baccata* species were evaluated for different physicochemical traits and maximum fruit weight (270 g) was recorded in apple cultivar CITH-Apple-SR-03 and CITH-Apple-SR-01. Highest firmness (87.2 RI) was observed in cultivar CITH-AAS-GP-BSP-11 followed by CITH-AAS-GP-BSP-12 with firmness of 80.4 RI, thus can have more shelf life and consumer acceptability. Sixteen Ambri variants have been evaluated for various traits related to fruit quality and significant variability was observed across the selections. In pear, 31 European and Asian cultivars were evaluated for different quality related attributes. Among the evaluated European pear cultivars maximum fruit weight (319.23 g) and fruit length (96.63 mm), were recorded in cultivar Gent Drouard and maximum fruit diameter (82.64 mm) was recorded in Max Red Bartlett and minimum fruit weight (53.63 g), fruit length (51.91 mm) and fruit diameter (41.15 mm) was recorded in cultivar Red Anjou. Other traits like fruit, colour characteristics, TSS,

acidity etc also showed high degree of variability among the genotypes. Among the Asian pear genotypes Chinese Sandy pear showed highest fruit weight (160.32 g), fruit length (69.33 mm) and fruit diameter (68.29 mm). Maximum TSS (14.2 B°) and acidity (1.27 %) was recorded in cultivar Japanese Pear and Chinese Sandy pear. In quince ten genotypes were evaluated for physico-chemical properties and fruit weight ranges from 118.57 to 227.75 g with maximum fruit weight in CITH-Q-07 while maximum fruit length (82.18mm) and fruit diameter (76.35 mm) were recorded in quince genotypes CITH-Q-11, CITH-Q-07. The maximum fruit firmness (82.53 RI) was recorded in CITH-Q-10.

In plum, 20 cultivars (Japanese and European) were evaluated for various physico-chemical and colour parameters. Among the evaluated cultivars the maximum fruit weight (90.88g), length (54.03 mm) and diameter (52.62 mm was recorded in Red Beaut and maximum value of firmness (80.97RI) was recorded in Frair. In cherry, 28 genotypes were evaluated for various traits and the wide variability was observed. A good number of genotypes (17) exhibited TSS higher than 15°B. The titratable acidity and pH of the fruit juice varied from 0.63 to 0.98 per cent and 3.50 to 4.79 respectively. Fruit yield per tree varied from 4.8 to 23.67 kg and sixteen genotypes yield more than 10 kg per tree. In apricot, 61 genotypes were evaluated for various tree, floral, and fruit traits. Great extents of variation were observed for various traits. Maximum yield at the tune of 20.50 kg/plant was recorded in CITH AP-2 and the heaviest (53.46g) fruit were recorded in CITH-AP -25. Twenty one genotypes produced fruits having TSS more than 20° B indicating their possibility for processing especially drying. In peach 31 genotypes were evaluated and maximum fruit weight (96.02 g) was found in CITH-P-5. Among all the varieties Kanto-5 recorded highest (16.26°B) TSS.

In walnut, 270 genotypes were evaluated for various nut and yield traits. Maximum nut weight (21.23g) and kernel weight (10.40g) was observed in CITH-W-1. Among 270 genotypes 133 genotypes produced nuts having kernel percentage more than 50%. The highest kernel percentage was recorded in genotype CITH-W-101 (67.05%) followed by PTS-1 (63.20%) and CITH-W-50 (61.96%). Nut weight of CITH released selection ranges from 7.40 -21.23 g. Twelve walnut genotypes were evaluated for their fatty acid profiling. Major fatty acids found were linoleic acid (34-71 %), linolenic acid (8.65-22.13%) and oleic acid (7.90-18.17%). All cultivars have higher PUFA (52.21-86.0%) values due to the higher content of unsaturated fatty acids. The ω 3: ω6 range from 0.14 to 0.61 with an average of 0.33. SFAs content represent minor fraction (11.25-16.60%) while as MUFA values were of moderate range (7.90-18.17%). In almond, 10 cultivars were evaluated for various traits related to flowering, nut and kernel characteristics and yield. The Waris and Pranyaj were found promising in respect of physical attributes of nut and kernel. Moreover, highest yield was recorded in Waris followed by Pranyaj and Nonpareil. Further, highest kernel recovery was obtained from Nonpareil. Apart from Makhdoom (66%) and Shalimar (67%) more than 85 per cent sound nuts were obtained in evaluated cultivars. Further, in evaluation of 22 genotypes of almond collected from Kashmir Valley, CITH-Almond-14, CITH-Almond-15 and CITH-Almond-19 were found promising in respect of physical attributes of nut and kernel, whereas CITH-Almond-9, CITH-Almond-15 and CITH-Almond-16 were found promising in respect of nut yield. Analysis of fatty acids was done in 32 almond genotypes and significant variability was observed in palmitic acid, stearic acid, oleic acid, linoleic acid and Linolenic acid. In almond FLC gene from different genotypes was amplified and sequenced for diversity analysis among almond genotypes.

In strawberry, 102 genotypes were evaluated and characterized for various physico-chemicals traits and highest fruit weight was recorded in Howard followed by Shasta, Kimberly and Missionary. Likewise maximum TSS was estimated in Dana IC-319105, Kalimpong Local and Banglora. In terms of yield per plant out of 102 genotypes highest yield was recorded in

Missionary. In olive, 17 cultivars fruited and were evaluated for fruit, yield and oil traits. Among fruit traits, biggest fruits (6.0 g) were produced by the cultivars Cornicobra and Cipressino. The stearic acid content was estimated highest in Pendolino followed by Tonda Ibea and Leccino and lowest in Messenese. Oleic acid content was found maximum in Ottobratica followed by Leccino and minimum in Picholine whereas linoleic acid content was highest in Picholine followed by Tonda Ibea and lowest in Cipressino.

In vegetable, 45 collections of carrot were evaluated for structural and economic traits like plant height (cm), leaf length (cm), number of leaves, root length (cm), root diameter (cm), root weight (g) and total weight (g) etc. The yield of the different germplasm ranged from 14.93 to 35.20t/ha. In turnip, 30 genotypes were evaluated and root yield of the different germplasm ranged from 19.73 to 85.60t/ha, root equatorial diameter from 4.20 to 9.50cm, root polar diameter from 3.18 to 10.67cm. In radish, 22 collections were evaluated and yield of the different germplasm ranged from 16.93 to 55.60t/ha, root length from 8.50 to 39.60cm, root diameter from 22.22 to 101.11cm, and average weight form 0.338 to 2.57 kg. At regional station Mukteshwar twelve genotypes of capsicum were evaluated and maximum plant height (95.73 cm), branch length (76.45cm) and average fruit weight (139.33g) were recorded in genotype Torquataito. Whereas, number of branches/plant (4.58) and fruit length (93.48 mm) were recorded with CITH-M-Sel-5. In chilli six genotypes were evaluated and maximum plant height (82.40 cm), branch length (67.80 cm), plant spread i.e. east-west (57.50cm), north-south (58.59cm), fruit breadth (23.31mm) and average fruit weight (12.40g) was recorded in genotype CITH-M-Sel-2. In development of CMS lines in long day onion, hybrids obtained from crosses between short day male sterile lines and promising long day onion cultivars were planted for evaluation under long day conditions. These plants will be identified for the absence of pollen viability in the upcoming flowering stage for development of CMS lines in long day background.

In development of superior cultivars in apple through conventional and non-conventional breeding methods, twenty eight apple hybrids were evaluated for fruit quality traits and other bioactive compounds in addition to biological activities like anti-oxidative and free radical scavenging potential. Most of the hybrids showed superior performance over their parents with respect to some traits under analysis. Significant variability with respect to total phenols, flavonoids, flavanols and anti oxidative and free radical scavenging potential was observed. Anti-oxidative and free radical scavenging potential was elucidated through DPPH and FRAP assays and both the assays showed significant variability across the hybrids. In breeding for nutra-rich varieties/ hybrids in root vegetable crops programme different crosses of Purple Globe, Purple Round, Pink Top White Globe, Pink Top White Round, Pink Top White Flat, Mustard Yellow, Pink Round, White Round, White Globe, White Flat, Pink Flat, Pink Globe, Golden Ball and Pusa Chandrima were made into turnip hybridization programme and simultaneously got different F_2 programme of turnips whereas in radish (green, white, and pink) were crossed and got F_1 hybrids of radish. The 15 carrot accessions and local temperate types were crossed for improvement of anthocyanin, lycopene and β-carotene content in temperate carrot. The different twenty two radish types were made crossing for enhancement of anthocyanin pigments in F_1 generations. In breeding for development of superior varieties/hybrids in Solanaceous crops twenty-two promising lines in chilli were evaluated for yield and related traits for the third year, the lines varied significantly for fresh red ripe fruit yield. In sweet pepper, 15 promising lines and in brinjal 16 lines were evaluated.

Crop Production

During the year, Institute produced about 33544 grafted plants of apple, walnut, cherry, peach and apricot on different rootstocks and 5656 budded plants of almond, apricot, cherry, peach, apple and plum. About 6.0 quintals of quality vegetable seed, strawberry runners (20, 000) and vegetable seedlings (15, 000) were also produced

Bud-wood (>50, 000 sticks) of elite varieties of apple, pear, peach, plum, apricot, cherry, walnut, almond and olive were also provided to the stakeholders for popularization of elite varieties.

Apple

For enhancing feathering through plant growth regulators for high quality nursery production in apple, various growth regulator combination were tried and it was found that all treatment of plant growth regulators increased number of feathers, feather length, branching zone and per cent feathered plants compared to control. To find out appropriate concentration, spray interval and spray frequency, factorial experiments were carried out separately on Gala Mast and Oregon Spur trees using three concentration of BA (500, 600 and 700 ppm), two spray interval (one week and two week) and three spray frequency (3, 4 and 5). The findings revealed that Gala Mast produce satisfactory feathers (9.71) with the application of four spray of 600 ppm BA at one week interval compared with control. Whereas, Oregon Spur needed five sprays of 600 ppm BA at two week interval to produce satisfactory feathers (8). In fruit drop management studies in apple cultivar Super Chief it was observed, that maximum fruit weight (183.85g), fruit length (66.24 mm), fruit diameter (76.60 mm) and pedicle length (18.05 mm) was recorded in thinning treatment i.e. one fruit /cluster. Effect of various fertigation treatments on nutrient uptake and accumulation was worked out. During the year for the purpose of enhancing the multiplication rate in clonal rootstocks of apple, rootstocks were planted at 15° angle in a greenhouse followed by pinching to select the vigorously growing laterals. When these laterals attained the size of 10-15 cm, treatment of 2500 ppm IBA were applied after giving the incision at the base of the these laterals to initiate rooting followed by covering these lateral up to 10cm with suitable substrates like cocopeat, vermiculite. The perlite and the multiplication rate of these rootstocks from the first year in stool beds in polyhouse conditions has increased to 5-8 rooted graftable size plants

Saffron

The saffron growing under spreading, erect, semi erect type of almond varieties and as sole, there was non-significant difference for most of the floral traits of saffron. Highest saffron yield was recorded in saffron planted under erect type varieties (1.428 kg/ha) followed by spreading type (1.015 kg/ha), semi erect (0.940kg/ha) and sole (0.970 kg/ha). Highest almond yield 9.50 q/ha was recorded in spreading type of varieties followed by semi erect (8.62q/ha) and erect (7.93 q/ha) type of varieties. Highest equivalent saffron yield (4.815 kg/ha) were recorded in saffron plants under spreading type of varieties. Highest crocin (4.713 mg/100mg) was recorded in semi erect followed by sole (4.107) and spreading (3.753 mg/100mg) type of almond varieties. Impact of various modes of nitrogen fertilization on carbon build up rate in saffron growing soils was studied and it was observed that maximum carbon build up rate per year was in soils where nitrogen was applied as mid rib placement upper to corms in two splits. This was a significant finding as carbon depletion can be reduced by this method of N application in saffron growing soils.

Strawberry

The effect of different substrates on soilless strawberry production was studied and different media constituents were tried and it was found that cultivar Douglas performed best in respect of growth, yield and quality by employing substrate coco peat + vermiculite (50:50), followed by the treatment coco peat: vermiculite: perlite (50:25:25) under protected conditions

Vegetables

Effect of vegetable intercropping on the fruit quality of apple was studied and effect of pea and cauliflower as inter crop for quality and yield of apple was statistically found significant. According to five year data treatment comprising FYM + vermicompost + biofertilizer + Inorganic was found best in terms of highest fruit length (63.06 mm and 63.90 mm), fruit diameter (71.13 mm and 71.59 mm), fruit weight (151.94g and

156.35g), fruit firmness (12.43 lb/ inch^2 and 13.35 lb/ inch^2) fruit TSS (13.46 °B and 12.39 °B) and yield (32.83 kg/tree and 29.38 kg/tree) of apple per tree as compared to other treatments intercrop with pea and cauliflower respectively. Under crop diversification technology for round the year vegetable production under protected conditions in mid and high hills of Uttarakhand six vegetable crops viz. tomato, cucumber, capsicum, broccoli, Chinese cabbage and lettuce were taken as components of diversification along with their nursery production in different media combinations. The cost benefit ratio for nursery and commercial production were also calculated and any high benefit giving crops were suggested further. Most of treatments exhibited significant differences for various growth, yield and quality parameters under study.

Crop Protection

Under characterization of pathogens associated with apple canker disease and evaluation of botanicals against most prevalent canker in Kashmir valley, 20 isolates representing north, central and south Kashmir were characterized at morpho-molecular level. 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, three morphological groups were formed and the fungus was identified as *Diplodia*. To confirm the identity of genus and species at the molecular level, the internal transcribed spacer (ITS) region was amplified in ten isolates from all the three groups using ITS1 as forward and ITS4 as reverse primer and the amplicon of 650bp obtained after PCR amplification was sequenced. The sequence data showed three species having 97%, 99%, 99% sequence homology with *Diplodia mutila, Diplodia bulgarica* and *Diplodia seriata* respectively. Seventeen botanicals of medicinal value were collected and evaluated (*in vitro*) using poisoned food technique at two different concentrations 1000ppm (C_1) and 2000ppm against, *Diplodia bulgarica*. Better inhibition of *Diplodia bulgarica* under *in-vitro* conditions was attained by some plant extracts which will be further evaluated on large scale for confirming their effect.

In diagnosis and prognosis of apple viruses periodic diagnosis and prognosis of four apple viruses in different plant tissues was done during different plant growth stages and seasons. It was observed that all four viruses showed seasonal variation with respect to infectivity in different tested tissues. Immunodiagnostic assay using DAS-ELISA confirmed the presence of ASGV and ASPV in all plant parts, except root and fruit. The DAS-ELISA values indicated virus titer was more in leaves, bark and whole flower compared to other parts of apple tree. Results obtained through DAS-ELISA were validated through RT-PCR and it was observed that the specific primers of coat protein gene of ASPV amplified ~ 370 bp and replicase gene specific primer of ASGV amplified ~ 200 bp amplicon from all tested samples except roots, fruits and healthy controls. Relative quantification of ASPV and ASGV in different tissues revealed that, 11.1%, 15.05%, 8.31%, 5.2%, 72.9% , 27.7%, 6.2% and 9.3%, 8.7%, 12.6%, 7.2%, 76.79%, 26.8% and 9.2% expression in sepals, anther, petals, anther, bark, whole flowers and seed respectively with respect to leaf as positive calibrator

Post-Harvest Management

Biochemical evaluation of chilli germplasm for estimation of oleoresin content and pungency revealed that some chilli lines having very good pungency in addition to other traits like anti-oxidative and free radical scavenging potential. The entire phenolic composition of the chilli extract ranged from 4.31 mg/g GAE in genotype KA2 to 8.56 mg/g GAE in SEL1065-E. Highest pungency was observed in genotype CITH-HP-92-13 with 64160 SHU and lowest pungency (16000 SHU) was observed in SEL1052-11. FRAP observations ranged from 87.41 µM Fe^{2+}/g DW to 394.294 µM Fe^{2+}/g DW. The highest FRAP value was shown by the genotype CITH-HP-92/13 which also showed highest percent inhibition (78.16%). Thus during the study elite chilli genotypes were identified which showed promise for large scale commercialization and adoption. Process technology was developed for making

quince candy. Nutritional study of quince candy revealed that this fruit is rich in malic acid and ascorbic acid and good quantity of minerals like potassium, phosphorus and calcium. The product was studied for their nutritional, anti-oxidant and quality parameters. The finish product was subjected to sensory evaluation at different intervals stored at ambient conditions and the product was found acceptable in terms of colour, anti-oxidant quality, texture, taste and quality up to 9 months.

Extension and other activities

ICAR-CITH has made an effort for speedy transfer of various technologies to the farmers by various extension modes. The Institute has organized 8 days national Model Training course, one brainstorming meeting on apple, ICAR-regional committee meeting-1, two days workshop on apple scab at Arunachal Pradesh, FPO campaign etc. The Institute has organized two crop days, two training programmes of seven days each, three training programmes of 2-3 days for line department and technical staff, two study visits cum training programme for officers of UFRMP, 38 one day training/ visits for farmers at Srinagar and 24 training/ demonstration activities at Mukteshwar. The technologies were also directly provided to the farmers through demonstrations and trainings under MGMG, TSP, NMSHE, network projects, livelihood and nutritional improvement of tribal farm women through horticulture programme. Besides these, 3 training programmes of one day for officers of Uttarakhand and one day training programmes to farmers of J&K, H.P, were also organized under various schemes. The scientists delivered 25 radio/ TV talks and displayed 2 exhibitions at various occasions.

Publication and Awards

The scientists of ICAR-CITH published 24 research papers, 7 review articles, 4 books, 6 book chapters, 3 proceedings, 12 popular articles and 8 extension bulletin/ folders for the benefit of students, researchers, extension functionaries and farmers. The scientists of ICAR- CITH received 17 awards during the year.

Introduction

Fruits and vegetables account for nearly 90% of total horticulture production in the country. India is now the second largest producer of fruits and vegetables in the world and is the leader in several horticultural crops, namely mango, banana, papaya, cashew-nuts, areca nut, potato and okra. The scenario of horticultural crops in India has become very encouraging. The percentage share of horticulture output in Agriculture has become 30 percent. Under the purview of Agriculture & allied activities, the share of plan outlay for horticulture which was 3.9% during 9th Plan, has increased to 4.6% during the Twelfth Plan. India has witnessed voluminous increase in horticulture production over the last few years. Significant progress has been made in area expansion resulting in higher production. Over the last decade, the area under horticulture grew by about 3% per annum and annual production increased by 5.4 percent. During 2016-17, the production of horticultural crops was about 295.2 million tonnes from an area of 24.9 million hectares. The production of vegetables has increased from 58.5 million tonnes to 175 million tonnes since 1991-92 to 2016-17.

Temperate horticulture is a very important component of horticulture as it is only confined to the hilly regions of a country. Temperate fruit crops represent a group, which is physiologically diverse from the sub-tropical and tropical fruit crops grown in other regions. The North Western and Eastern Himalayan states with temperate climate have monopoly in production of temperate fruits, vegetables, ornamentals, medicinal and aromatic plants which have vital role in nutritional and economic security of the region. These crops serve as the backbone of region's economy by supporting about 10-12 million people and generating revenue of about Rs. 12, 000 crores annually. In 1960-61 the area under temperate fruits in the country was just 0.82 lakh hectares which increased to 6.0 lakh hectares and production increased from 3.0 lakh tonnes to 35.0 lakh tones. Among various crops, apple and walnut are the major crops of temperate fruits covering about 75% of the total area and accounting for 65% of temperate fruit production, respectively while rest of the production comes from other fruits like peach, plum, almond, apricot, cherry etc. During 2016-17 apple crop covered an area of 277.16 thousand ha with 2521 thousand MT national production. Walnut being second important crop covering an area of 92 thousand ha with 228 thousand MT production at national level. Other important temperate crops include almond (area = 12,000 ha; production = 8, 000 MT), pear (area = 40, 000 ha; production = 312, 000 MT), peach (area =18, 000 ha; production = 312, 000 MT), plum (area = 22, 000 ha; production = 76, 000 MT) etc. No doubt, there has been manifold increase in area, production and productivity but as compared to average world productivity (8.80 t/ha) our position is far behind (6.00 t/ha).

Temperate fruit crops are contributing significantly to the economic development of the country. Value of output of apple and walnut in the country is Rs 389760 lakhs and 225378 lakhs, respectively. Other crops like cherry, almond and pear are also contributing with the value of output of Rs 8207 lakhs, 16343 lakhs and 71075 lakhs respectively. Keeping in view the importance of these crops with respect to involvement of major population in temperate region in their cultivation and their contribution towards national economy a separate Institution has been established under the aegis of Indian Council of Agricultural Research at Srinagar, Jammu and Kashmir. ICAR-Central Institute of Temperate Horticulture, Srinagar with its two regional stations at Mukteshwar, (Uttarakhand)

and Dirang, (Arunachal Pradesh) are playing a great role in designing and developing research programmes on crop improvement, production, protection and post-harvest management for achieving economic and nutritional security in the entire Himalayan region. Institute is mainly focussing on research and development in temperate fruits, nuts, vegetables, ornamentals, medicinal & aromatic plants and saffron.

To overcome the production constraints the research on temperate horticultural crops is being carried out both at main campus Srinagar and at its Regional Stations with the following mandate and objectives:

Mandate

- To act as national repository of germplasm & scientific information on temperate horticultural crops.
- To undertake basic, strategic and applied research on temperate horticultural crops in collaboration with national and international agencies to enhance productivity and quality.
- To serve as centre of training for human resource development & transfer of technology.

Objectives

- Establishment of field gene bank and management of genetic resources and scientific data base of temperate horticultural crops.
- Genetic improvement of temperate horticultural crops for yield, maturity, quality, resistance to biotic and abiotic stresses through conventional breeding methods and biotechnological tools.
- Standardization of nursery management and high tech propagation techniques of temperate horticultural crops.
- To device efficient and cost effective production technologies and cropping systems for increasing productivity and improving quality of temperate horticultural crops.
- To develop eco-friendly integrated diseases/ pest management modules and diagnostics.
- Post-harvest value addition, product diversification and waste utilization for increasing availability and returns.
- To work out economics of production and impact assessment of technologies.
- Commercialization and transfer of technologies and skilled manpower development.

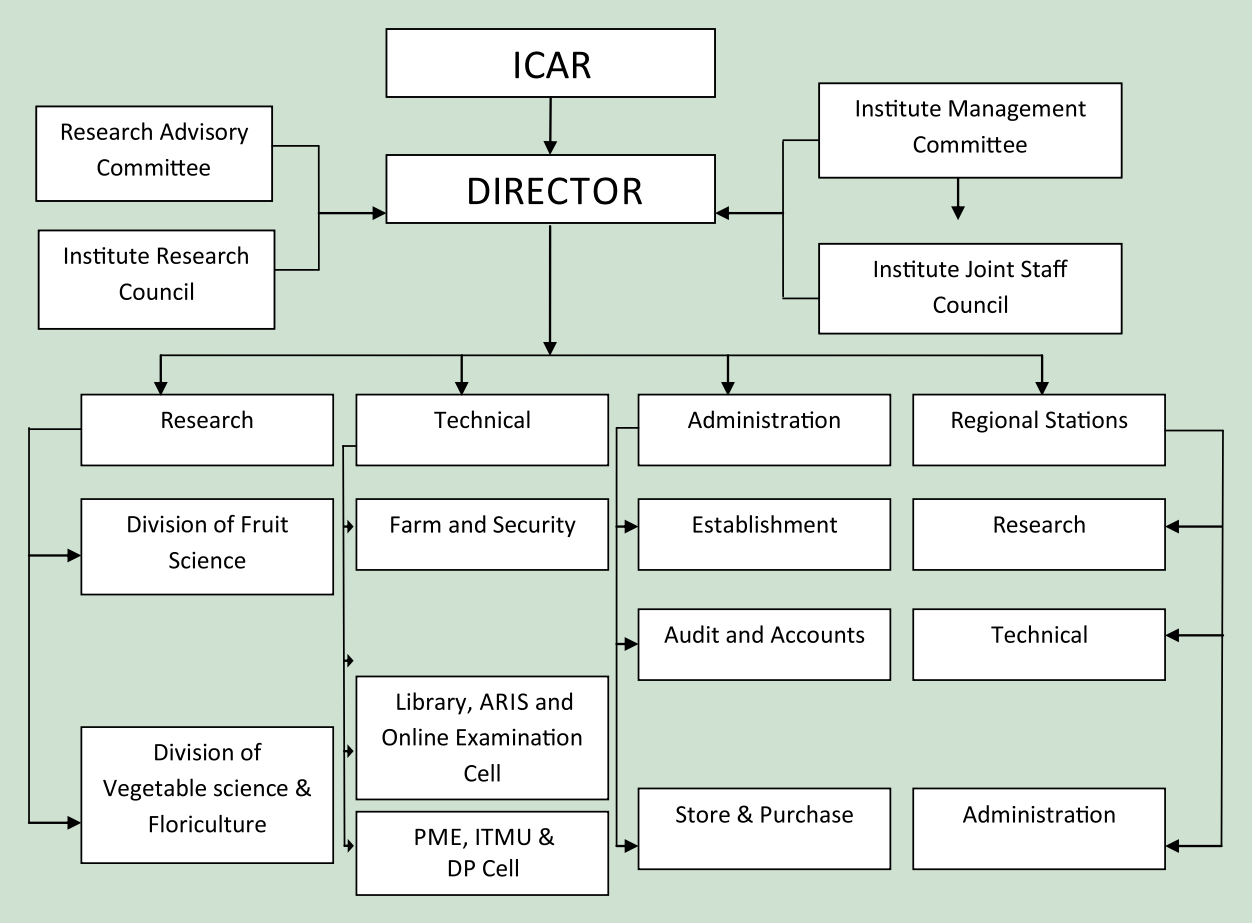
Staff Position (2018-19)

Category	Sanctioned	Filled (as on 31st March, 2019)	Vacant (as on 31st March, 2019)
Scientific	32+1RMP	11+1	21
Administrative	15	14	1
Technical	16	12	4
Supporting	19	11	8
Total	73	51	22

Financial Statement (2018-19)

S. No.	Sub-Head	Expenditure (Rs in Lakhs)
1	Capital	45.01
2	Establishment Charges	520.52
3	T.A.	19.48
4	Research & Operation Expenses	219.67
5	Administrative Expenses	154.95
6	Miscellaneous Expenses	2.74
7	Pension	109.57
8	Loans and Advances	3.0
Total		1074.94

ORGANOGRAM OF CITH



Research Achievements

i. Crop Improvement

The temperate region which extends from North Western Himalayas to North Eastern Himalayas enjoys monopoly in production of temperate fruits, vegetables, ornamentals, medicinal and aromatic plants which have vital role in nutritional and economic security of the region. The horticulture in this Himalayan states, is the backbone of states economy which supports about 15-20 lakh families and provides direct or indirect employment to the tune of about 8-10 million people annually. Among various crops apple, pear and walnut represent major crops of temperate fruits covering about 80% of the total area and accounting for 88% of temperate fruit production while rest of the production comes from other fruits like peach, plum, almond, apricot, cherries etc. which have significance in regions economy. No doubt, there has been manifold increase in area, production and productivity but as compared to average world productivity and productivity of advanced countries, our position is far behind. In addition to productivity, quality of fruit produced and commercialized in our country is far behind than advanced countries. The ICAR-CITH, Srinagar and its regional stations Mukteshwar and Dirang are continuously engaged in identification of superior cultivars/ genotypes suitable for commercial production and upliftment of socio-economical life style of hilly farmers through temperate horticulture. The research work carried out by ICAR-CITH and its regional station Mukteshwar on crop improvement during 2018-19 is presented project wise below:

Survey, collection, evaluation, characterization and documentation of temperate horticultural crops

The Western Himalaya is abundant source of diversity for temperate horticultural crops. The institute has made an effort for collection and conservation of germplasm from different regions and sources. The institute is maintaining a good repository of germplasm for evaluation, characterization and for future use. During 2018-19 institute has added 120 new genotypes in various crops and the total number has reached up to 2742 (Table 1).

Table 1. Germplasm collection and conservation at CITH (2018-19)

S. No	Crop/Group	Germplasm status 2017-18	Added 17-18	2019
1	Fruits:	1183	90	1273
	Pome	398	40	438
	Stone	218	35	253
	Nuts	388	10	398
	Others	179	5	184
2	Vegetables	1067	30	1097
3	Ornamentals	339	-	-
4	Medicinal & aromatic plants	33	-	-
	Total	**2622**	**120**	**2742**

The new genotypes which were introduced earlier and fruited first time at ICAR-CITH, Srinagar were plumcots (E-143, E329, E 215), plums (Au Rubrum, Red Beauty, Durate), pear (Carmine, Packham) and apple (Belerina and Early Red One)

Plumcots and plums genotypes Mirocais, Flor Tsirag, DPRU 0708, Friar,Au Rubrum, Red Beauty and Durate

Pear and apple genotypes Carmine, Packham, Bellerina and Early Red one

Apple

Evaluation of apple cultivars for different fruit quality traits

Catechins and rutin are among the main metabolites found in apple fruit. Sixty apple genotypes were analyzed for their phenolic content and antioxidant activity. The HPLC analysis showed that the catechin concentration ranged from 109.98 to 5290.47 µg/g, and the rutin concentration ranged from 12.136 to 483.89 µg/g of apple fruit. All the genotypes except Summer Red contain higher catechin content but it contain higher rutin content. Based on these two compounds apple genotypes were grouped into five main clusters. *Malus floribunda* does not form the part of any cluster due to its very high contents of rutin (86 (µg/g)) and catechin (5290 µg/g). The level of DPPH activity ranged from 9.04% to 77.57%, and almost half of the 15 genotypes showed below 30–40% DPPH activity. The apple genotypes Lal Ambri, Green Sleeves, and *Malus* floribunda, showed the highest (70% and 80% respectively) DPPH activity while Schlomit, Mayan and Ananas Retrine showed the lowest (0.02–0.09%) ferric reducing antioxidant power (FRAP) activity. Statistical analysis showed a correlation between DPPH activity and catechin content (r = 0.7348) and rutin content (r = 0.1442). Regarding antioxidant activity, fractionated samples of apple genotypes revealed significantly high activity comparable to that of ascorbic acid. There was also a consistent trend for FRAP activity among all apple genotypes and a significant positive correlation between FRAP activity and rutin content (r=0.244). Thus, this study reveals

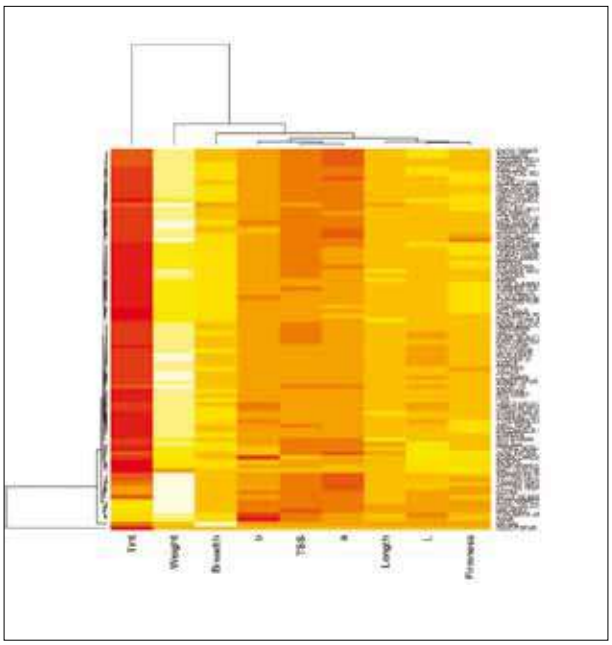


Fig 1. Heat-map constructed by "R package" showing clustering of 60 apple genotypes with variable fruit quality traits


Chaubatia Ambrose


Tydmen's EW


Mayan


Gala Mast


Spartan


Red Chief


Red Spur


Red Delicious


Royal Delicious


Scarlet Gala


Shireen


Silver Spur

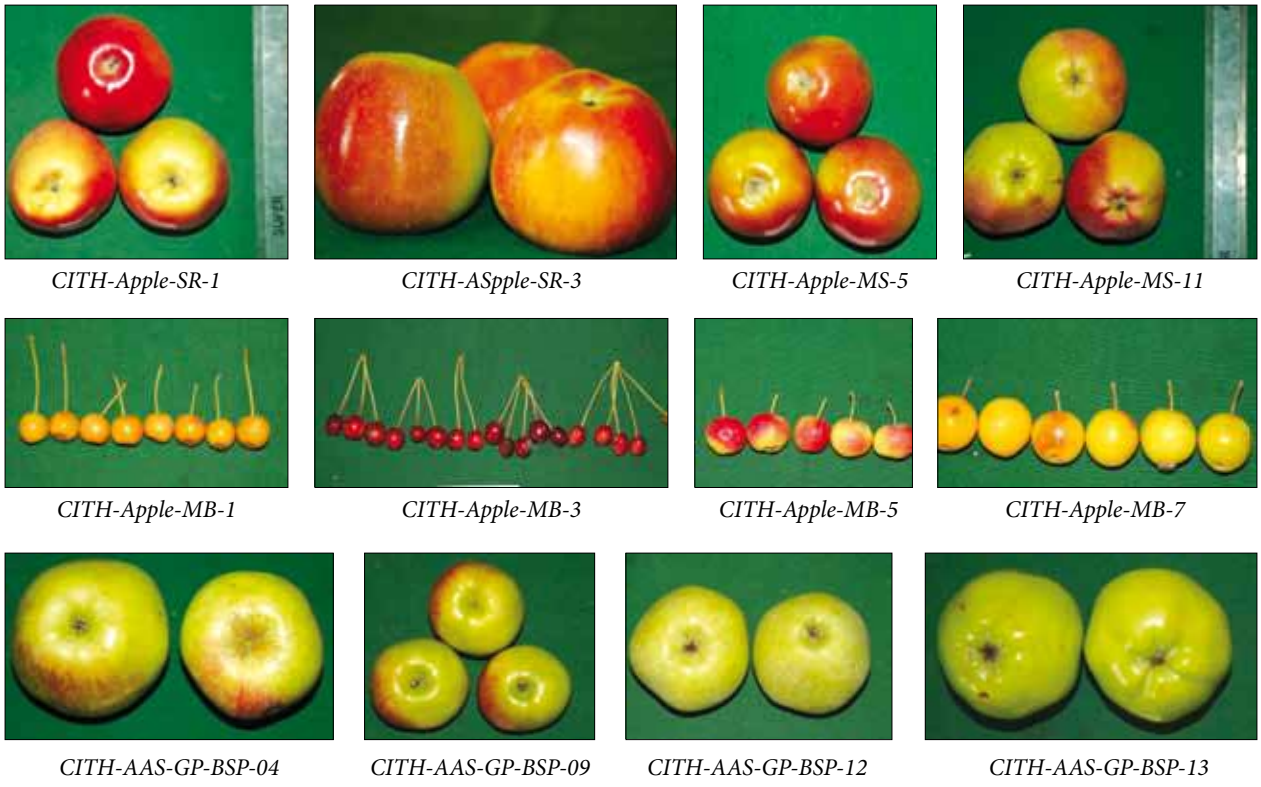
a significant variation in antioxidant potential among apple genotypes. This data could be useful for the development of new apple varieties with added phytochemicals by conventional and modern breeding approaches. Heatmap showing clustering of genotypes based on variability in Tint, fruit weight, length, breadth, TSS, firmness and colour values (Fig 1).

Evaluation of columnar apple cultivars for morphological and biochemical characteristics

Four columnar apple cultivars viz Redlane, Goldlane, Sunlight and Moonlight were evaluated to check their performance in the field conditions at ICAR-CITH, Srinagar during 2018-19. All the four cultivars showed profuse flowering and fruit set. Maximum number of fruits (180) were set in cultivar Redlane followed by Goldlane with 95 fruits. Highest fruit weight (160 g) was observed in Goldlane followed by Sunlight (150 g) and Moonlight (110 g) but Redlane although had highest crop density but have small fruit size (60 g). Columnar apple cultivars showed very good anti-oxidative and free radical scavenging potential as revealed by DPPH assay but these cultivars are acidic in taste. Ascorbic acid content varies from 6.8 to 7.5 mg/100g of fruit weight and total phenolic content varies from 120 mg/kg (Moonlight & Red lane) to 143 mg/kg (Goldlane). Percent inhibition estimated through DPPH assay varied from 48% (Moonlight) to 60% (Goldlane).

Evaluation of apple selections for different fruit quality traits

In order to study the trait stability and uniformity among the apple selections made at ICAR-CITH, Srinagar were evaluated with respect to qualitative and quantitative traits. Apple selections representing scab resistant, cultivars with variable fruit quality and selections from *Malus baccata* species were evaluated for different physico-chemical traits. Maximum fruit weight (270 g) was recorded in apple CITH-Apple-SR-03 and CITH-Apple-SR-01. Highest



CITH-Apple-SR-1 *CITH-ASpple-SR-3* *CITH-Apple-MS-5* *CITH-Apple-MS-11*

CITH-Apple-MB-1 *CITH-Apple-MB-3* *CITH-Apple-MB-5* *CITH-Apple-MB-7*

CITH-AAS-GP-BSP-04 *CITH-AAS-GP-BSP-09* *CITH-AAS-GP-BSP-12* *CITH-AAS-GP-BSP-13*

Fruits of different apple selections

firmness (87.2 RI) was observed in CITH-AAS-GP-BSP-11 followed by CITH-AAS-GP-BSP-12 with firmness of 80.4 RI thus can have more shelf life and consumer acceptability. *Malus baccata* selections although were very small in size but are sweet in taste with high TSS (28-30°B).

Physico chemical characteristics and colour attributes in Ambri genotypes

During the year 2018, sixteen Ambri variants have been evaluated for various traits related to fruit quality. Among the genotypes maximum fruit weight (124.27g), fruit length (62.58 mm), and fruit diameter (68.81 mm) was recorded in CITH-A-01 and minimum fruit weight (56.97g) in CITH-A-17, fruit length (51 mm) and fruit diameter (51.13 mm) in CITH-A-06. Fruit firmness in Ambri genotypes ranged from 53.67 RI (CITH-A-22) to 63.40 RI (CITH-A-07). The colour characteristics (L*, a* and b*) of Ambri genotypes were determined on sun-exposed side of each fruit with a Hunter lab colorimeter, L* value ranges from 54.28 in CITH-A-23 to 73.31 in CITH-A-04, the a* values ranged from 5.84 (CITH-A-12) to 22.64 (CITH-A-36). Values for b* scale range from 16.90 (CITH-A-01) to 44.46 (CITH-A-20). The values for tint ranged between -50.87 in CITH-A-23 to -21.15 in CITH-A-07. Maximum TSS (15.53 B°) was recorded in genotype CITH-A-23 and minimum TSS (13.23 B°) in CITH-A-27. Maximum acidity (1.33%) was recorded CITH-A-17 and minimum (0.67%) in CITH-A-31.

Malus baccata

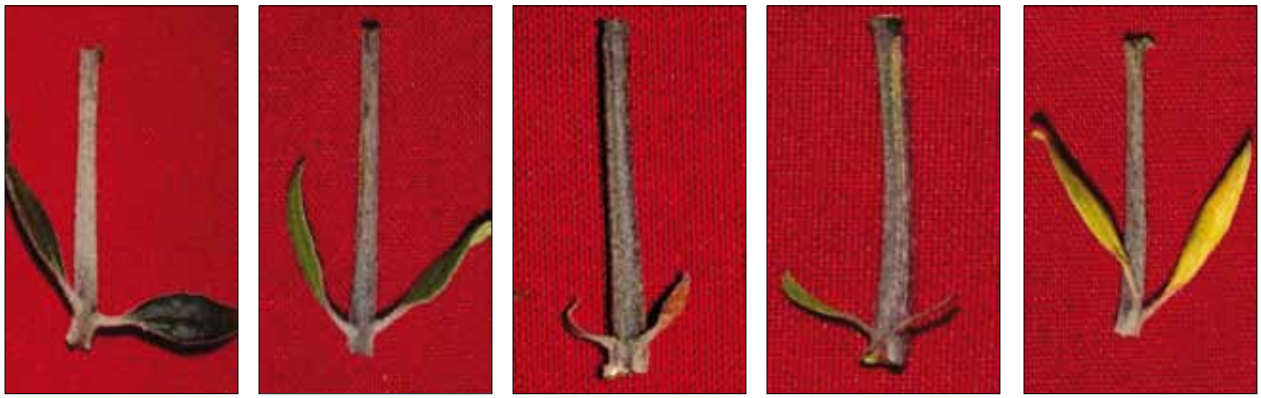
During the year 2018, 20 *Malus baccata* genotypes collected at CITH, Srinagar have been evaluated for different morphological traits and a lot of variability has been observed in respect of leaf, fruit, and other morphological characteristics. Among the evaluated genotypes, fruit weight ranges from 1.26 to 6.62 g with maximum fruit weight in CITH-B-09, maximum fruit length (21.83mm) in CITH-B-12 and maximum fruit diameter was recorded in CITH-B-13(23.68mm) while minimum fruit weight (1.26g), fruit length (12.19mm) and fruit diameter (12.45mm) were recorded in genotype CITH-B-09 . Fruit firmness

ranges from 42.87 RI in CITH-B-21 to 77.53 RI in CITH-B-24. Among the colour values L* ranges from 22.46 to 55.47, the highest L value was recorded in CITH-B-03 and lowest value was recorded in CITH-B-09. Value for a* ranges from 1.87 to 39.72, the highest a* value was recorded in CITH-B-13 and lowest value was recorded in CITH-B-06. Value for b* ranges from 11.57 to 35.79, the highest b* value were recorded in CITH-B-24 and lowest value was recorded in CITH-B-17.The values for tint ranges from –164.76 in CITH-B-13 to -9.77 in CITH-B-24. The TSS among the genotypes varies from 22.63B° to 36.90 B°. The maximum TSS was observed in the CITH-B-01 and minimum was recorded in CITH-B-03. Fruit firmness ranges from 42.87 RI in CITH-B-21 to 77.53 RI in CITH-B-24. Among the leaf characteristics Leaf length ranges from 67.82 to 95.33 mm with maximum leaf length in CITH-B-14 and the minimum was recorded in CITH-B-06, leaf width ranges from 35.82 to 55.21 mm with the maximum was recorded in CITH-B-09 and minimum was in CITH-B-30. Petiole length ranges from 21.30 to 46.06 mm with maximum petiole length in CITH-B-13 and the minimum was recorded in CITH-B-18. The evaluated genotypes can be used for future rootstocks improvement programmes.

Evaluation of clonal rootstocks of apple for identification.

During the year 2018 clonal rootstocks (MM- 106, MM-111, M- 9, B-9, P-22 and M-27) including three sub clones of M-9 (T337, T339 and Pajam-1) of apple were evaluated for various morphological traits based on UPOV guidelines. Shoot length varies from 66.00 to 119.00cm with maximum shoot length in M-9 sub clone M9-T337 and minimum was recorded in B-9. Shoot thickness was in the range of 7.02 to 9.38 mm with maximum in M9 (T337) and the minimum was in M-27. The intermodal length varies from 13.92 mm in P-22 to 26.43 mm in MM-106. The maximum length (1.31mm) of lenticels was observed in M9-T337 and the minimum (0.86mm) in B-9. The leaf blade length was in the range of 92.93 mm in M-27 to 119.35 mm in B-9. The leaf blade width ranges from 48.51 mm to 75.09 mm with maximum in M9-T339 and the minimum in Pajam-1. The leaf blade length of tip varies from 7.32 to 8.86 mm with the maximum value in Pajam-1 and the minimum in MM-106. Petiole length ranges from 26.39 to 34.14 mm with maximum petiole length in MM-111 and the minimum was recorded in B-9. The stipule length varies in the range of 9.61 mm in B-9 to 21.71mm in MM-111. Number of spines were observed same in all the rootstocks with the value of 2.0.

Morphological variations observed in length of stipules in different clonal rootstock of apple.



MM-111 (US) MM-106 (US) B-9 (US) M-27 (US) P-22 (US)

MM-111 (LS) MM-106 (LS) B-9 (LS) M-27 (US) P-22 (US)

*US-Upper side, LS-Lower side

Pear

During the year 2018-19, 31 European/Asian cultivars of pear have been evaluated for different quality related attributes. Among the evaluated European pear cultivars maximum fruit weight (319.23 g) and fruit length (96.63 mm) were recorded in cultivar Gent Drouard and maximum fruit diameter (82.64 mm) was recorded in Max Red Bartlett while minimum fruit weight (53.63 g), fruit length (51.91 mm) and fruit diameter (41.15 mm) was recorded in cultivar Red Anjou. Fruit firmness in pear cultivars ranged from 45.6 to 65.3 RI. Among colour parameters L* values range from 40.23 (Starkrimson) to 65.81 (Doyenne du Commice), a* value ranges from -4.56 (Smart) to 17.31 (Red Anjou) and b* ranged from 12.72 (Starkrimson) to 46.56 (Beurre d Amanlis). Maximum TSS (18.7 B°) was recorded in cultivar Vickar of Winkfield and minimum TSS (11.3 B°) in ZH Copeace. Maximum Acidity (1.65%) was recorded in Severenta and minimum (0.67%) in Batteria Giffard. Among the Asian pear genotypes Chinese Sandy pear showed highest fruit weight. (160.32 g), fruit length (69.33 mm) and fruit diameter (68.29 mm) and minimum fruit weight (71.32 g) was recorded in Punjab Gold, minimum fruit length (57.16 mm) and fruit diameter (48.92 mm) were recorded in cultivar Punjab Beauty. In case of Asian pear cultivars the L* values of color ranges from 44.61 (Kashmiri Nakh) to 59.09 (Punjab Gold), a* from -2.61 (Punjab Nectar) to -0.19 (Punjab Beauty) and b* ranged from 25.56 (Chinese Sandy pear) to 40.25 (Badshah Nakh).

Quince

Ten genotypes of quince were evaluated for physico-chemical properties during 2018-19. Fruit weight ranges from 118.57 to 227.75 g with maximum in CITH-Q-07, maximum fruit length (82.18mm) and fruit diameter (76.35 mm) were recorded in quince genotypes CITH-Q-11 and CITH-Q-07. The maximum fruit firmness (82.53 RI) was recorded in CITH-Q-10 and minimum (61.47 RI) was recorded in CITH-Q-11. Among the colour values, the highest a* value (6.80) was recorded in CITH-Q-01 and lowest value (-8.03)

Badshah Nakh William Bartlett Starkrimson

Fruits of some pear genotypes


CITH-Q-01


CITH-Q-07


CITH-Q-10

Fruits in some quince genotypes

was recorded in CITH-Q-13, negative a* value were recorded in 04 genotypes. Highest b* value (56.07) were recorded in CITH-Q-06 and lowest value (-1.51) was recorded in CITH-Q-01 while one genotype is showing the negative value for b* which indicates genotypes CITH-Q-01 has bluishness in colour. The values for tint ranged between -40.05 to 3.25. The maximum TSS (22.07 B°) was observed in the genotype CITH-Q-13 and minimum (12.9 B°.) in genotype CITH-Q-06. Maximum acidity (1.61%) was recorded in genotype CITH-Q-06 and minimum (0.70%) in CITH-Q-10. Highest total sugar value (10.42%), were recorded in the genotype CITH-Q-05 and the lowest (8.83%) in genotype CITHQ-04. The reducing sugar among the quince genotypes ranged from 4.83% to 6.09% being highest in CITH-Q-11 genotype and minimum (4.83%) in CITH-Q-06 genotype. The ascorbic acid content among the quince genotypes ranged from 15.01 to 17.75 mg/100g, the pectin content ranged from 1.05 to 1.92 g/100g and the pH ranges from 3.24 to 3.69. Among the other fruit quality parameters, highest edible matter (91.48%), was recorded in quince genotype CITH-Q-08 and maximum peel percent (6.04%) and seed percent (5.22%) were recorded in genotype CITH-Q-06.

Plum

Twenty plum cultivars (Japanese and European) were evaluated for various physico-chemical traits and maximum fruit weight (90.88g), length (54.03 mm) and diameter (52.62 mm) was recorded in Red Beaut, and the minimum fruit weight (7.51 g), fruit length (22.35mm) and fruit diameter (22.85 mm) were recorded in Methley. The pedicle length in these evaluated plum cultivars ranged from 7.78 – 19.10 mm, being maximum Kala Amritsari and the minimum in Black Beauty. Maximum TSS and acidity were recorded in Frair (19.70 °B) and Au-Rosa (1.67 %) respectively and minimum in Beauty (12.30 °B) and Red Plum (0.60 %) respectively. The L* value ranges from 22.10 in Red Plum to 63.11 in Kanto-5 .Values of a* scale ranged from -1.43 in Kubio Plum to 31.70 in Beauty. In case of b* the value ranged from 2.33 in Kala Amritsari to 51.73 in Kanto-5. The values for tint ranged between -146.06 in Beauty to -2.14 in Au-Cherry. The maximum value (80.97RI) of firmness was recorded in Frair and minimum (37.13 RI), value was recorded in Kubio Plum.


Kanto-5


Krassivica Plum


Santa Rosa

Fruits in some plum cultivars

Cherry

In evaluation of 28 cherry genotypes, wide variability for various traits was noticed. A good number of genotypes (17) exhibited TSS higher than 15°B. The titratable acidity and pH of the fruit juice varied from 0.63 to 0.98 per cent and 3.50 to 4.79 respectively. Fruit yield per tree varied from 4.8 to 23.67 kg and sixteen genotypes yield more than 10 kg per tree. The L* value ranged from 16.3 to 49.87, a* values from 14.89 to 35.74 and b* values from 4.75 to 33.11 indicating the wide variation among the different genotypes for color.

Apricot

Sixty one genotypes of apricot were evaluated for various tree, floral, and fruit traits and great extents of variation were observed for various traits. Maximum yield at the tune of 20.50 kg/ plant was recorded in CITH AP-2 while it was minimum in CITH-AP-9 (0.277 kg/ plant). The heaviest (53.46g) and smallest (9.70g) fruit were recorded in CITH-AP -25 and CITH -AP-30 respectively. Twenty one genotypes produced fruits having TSS more than 20^0 B indicating their possibility for processing especially drying. Maximum fruit length, width and fruit thickness were recorded in CITH-AP-36. In this year comparatively low yield were observed in apricot due to adverse climatic conditions especially stress during development stages. Top fifteen high yielding genotypes observed during 2018 based on yield were CITH-AP-2, CITH-AP-1 Rival, Tilton, CITH-AP-5, CITH-AP-34, CITH-AP-8, CITH-AP-25, Harcot, D-8, Australian, PAS-1, CITH-AP-32, Balcota and CITH-AP-36. Among 61 genotypes, 48 produced kernels having sweet taste while 13 yielded bitter kernels. The kernel weight was maximum (1.163 g) in CITH-AP-15 and minimum (0.420 g) in plumcot. To know the fruit fullness behavior all genotypes were bagged with selfing bag and percent fruit set was observed from 0% in 22 genotypes and 55 % in New Castle. Similarly in open pollination the fruit set varies from 0% in six genotypes and 75% in CITH-AP-6. This indicates the chances of self-unfruitfulness behavior in some genotypes and new suitable pollinizer varieties for other genotypes which fail to set fruit under open pollination.

Peach

Thirty four varieties of peach were evaluated for various physicochemical characteristics and fruit weight was found maximum in CITH-P-5 (96.02 g) and lowest (40.03 g) in Shan -i – Punjab. Among all the varieties Kanto-5 recorded highest (16.26 ^{0}B) TSS. Stone weight was found maximum in Crest Heaven (6.807 g) followed by Fantasia (6.77 g) while lowest stone weight was found in CITH –P-5(2.13 g) while stone length was recorded highest in Nimla followed by CITH-P-1 (34.07 and 33.77 mm), respectively. Lowest stone length was found in Southland P1(22.64 mm). Stone diameter was found highest in CITH-P-1(27.96 mm) and lowest in Stark Early (15.54 mm).Stone thickness was found highest in CITH- P- 1(20.92 mm) followed by Snow Crest (19.28 mm) and CITH- P -5 showed lowest stone thickness (11.78mm). Flesh and fruit color was also observed in different peach varieties which showed variation in L,a,b and Tint.

Walnut

In walnut, 270 genotypes were evaluated for various nut and yield traits. Due to prevailed climatic conditions during kernel filling stage, drastic decrease occurred in nut quality parameters during 2018. Maximum nut weight (21.23g) and kernel weight (10.40g) was observed in CITH-W-1. Among 270 genotypes 133 genotypes produced nuts having kernel percentage more than 50%. the highest kernel percentage was recorded in genotype CITH-W-101 (67.05%) followed by PTS-1 (63.20%), CITH-W-50 (61.96%), Hamdan (61.01%), PB-1 (59.73 %), CGB-1(59.69%), PTS-5(59.63%), CITH-W-100(59.53%), KGM-1 (59.45%), CITH-W-69 (59.39%), CITH-W-30 (59.31%), CITH-W58(59.24%),Shalimar-6 (58.58%),CITH-W-84 (58.34%) and Shalimar-7(58.23%). Nut weight of CITH released selection ranges from 7.40 -21.23 g. Twelve walnut genotypes were evaluated for their fatty acid profiling. Major fatty acids found were linoleic acid (34-71 %), linolenic acid (8.65-22.13%) and oleic acid (7.90-18.17%). All cultivars have higher PUFA (52.21-86.0%) values due to the higher content of unsaturated fatty acids. The ω 3: ω6 range from 0.14 to 0.61

with an average of 0.33. SFAs content represent minor fraction (11.25-16.60%) while as MUFA values were of moderate range (7.90-18.17%). The PUFA/MUFA ratio varied from 3.43 to 8.66 with an average of 5.41. Iodine Value representing the level of unsaturation ranged from 118.76-187.02 with an average of 153.28 (Table.2). Therefore the genotypes identified in present study showed the potential for enhancing productivity and providing better quality uniform produce for higher returns.

Almond

In almond, 10 cultivars were evaluated for various traits related to flowering, nut and kernel characteristics and yield. The Waris and Pranyaj were found promising in respect of physical attributes of nut and kernel. Moreover, highest yield was recorded in Waris followed by Pranyaj and Nonpareil. Further, highest kernel recovery was obtained from Nonpareil. Apart from Makhdoom (66%) and Shalimar (67%) more than 85 per cent sound nut were obtained in evaluated cultivars. Double kernel has reported in all cultivars with variable number ranging from 01 (California Paper Shell) to 38 per cent (Shalimar). With the exception of CPS (1%) and IXL (8%) all other cultivars observed more than 10 per cent double kernel. However, twin kernel was not observed in any cultivar. Further, in evaluation of 22 genotypes of almond collected from Kashmir Valley, CITH-Almond-14, CITH-Almond-15 and CITH-Almond-19 were found promising in respect of physical attributes of nut and kernel, whereas CITH-Almond-9, CITH-Almond-15 and CITH-Almond-16 were found promising in respect of nut yield. CITH-Almond-04, CITH-Almond-10 and CITH-Almond-19 gave maximum kernel recovery among evaluated genotypes.

Analysis of fatty acids was done in 32 almond genotypes and highest content of palmitic acid (8.13 %) was obtained in Nonpariel, stearic acid (2.53%), oleic acid (80.81%) and lowest amount of linoleic acid (11.63%) were detected in CITH-A-6. In contrast, the lowest amount of oleic acid (53.70%) and highest amount of Linoleic acid (36.88) were detected in CITH-A-21. As far as linolenic acid to concern, the highest content was detected in CITH-A-18. On the other hand linolenic acid content was

Table. 2. Fatty acid composition of walnut genotypes and their respective Iodine Values.

Fatty Acids (%)	Oil Content (%)	Palmatic acid	Stearic acid	Oleic acid	Linoleic acid	Linolenic acid	MUFA	PUFA
Genotype								
CITH-W-1	65.71^{cde}	4.26^{a}	7.98^{abc}	13.45^{bcd}	52.63^{e}	16.23^{cd}	13.45^{bc}	68.86^{de}
CITH-W-2	67.48b^{cde}	4.95^{a}	7.99^{abc}	9.77^{fe}	34.00^{h}	18.21^{bc}	9.77^{e}	52.21^{h}
CITH-W-3	71.76^{a}	4.66^{a}	8.82^{abc}	18.17^{a}	44.64^{g}	17.69^{bc}	18.17^{a}	62.34^{f}
CITH-W-4	57.54^{f}	4.98^{a}	5.20^{c}	7.90^{f}	47.83^{f}	20.57^{ab}	7.90^{e}	68.39^{de}
CITH-W-5	69.59^{abc}	5.12^{a}	10.13^{a}	13.98^{bcd}	64.00^{c}	18.00^{bc}	13.98^{b}	82.00^{b}
CITH-W-6	64.64^{de}	5.16^{a}	6.87^{abc}	10.46^{def}	68.59^{ab}	9.60^{f}	10.46^{de}	78.19^{c}
CITH-W-7	68.71^{abc}	3.65^{a}	6.23^{bc}	13.10^{bcde}	36.13^{h}	22.13^{a}	13.10^{bcd}	58.26^{g}
CITH-W-8	70.41^{ab}	5.40^{a}	6.96^{abc}	10.76^{cdef}	47.09^{fg}	8.65^{f}	10.76^{cde}	55.74^{g}
CITH-W-9	67.68^{bcd}	4.80^{a}	5.78^{bc}	14.24^{bc}	47.40^{fg}	19.00^{abc}	14.24^{b}	66.40^{e}
CITH-W-10	63.53^{e}	5.12^{a}	9.28^{ab}	17.88^{a}	71.08^{a}	14.12^{de}	17.88^{a}	85.20^{a}
Suleiman	72.08^{a}	5.23^{a}	8.71^{abc}	16.02^{ab}	68.00^{b}	18.00^{bc}	16.02^{ab}	86.00^{a}
Hamdan	67.44^{bcde}	5.32^{a}	8.21^{abc}	15.59^{ab}	58.42^{d}	12.80^{e}	15.59^{ab}	71.22^{d}

**Means followed by the same letter within the columns are not significantly different (p=0.05) using Duncan's multiple range test*

not detected in IXL, Pranyaj, Nonpareil and Merced. The lowest content of saturated fatty acids (6.32%) and highest content of unsaturated fatty acids (93.69%) among the genotypes were obtained in CITH-A-17. In contrast, the highest content saturated fatty acids (10.09%) and lowest content unsaturated fatty acids (89.91%) were obtained in Nonpariel. Likewise, highest rates of monounsaturated fatty acids (80.81%) and lowest rates of polyunsaturated fatty acids (11.71%) were found in CITH-A-6. On the other hand lowest rates of monounsaturated fatty acids (53.7%) and highest rates of polyunsaturated fatty acids (36.97%) were found in CITH-A-21. The genotype CITH-A-17 had a higher value (14.82) then the other for UFA:SFA ratio. The Iodine value varied from 93.96 (CITH-A-6) to 115.42 (CITH-A-21). Analysis of micronutrients were also done in 32 almond genotypes and wide variability observed for Fe (2.06 mg/100g), Mn (2.32 mg/100g), Zn (3.53 mg/100g) and Cu (1.92 mg/100g) content.

Strawberry

The existing 102 field germplasm of strawberry were evaluated and characterized for various physico-chemicals and yield attributes Highest fruit weight was recorded in Howard followed by Shasta, Kimberly and Missionary. Likewise maximum TSS was estimated in Dana IC-319105, Kalimpong Local and Banglora. In terms of yield per plant out of 102 genotypes highest yield was recorded in Missionary followed by IC-319135, EC-439590 and IC-319093.Total anthocyanin was estimated highest in EC-362601, IC-319140, Lucandi, IC-319129 and Pajaro whereas DPPH

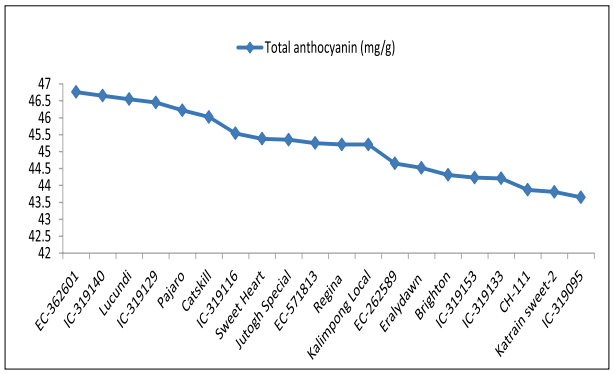


Fig.2. Top 20 strawberry genotypes having maximum total anthocyanin content

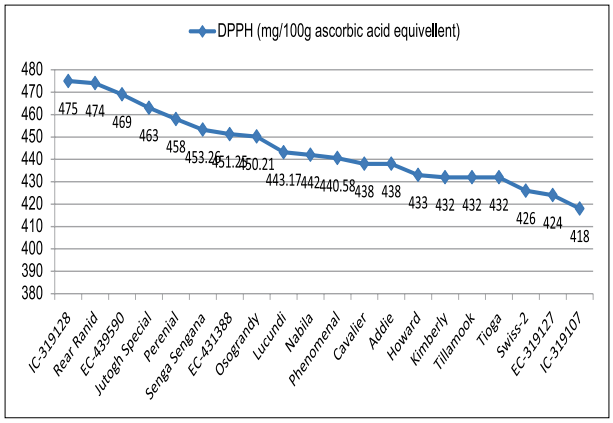


Fig.3. Top 20 strawberry genotypes having maximum DPPH (antioxidant potential) content

was recorded highest in IC-319128, Rear Ranid, Jutogh Special and Perenial (Fig 2 &3)

Olive

In olive out of 18 cultivars, 17 cultivars fruited and were evaluated for fruit, yield and oil traits. Among fruit traits, biggest fruits (6.0 g) were produced by the cultivars Cornicobra and Cipressino. The smallest fruit (2.7 g) were produced by Ottobratica. Cultivar Cornicobra produced fruits having maximum length (28.25 mm) and diameter (20.35 mm). Highest yield of 31.47 kg/plant was found in cultivar Messenese followed by Picholine (26.03 kg/plant) and Leccino (25.67 kg/plant). Highest oil percentage (fresh weight basis) was recorded in cultivar Itrana (21.3 %) followed by Coratina (20.01%). Based on yield efficiency cultivars Messenese (1.052 kg/cm^2), Picholine (0.946kg/cm^2), Leccino (0.832kg/cm^2), Coratina(0.744kg/cm^2) and Zaituna (0.663 kg/cm^2) were found best for commercial cultivation in Kashmir. Fatty acid profiling of 18 olive genotypes (Fig 5,6 &7) revealed significant variation among the genotypes and maximum content of palmatic acid was observed in Morolio followed by Cornicobra and Cipressino however minimum in Toffohai. The stearic acid content was estimated highest in Pendolino followed by Tonda Ibea and Leccino and lowest in Messenese. Oleic acid content was found maximum in Ottobratica followed by Leccino and minimum in Picholine whereas linoleic acid content was highest in Picholine followed by Tonda Ibea however lowest in Cipressino. The linolenic acid

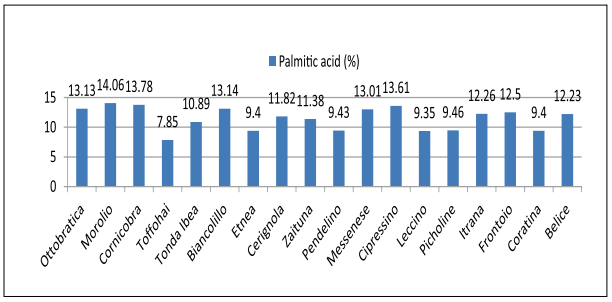


Fig 4. Variation in palmatic acid content in 18 olive genotypes

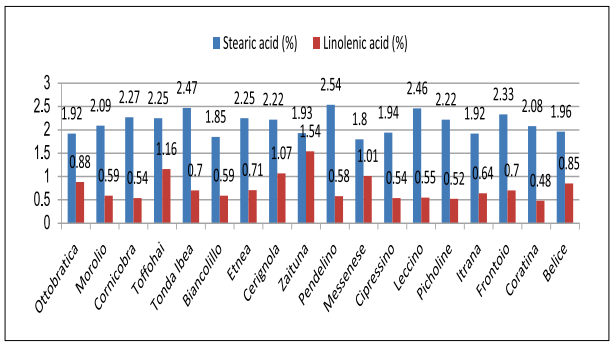


Fig. 5. Variation in stearic acid and linolenic acid content in 18 olive genotypes

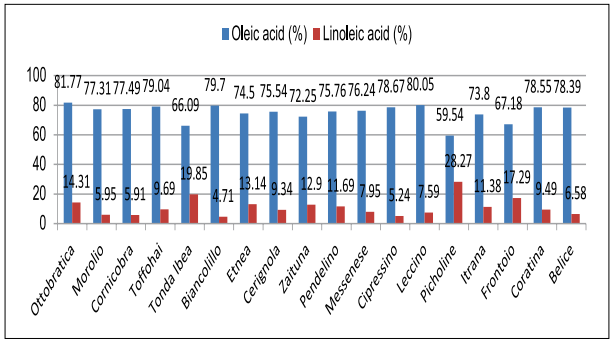


Fig.6. Variation in oleic and linoleic acid content in 18 olive genotypes

content was recorded higher in Zaituna followed by Toffohai and lowest in Coratina (Fig 4, 5 & 6)

Vegetable crops

In vegetable crops evaluation was done in carrot, turnip and radish and salient findings were achieved as described below:

Carrot

Forty five collections of carrot were evaluated for structural and economic traits like plant height (cm), leaf length (cm), number of leaves, root length (cm), root diameter (cm), root weight (g) and total weight (g) etc. The yield of the different germplasm ranged from 14.93 to 35.20t/ha, root length from 10.12 to 26.55cm, root diameter from 1.53 to 3.55cm, core diameter from 0.70 to 0.73cm and average weight form 0.025 to 0.294 kg. All these selections were chosen for hybridization and backcrossing of carrots for root colour and shape.

Turnip

Thirty genotypes of turnip were evaluated for economic yield traits like plant height (cm), leaf length (cm), number of leaves, root length (cm), root diameter (cm), root weight (g) and total weight (g) etc. The root yield of the different germplasm ranged from 19.73 to 85.60t/ha, root equatorial diameter from 4.20 to 9.50cm, root polar diameter from 3.18 to 10.67cm. All these selections were chosen for hybridization of turnips for root colour and shape.

Radish

Twenty two collections of radish were evaluated for structural and economic traits like plant height (cm), leaf length (cm), number of leaves, root length (cm), root diameter (cm), root weight (g) and total weight (g) etc. The yield of the different germplasm ranged from 16.93 to 55.60t/ha, root length from 8.50 to 39.60cm, root diameter from 22.22 to 101.11cm, and average weight form 0.338 to 2.57kg. All these selections were chosen for hybridization and backcrossing of radishes for root colour and shape.

Cabbage

Since red cabbage line (CITH-RC-1) with the institute fails to produce proper heads with slight change in weather, the yields obtained are inconsistent and generally low, so its hybridization was attempted with cabbage cv. Golden Acre to obtain multicolored, nutritionally enriched cabbage hybrid with high yield for salad purpose during the year 2017-18. Consequently in 2018-19, preliminary evaluation of the hybrid for yield was done for comparison with parents. Higher yield (44.58 t/ha) was obtained in hybrid against Golden Acre (33.93 t/ha).

Regional Station, Mukteshwar

Regional Station Mukteshwar is maintaining 350 germplasm accessions of different horticultural crops and 182 accessions of vegetable and ornamental crops were added during 2018-19. During the year evaluation was carried out in peach, apple, plum, apricot, persimmon and kwi fruit. Salient findings during evaluation of these crops is given below:

Peach

In peach highest fruit weight (164.36 g), fruit volume (190.00 cc), fruit length (6.59 cm), pulp weight (155.48 g) and pulp stone ratio (18.93) was recorded in Red June cultivar, while the lowest fruit weight (79.95 g), fruit volume (78.00 cc), fruit length (4.92 cm), fruit diameter (5.25 cm) and pulp weight (73.08 g) was recorded in Red Nectarine. Maximum fruit firmness (9.80 lb/inch^2) was recorded in Red Nectarine, while lowest fruit firmness (3.37 lb/inch^2) was recorded in FLA-16-33. The highest T.S.S. was recorded in Red Nectarine (14.00 °B), while lowest in FLA-16-33 (9.77 °B). The minimum acidity was recorded in Red Nectarine (0.64%), while maximum in Red June (0.85%). The highest ascorbic acid content (8.47 mg/100g), total sugars (7.06 %) and reducing sugars (4.46 %) recorded in Red June. The maximum carotene content was recorded in Flordaking (1722.37 µg/100 g), while minimum (535.12 µg/100 g) was recorded in Flordasun. The highest total anti-oxidant activity was recorded in Red Nectarine (23.26 mMTE/L), while lowest (14.75 mMTE/L) total anti-oxidant activity was recorded in Red June. The most of the physico-chemical characteristics of fruits was found superior in Red June as compared to other peach cultivars. In shelf life studies of five peach cultivars, Red June exhibited minimum physiological loss in weight and fruit decay percentage, rich in T.S.S, total sugar, reducing sugars, carotene content and having highest total anti-oxidant activity than other peach cultivars. Red Nectarine exhibited highest fruit firmness as compared to other peach cultivars during 12 days of storage. Conclusively, Red June and Red Nectarine have better shelf-life than other peach cultivars under ambient storage conditions.

Plum

In evaluation of plum highest fruit weight (77.94 g), fruit volume (75.67 cc), fruit length (5.11cm), fruit diameter (5.10 cm), pulp weight (76.23 g) and pulp stone ratio (44.82) was recorded in Satsuma cultivar, while the lowest fruit weight (31.23 g), fruit volume (28.67 cc), fruit diameter (3.73 cm), pulp weight (29.41g) and pulp stone ratio (12.60) was recorded in Green Gage. The highest T.S.S (12.47°B) and minimum acidity (0.69 %) were recorded in Santa Rosa respectively. The highest (24.23 mg/100 g) ascorbic acid content was recorded in Late Plum. The maximum carotene content was recorded in Satsuma (719.90 µg/100 g), while minimum in Late Plum (371.19 µg/100 g). The highest total anti-oxidant activity was recorded in Satsuma (33.19 mMTE/L), while lowest in Green Gage (19.64 mMTE/L). The most of the physico-chemical characteristics of fruits was found superior in Satsuma as compared to other plum cultivars. In shelf life study of five plum cultivars at ambient storage condition cv. Santa Rosa exhibited highest firmness, total sugars, carotene content and lowest acidity however; the cv. Green Gage exhibited highest T.S.S, carotene content and fruit decay percentage as compared to other plum cultivars during 15 days of storage. Conclusively, Satsuma, Santa Rosa and Green Gage have better shelf-life than other plum cultivars under ambient storage conditions.

Apple

In apple 26 cultivars were evaluated for various traits and highest fruit weight (217.40 g) in cultivar Top Red while the lowest fruit weight (68.46 g) was recorded in Early Shanburry cultivar. The highest T.S.S. was recorded in Krimson Gold (14.03 °B) followed by Skyline Supreme (14.00 °B) while lowest in Early Shanburry (8.63 °B), The highest value for ascorbic acid (17.30 mg/100 g) was recorded in Rich-a-Red followed by Bright-N-Early (17.03 mg/100 g) and Red Chief (16.92 mg/100 g) while lowest (5.11 mg/100 g) in Rymer. The highest total anti-oxidant activity (46.20 mMTE/L) was recorded in Top Red while lowest in Golden Delicious (35.23 mMTE/L). The highest anthocyanin content (437.49 mg/100 g) was recorded in Bright N Early while lowest in

Mollies Delicious (69.83 mg/100 g). Based on various traits cultivar Top Red performed better in the region under prevailing climatic conditions.

Persimmon

In persimmon a survey was conducted and seven genotypes were evaluated and based on various physicochemical traits Collection-3 and Collection-7 were found superior.

Kiwi Fruit

In evaluation of kiwi fruit various traits, highest fruit weight (82.57 g), fruit volume (83.33 cc) and fruit diameter (4.91 cm), fruit firmness (10.87 lb/inch^2) and specific gravity (0.99) were recorded in cultivar Hayward, while these parameters were lowest in cultivar Monty. The highest T.S.S (14°B), and minimum acidity (0.11 %) were recorded in Hayward respectively. Highest (8.63 %) total sugars, reducing sugar (6.26 %) and non-reducing sugar (2.37%) were recorded in Monty, while lowest total sugars (5.63%), reducing sugar (4.01) and non-reducing sugar (1.45%) were recorded in Hayward. The maximum carotene content (311.00 **µg**/100g) and total anti-oxidant activity (35.19 mMTE/L) were recorded in Abbott while minimum carotene content (219.71 **µg**/100 g) was recorded in Monty. The most of the physico-chemical characteristics of fruits was found superior in Hayward and Abbott as compared to other cultivars. In shelf-life studies at ambient storage conditions cv. Hayward exhibited minimum physiological loss in weight and maximum fruit firmness and TSS. While maximum total sugar and reducing sugar recorded in Allison cultivar. Maximum ascorbic acid, carotene content and total antioxidant activity recorded in Abbott as compared to other cultivar during the 40 days of storage. Conclusively, Hayward and Abbott have better shelf-life than other kiwifruit cultivars under ambient storage conditions.

Characterization and diversity analysis of flowering related gene/ gens in almond

Flowering time is an important agronomic trait in almond since it is decisive to avoid the late frosts that affect production in early flowering cultivars. Evaluation of this complex trait is a long process because of the prolonged juvenile period of trees and the influence of environmental conditions affecting gene expression year by year. Consequently, flowering time has to be studied for several years to have statistical significant results. Moreover, dismal pollinator activity under chilling temperatures further reduces the fruit set. Flowering Locus C (FLC) is an important gene regulating flowering in plants. Nucleotide sequences of FLC gene of several stone fruit species were retrieved from NCBI and degenerate primers designed. These primers were used to amplify the FLC gene from genomic DNA of ten almond cultivars and approximately 1 kb fragment revealing high sequence identity with FLC gene of *P. persica* was amplified and sequenced. Based on nucleotide sequence of FLC gene from ten almond cultivars and 8 additional sequences retrieved from NCBI Gene Bank based on sequence similarity (>50%), UPMGA alignment and clustering was done in which a total of three main clusters were obtained. Each cluster was represented by six genotypes. One cluster was exclusively represented by partial sequence of *FLC* gene from almond (*PdFLC*) cultivars from ICAR-CITH, Srinagar viz Drake, IXL, Waris, Merced, Non-Pariel and CITH-4 and other cluster represented by Shalimar, Primorskij, Calfornia Paper Shell and three sequences of FLC

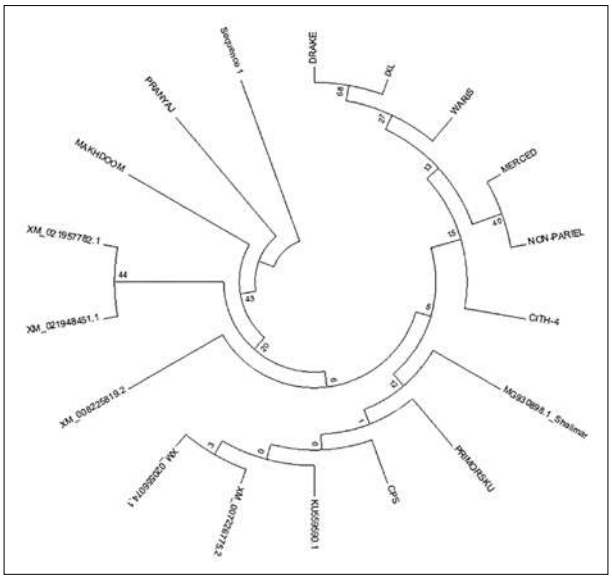


Fig. 7. Cladogram obtained from ten FLC gene sequences of ten almond cultivars and eight sequences similar to these sequences form NCBI genebank through MEGA-7.

gene retrieved from NCBI Genebank. Primorskij and Mokhdoom formed the part of third cluster along with four sequences retrieved from NCBI Genebank (Fig 7).

Development of superior cultivars/hybrids in temperate fruits through conventional and non-conventional methods

Fruit quality analysis of apple hybrids

Apple hybrids were evaluated for total phenols, flavonoids, flavanols, antioxidative and free radical scavenging potential during 2018-19 and their performance was found stable as in 2017-18. Twenty eight apple hybrids were evaluated for fruit quality traits like fruit size, fruit dimensions, firmness, TSS, acidity, ascorbic acid and other bioactive compounds in addition to biological activities like anti-oxidative and free radical scavenging potential. Most of the hybrids showed superior performance over their parents with respect to some traits under analysis. Significant variability with respect to total phenols, flavonoids, flavanols and ant oxidative and free radical scavenging potential was observed. Anti-oxidative and free radical scavenging potential was elucidated through DPPH and FRAP assays and both the assays showed significant variability across the hybrids. Four hybrids (Starkrimson x Tydman's Early, Ambri x Mollies Delicious-1, Ambri x Mollies Delicious-2 and Golden Delicious x Snow Drift) have fruit size more than 150 g. Higher TSS (> 17 °Brix) was found in seven hybrids (Prima x Top Red-1, *M floribunda* x Prima, Prima x Red Delicious-1, Mollies Delicious x Well Spur, Prima x Top Red-3, Golden Delicious x Red Fuji and Golden Delicious x Cooper-IV). Based on quality parameters, taste and appeal seven superior hybrids were identified viz Prima x Ambri, Prima x Top Red, Ambri x Mollies Delicious, Prima x Red Delicious, Ambri x Top Red and Red Delicious x Mollies Delicious and Golden Delicious x Snow Drift. These six hybrids are being multiplied testing (Table 3).

Cross	Bearing in different cross combinations		
			
Prima x Ambri	Prima x White Dotted Red	Golden Del x Silver Spur	Ambri x White Dotted Red
			
Prima × R.D	Prima x Top Red	Ambri x Mollies Delicious	Ambri x Top Red

Fruits of apple crosses evaluated for fruit quality parameters during 2018-19

Table. 3. Fruit quality parameters of apple hybrids

Hybrid	Weight (g)	TSS (%)	PH	Acidity (%)	Ascorbic Acid (mg/100gFW)	Firmness (RI)	Colour			
							L	A	B	Tint
Red Delicious x Silver Spur	135.71^{f}	11.2^{ih}	4.4b^{c}	0.3^{b}	8.05^{k}	54.6^{l}	84.58^{a}	15.6^{h}	44.15^{b}	-30.19^{f}
Starkrimson x Tydman's Early	168.25^{b}	12.5^{gifh}	3.43^{m}	0.29^{b}	5.95^{p}	65.1^{dc}	46.23^{n}	23.01^{d}	18.64^{no}	-88.99^{t}
Prima x White Dotted Red	95.44^{ij}	14.2^{gfdhe}	4.25^{dec}	0.21^{b}	7.35^{l}	64.4^{de}	58.64^{gh}	20.89^{e}	17.89^{o}	-82.63^{r}
Prima x Ambri 1	107.46^{h}	14.7^{gcfde}	4.31^{bc}	0.31^{b}	6.3^{o}	67.8^{b}	59.06^{gh}	12.67^{j}	31.9^{f}	-54.2^{l}
Prima x Top Red 1	99.7^{i}	17.2^{cadb}	4.58^{a}	0.22^{b}	7^{m}	56.8^{k}	58.22^{h}	11.63^{l}	33.32^{e}	-53.15^{k}
Ambri x Mollies Delicious 1	196.5^{a}	11.2^{ih}	4.09^{fg}	0.31^{b}	8.4^{j}	62.1^{fgh}	55.08^{k}	19.05^{g}	23.75^{l}	-70.81^{p}
Red Delicious x Mollies Delicious	99.2^{i}	12.5^{gifh}	3.82^{jhi}	0.35^{a}	9.45^{g}	60.3^{ih}	62.26^{ef}	4.49^{o}	30.71^{g}	-28.45^{e}
Golden Del x Mollies Delicious	79.4^{l}	14.2^{gfdhe}	3.8^{hi}	0.37^{b}	10.85^{c}	57.4^{jk}	62.41^{e}	10^{m}	26.26^{j}	-41.08^{h}
Prima x Top Red 2	88.62^{k}	14.7^{gcfde}	3.42^{m}	0.41^{b}	9.1^{h}	68.2^{b}	55.17^{k}	15.14^{h}	37.28^{d}	-69.45^{o}
M. floribunda x Prima	100.53^{i}	17.2^{cadb}	3.6^{kl}	0.39^{b}	10.15^{e}	58.1^{jk}	27.11^{r}	11.75^{lk}	3.34^{r}	-54.93^{m}
Ambri x White Dotted Red	107.82^{h}	12.1^{gifh}	3.49^{ml}	0.28^{b}	9.45^{g}	41.6^{n}	74.28^{b}	-9.17^{t}	46.66^{a}	3.13^{a}
Prima x Red Delicious	120^{g}	13.6^{gfhe}	3.41^{m}	0.33^{b}	11.2^{b}	61.8^{fgh}	55.63^{kj}	23.57^{d}	26^{j}	-85.51^{s}
Ambri x Top Red 2	143.56^{e}	14.3^{gfdhe}	4.09^{fg}	0.27^{b}	6.3^{o}	54.1^{l}	37.97^{p}	29.49^{b}	14.48^{p}	-122.81^{x}
Ambri x Mollies Delicious 2	150.23^{d}	14.5^{gcfdhe}	4.41^{b}	0.35^{b}	10.5^{d}	59.2^{ij}	61.56^{f}	15.21^{h}	31.87^{f}	-59.86^{n}
Prima x Red Delicious 1	117.18^{g}	18.2^{ab}	3.62^{kl}	0.37^{b}	9.1^{h}	62.6^{fge}	48.55^{m}	25.25^{c}	25.03^{k}	-100.23^{v}
Mollies Delicious X Well Spur	54.59^{m}	17.8^{cab}	3.7^{jki}	0.29^{b}	11.54^{a}	60.8^{igh}	36^{q}	29.47^{b}	21.67^{m}	-139.01^{y}
Red Delicious x Gala Mast	100^{i}	13.9^{gfdhe}	3.75^{jki}	0.27^{b}	8.05^{k}	68.5^{b}	59.21^{g}	14.4^{i}	31.95^{f}	-59.6^{n}
Prima x Top Red 3	108.42^{h}	18.4^{ab}	4.3^{dbc}	0.3^{b}	5.6^{q}	68.2^{b}	55.5^{k}	10.64^{m}	27.31^{i}	-48.06^{i}
Golden Delicious x Red Fuji	116.78^{g}	18.8^{a}	3.45^{m}	0.32^{b}	9.8^{f}	57.3^{jk}	56.37^{ij}	12.44^{jk}	26.29^{j}	-52.06^{j}
Golden Delicious x Cooper IV	162^{c}	17.2^{cadb}	3.85^{hi}	0.36^{b}	8.75^{i}	50.1^{m}	43^{o}	28.88^{b}	19.21^{n}	-114.93^{w}
Golden Delicious x Silver Spur 1	108.63^{h}	16.5^{cadbe}	3.95^{hg}	0.38^{b}	8.05^{k}	64.1^{de}	57.09^{i}	5.37^{n}	29.22^{h}	-32.45^{g}
Golden Delicious x Silver Spur 2	91.62^{kl}	15.3^{cfdbe}	3.81^{jhi}	0.41^{b}	10.85^{c}	58.1^{jk}	65.54^{c}	-0.05^{q}	43.84^{b}	-21.06^{d}
Golden Delicious x Silver Spur 2	95.66^{ij}	15^{gcfdbe}	3.67^{jk}	0.47^{b}	10.15^{e}	71.1^{a}	65.23^{c}	-6.52^{s}	37.2^{d}	-0.17^{b}
Prima x Ambri 2	110.01^{h}	11.59^{gih}	4.13^{fe}	0.36^{b}	8.05^{k}	63.5^{fde}	55.56^{k}	-5.6^{r}	39.14^{c}	-3.16^{c}
Prima x White Dotted Red	109.62^{i}	10.13i	4.26d^{bec}	0.23^{b}	11.5^{a}	61.8^{fgh}	52.36^{l}	20.12^{f}	13.52^{q}	-91.63^{u}

Golden Delicious x Oregon Spur	135.36^{f}	15^{gcfdbe}	4.15^{dfe}	0.39^{b}	7.35^{l}	58.2^{jk}	36.03^{q}	34.11^{a}	15.11^{p}	-147.58^{z}
Golden Delicious x Gala Mast	99.6^{i}	16.7^{cadbe}	3.95^{hg}	0.42^{b}	6.65^{n}	61.8^{fgh}	56.44^{i}	21.49^{e}	24.81^{k}	-77.34^{q}
Golden Delicious x Snow Drift	162.01^{c}	14.6^{gcfdhe}	4.29^{dbc}	0.37^{b}	9.1^{h}	66.8^{bc}	63.95^{d}	2.35^{p}	3.87^{r}	-28.45^{e}
Pr<F	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Means followed by the same letter within the columns are not significantly different (P=0.05) using Duncan's multiple range test.

Screening of apple hybrids for presence of scab resistant gene (s)

In continuation to previous year hybrids with parentage of either Prima or *M. floribunda* were again screened for the presence of scab resistant gene (s) and it was found that three hybrids viz Prima x Red Delicious, Well spur × *M. floribunda* and American Apirogue × *M. floribunda* showed the presence of resistant gene Vf Rvi6. The resistant gene in these hybrids is contributed by their parents viz Prima and *M. floribunda*. Thus the stability of the gene over second year was ascertained. Out of three genes tested only VfRvi6-a gene was found present in these hybrids (Fig.8).

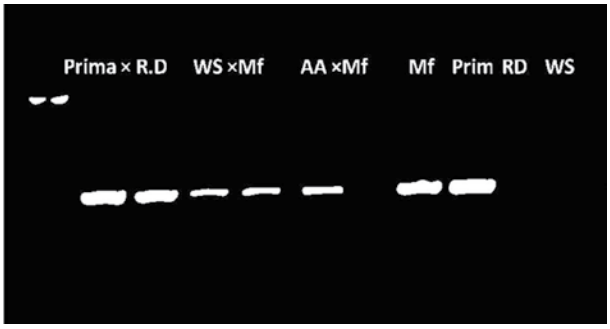


Fig.8. Amplification of Vf (Rvi6) gene in hybrids and their respective parents

Hybridization for disease resistance and fruit quality traits in apple cultivar Ambri

During 2018-19, crosses were made between apple cultivar Ambri x *Malus floribunda* for introgresing scab resistance and fruit color traits into cultivar Ambri. Two cross combinations were made between apple cultivar Ambri with Oregon Spur & Prima for introgression of fruit quality traits from cultivar Oregon Spur and scab resistance from cultivar Prima. Crossed population of about 1000 individuals were raised in each cross combination and will be grafted on M-9 rootstock for early bearing and further evaluation.

Ambri x Prima

Ambri x Oregon Spur

Hybrid seed germination and maintenance for further evaluation

Compatibility studies in pear

Cross-pollination is necessary in pear to obtain high yields as well as properly shaped fruits. During the establishment of an orchard, it is very important to select compatible pollinizers from diploid cultivars having synchronization in blooming period. Keeping in view problem of low fruit set in pear, 29 crosses/ reciprocal cross combinations were performed during the year 2018, based on the synchronization of the flowering between the cultivars. The crossing were done using eleven pear cultivars including William Bartlett (WB), Santya Braskaya (SB), Fertility (F), Gent Drouard (GD), Z H Copaceae (ZH), Kashmiri Nakh (KN), Badshah Nakh (BN), Japanese Pear (JP), Chinese Sandy Pear (SP) and Starkrimson (ST). Among the crosses performed the fruit set success percentage ranges from 0%-90% . The highest fruit set percentage (90%) was recorded in cross between (WB x GD). Out of total crossing zero percent fruit set was achieved in two cross combinations (F x KN and ST x F). From the information it can be concluded that Starkrimson and Chinese sandy pear can be employed as potential pollinizer for the Nakh cultivars and can increase the fruit set percentage.

Breeding for nutrarich varieties/hybrids in root vegetable crops

To develop nutrarich varieties/hybrids in root vegetable crops, different carrot, radish and turnip accessions were evaluated for hybridization. The different crosses of Purple Globe, Purple Round, Pink Top White Globe, Pink Top White Round, Pink Top White Flat, Mustard Yellow, Pink Round, White Round, White Globe, White Flat, Pink Flat, Pink Globe, Golden Ball and Pusa Chandrima were made in turnip hybridization programme and simultaneously got different F_2 programme of turnips whereas in radish, green, white, and pink types were crossed and got F_1 hybrids of radish. The 15 carrot accessions and local temperate types were crossed for improvement of anthocyanin, lycopene and β-carotene content in temperate carrot. The different twenty two radish types were crossed for enhancement of anthocyanin pigments in F_1 generations.

Turnip Hybrids (Top purple round ×White Long, White Long Top ×Purple Round, Green Round × White Long)

Trait specific Radish germplasm suitable for hybridization

Breeding for development of superior varieties/hybrids in Solanaceous crops

In this project following work was done in different crops at Srinagar and Mukteshwar:

Srinagar

Advanced evaluation of promising lines in chilli, sweet pepper and brinjal

Twenty-two promising lines each in chilli were evaluated for yield and related traits for the third year. The lines varied significantly for fresh red ripe fruit yield that ranged from 5.75 to 25.32 t/ha. The top three yielders were KA-2-Sel-1, CITH-HP-91/13 and Sel-1011-2(E) with yield from 25.32 to 23.81 t/ha. However, all three were statistically at par with local check Kashmiri Long-1 (21.17) but superior to national check ARCH-228 (14.27). In sweet pepper, 15 promising lines were evaluated and lines didn't differ significantly with respect to total fruit yield that ranged from 46.69 to 76.81 t/ha. All lines performed at par with local check Nishat-1 (67.88) and the top yielders were N-7-Sel-2, Gold-1 and Sel-19/11 which yields from 76.80 to 71.56 t/ha. In brinjal 16 lines were evaluated. There were significant differences for total fruit yield that ranged from 17.69 to 38.30 t/ha. The top yielders were Gulabo, B-SB-2 and B-4-16 with yield range of 38.30 to 31.20 t/ha.

Mukteshwar

Evaluation of F_2 population of tomato hybrid

Among fifteen genotypes of tomato evaluated during 2018, maximum plant height (2.80 m), branch length (1.71m) and number of branches/ plant (2.91) were recorded in genotypes FMS x Shalimar, FMS x Roma and FMS x NS-630, respectively. The maximum plant spread i.e. east-west (71.94 cm) and north-south (63.39 cm) was recorded in genotypes FT-1 and Roma, respectively. The highest fruit length (55.65 mm), fruit breadth (62.61 mm) and number of fruits/ plant (32.01) were recorded in FT-5, Marglobe and FMS x CT-1, respectively. The maximum average fruit weight (123.20 g), total yield/plant (1.037 kg) and total yield/ha (400.00 q) were recorded in genotypes FMS x Sioux, FMS x VL-4 and VL-4, respectively.

Fruiting in different tomato genotypes

Capsicum

Among twelve genotypes evaluated during 2018, maximum plant height (95.73 cm), branch length (76.45cm) and average fruit weight (139.33g) were recorded in genotype Torquataito, whereas, number of branches/plant (4.58) and fruit length (93.48 mm) were recorded with CITH-M-Sel-5. The maximum plant spread east-west (47.61 cm), north-south (39.60 cm), fruit breadth (77.38 mm), number of fruits/plant (17.16), total yield/plant (1.48 Kg) and total yield (548.14 q/ha) recorded in CITH-M-Sel-4, respectively (Table 4&5) .

Table 4. Vegetative growth parameters of capsicum genotypes

S. No.	Genotypes	Plant height (cm)	Branch length (cm)	No. of branches/ plant	Plant spread (cm)	
					East-West	North-south
1.	Swanwarra	83.94	59.87	3.38	28.97	27.66
2.	Orobelle	64.28	50.82	3.04	25.64	21.77
3.	Tarquataito	95.73	76.45	3.36	35.12	29.01
4.	Swarn Bharat	56.68	44.31	3.53	30.93	28.14
5.	Lucky Star	53.74	36.42	3.20	26.53	22.64
6.	Tanvi	56.70	43.91	3.40	27.53	24.90
7.	Indam Super	39.41	28.50	3.08	20.34	17.20
8.	Indam Lakshmi	43.98	25.39	3.06	24.93	22.06
9.	Yellow Wonder	56.81	31.55	4.19	33.72	29.33
10	CITH-M-Sel-2	48.65	24.00	2.41	26.02	22.63
11.	CITH-M-Sel-4	59.32	39.77	4.80	47.61	39.60
12	CITH-M-Sel-5	63.57	41.89	4.58	41.16	33.56
	CD 5%	*6.74*	*6.68*	*0.678*	*3.59*	*3.95*

Table 5. Fruit and yield parameters of capsicum genotypes

S. No.	Genotypes	Fruit length (mm)	Fruit breadth (mm)	No. of fruits /plant	Av. Fruit weight (g)	Total yield/ plant (Kg)	Total yield (q/ha)
1.	Swanwarra	85.66	72.12	9.22	100.93	1.35	500.00
2.	Orobelle	70.74	65.48	8.36	90.66	0.879	325.55
3.	Tarquataito	93.36	75.04	10.55	139.33	0.975	361.11
4.	Swarn Bharat	61.03	60.21	6.80	108.26	0.599	221.85
5.	Lucky Star	74.40	55.89	6.40	96.40	0.661	244.71
6.	Tanvi	61.79	66.53	5.23	120.73	0.577	213.70
7.	Indam Super	76.08	68.44	3.61	127.80	0.436	161.48
8.	Indam Lakshmi	59.53	67.48	4.91	100.40	0.390	144.44
9.	Yellow Wonder	77.18	70.82	7.75	95.06	0.659	244.07
10	CITH-M-Sel-2	86.35	57.67	13.33	74.13	0.909	336.66
11.	CITH-M-Sel-4	85.33	77.38	17.16	117.20	1.48	548.14
12	CITH-M-Sel-5	93.48	46.61	14.50	80.13	0.981	363.33
	CD at 5%	14.61	10.05	2.54	23.49	0.161	6.60

Chilli

Among the six genotypes of chilli evaluated during 2018 maximum plant height (82.40 cm), branch length (67.80 cm), plant spread i.e. east-west (57.50cm), north-south (58.59cm), fruit breadth (23.31mm) and average fruit weight (12.40g) was recorded in genotype CITH-M-Sel-2. Whereas, the number of branches/plant was recorded highest in Kashi Tej (6.83). The maximum fruit length (11.09 cm), number of fruits/plant (47.00), total matured fruit yield/plant (0.578 Kg) and total yield (214.07 q/ha) recorded in Kashi Anmol, respectively (Table 6&7).

Development of CMS lines in long day onion (*Allium cepa* L.)

The hybrids obtained from crosses between short day male sterile lines and promising long day onion cultivars were planted for evaluation under long day conditions. The hybrids have developed bulbs and will be evaluated for yield, bulb characteristics and post harvest life. The transferred S-cytoplasm in the long day parents will increase the frequency of male sterile plants. These plants will be identified for the absence of pollen viability in the upcoming flowering stage for development of CMS lines in long day background.

Table 6. Vegetative growth parameters of chilli genotypes

S. No.	Genotypes	Plant height (cm)	Branch length (cm)	No. of branches/ plant	Plant spread (cm)	
					East-West	North-south
1.	Kashi Tej	48.86	33.70	6.83	46.75	42.74
2.	CITH-M-Sel-1	49.12	33.69	3.16	32.83	32.09
3.	Kashi Anmol	60.49	41.28	4.78	45.96	46.92
4.	Kashi Surj	68.26	50.12	4.50	40.39	37.00
5.	CITH-M-Sel-2	82.40	67.80	6.00	57.50	58.59
6.	Local	82.13	60.91	3.64	49.20	42.45
	CD at 5%	11.71	8.46	1.17	7.84	5.08

Table 7. Fruit and yield parameters of chilli genotypes

S. No.	Genotypes	Fruit length (cm)	Fruit breadth (mm)	No. of fruits/ plant	Av. weight of matured fruit(g)	Total yield/ plant (kg)	Total yield (q/ha)
1.	Kashi Tej	7.28	7.16	29.50	1.86	0.260	96.29
2.	CITH-M-Sel-1	8.28	7.15	5.83	3.80	0.376	139.25
3.	Kashi Anmol	11.09	12.17	47.00	3.86	0.578	214.07
4.	Kashi Surj	9.87	12.39	43.00	5.00	0.114	42.22
5.	CITH-M-Sel-2	8.00	23.31	13.00	12.40	0.174	64.44
6.	Local	6.56	9.14	6.00	3.60	0.186	68.88
	CD at 5%	1.97	1.81	5.17	1.25	0.760	7.31

View of onion field for development of CMS line

ii. Crop Production

The quality planting material is the main component of horticulture industry to boost the productivity of quality produce and can increase income and socio economic status of farmers. ICAR- CITH Srinagar and its regional stations are continuously propagating planting material of elite varieties of temperate fruits, nuts, vegetables and ornamentals to supply quality planting material to farmers, line department and research organizations. The demand for institute planting material is increasing year after year. During 2018-19, institute has supplied more than 22000 plants of different temperate fruit crops including 5000 budsticks and 1600 strawberry runners. The institute has grafted/ budded about 50000 plants and raised 40000 almond rootstocks for next year. In vegetables, 358 kilogram of seed was produced in vegetable crops and supplied/ sold to different stakeholders and consumers like kitchen gardeners, vegetable growers, research organization etc. About 120 kg cloves of garlic varieties CITH-G-1 and CITH-G-3 were supplied to the Department of Agriculture, Kashmir for the benefit of garlic growers of the valley. During the year 2018-19 emphasis was given for multiplication and commercialization of walnut varieties released by ICAR-CITH, Srinagar. About 5000 grafted plants of CITH-W-1, CITH-W-2, CITH-W-3, CITH-W-4, CITH-W-5, CITH-W-6, CITH-W-7, CITH-W-8, CITH-W-9 and CITH-W-10 were provided to Uttarakhand Forest Resource Management Project for establishment of mother orchards under project promotion of walnut in Uttarakhand funded under JICA. During the year 2018-19 an area of about 35 ha was covered under these varieties in Uttarakhand region. In addition about 900 grafted plants of these walnut varieties covering an area of about 6 ha was provided to Department of Horticulture, Kashmir for establishing progeny orchards for further popularization of these varieties among the farmers.

Enhancing feathering through plant growth regulators for high quality nursery production in apple.

Feathering is the important component of nursery production especially in apple for adoption of desired training system and early returns. To standardize technique for inducing feathers in one year old apple nursery plant to produce two year old well feathered apple nursery tree which is critical component of most of the modern high density apple orchard. Number of trials has been conducted at ICAR-CITH, Srinagar during 2017 and 2018 to find out appropriate concentration, spray interval and spray frequency. A factorial experiments were carried out separately on Gala Mast and Oregon Spur trees using three concentration of BA (500, 600 and 700 ppm), two spray interval (one week and two week) and three spray frequency (3, 4 and 5). The findings revealed that Gala Mast produce satisfactory feathers (9.71) with the application of four spray of 600 ppm BA at one week interval compared with control. Whereas, Oregon Spur needed five sprays of 600 ppm BA at two week interval to produce satisfactory feathers (8). Furthermore to produce highly feathered nursery plant suitable for vertical planner canopy orchard planting system, factorial experiments were laid out in both above mentioned cultivars separately using higher concentration of BA (1000, 1500 and 2000 ppm), two spray interval (one week and two week) and three spray frequency (3, 4 and 5). The results revealed that one year old Gala Mast nursery trees produce highly feathered nursery trees (11.33 feathers) in second year of nursery cycle when three times sprayed with 1000 ppm BA at weekly interval. In contrast during second year of nursery cycle Oregon Spur trees produce highest number of feathers (10.25) when sprayed five times with 2000 ppm BA at two week interval. Another experiment was conducted to find out appropriate apical growth for first spray of benzyladenine to one year old apple nursery tree

for feather induction on Oregon Spur cultivar of apple. Four sprays of 600 ppm BA were performed at two week interval. The treatments include varying new apical growth *i.e.* 0 or no growth, 1-5, 5-10, 10-15, 15-20 and 20-25 cm at the time of first application of benzyladenine. The result obtained from investigation revealed that 15-20 cm new growth was found most appropriate for first spray of benzyladenine to produce desirable number of feathers (7.5) with appropriate height (75.5 - 99 cm), optimum length (88% feathers with 10-40 cm length), moderate vigor (2.58 trunk to mean feather diameter ratio) and satisfactory crotch angle (45° from vertical) on one year old Oregon Spur nursery plant. One more experiment was conducted to find out ideal height of one year old apple nursery tree for feathering through plant growth regulator application on Gala Mast. Four sprays of 600 ppm BA were applied at one week interval. The treatment include different height of one year old nursery plants *i.e.* 40-50, 50-60, 60-70, 70-80, 80-90, 90-100 and 100-110 cm for application of plant growth treatment for feathers induction. Results based on all the studied parameters proved that 60-80 cm plant height was found most appropriate for feathering in one year old nursery tree of Gala Mast.

Management of pre harvest fruit drop in apple.

During 2018-19 an experiment on fruit drop management was conducted in apple cultivar Super Chief and it was observed, that maximum fruit weight (183.85g), fruit length (66.24 mm), fruit diameter (76.60 mm) and pedicle length (18.05 mm) was recorded in thinning treatment i.e. one fruit /cluster respectively while the minimum values for fruit weight (153.71g), fruit length (63.92mm) and fruit diameter (70.02mm) were recorded in control. Among the colour characteristics L* values ranged from 32.78 in control to 37.12 in 3 fruits/cluster, a* values ranges from 24.52 in 01 fruit/cluster to 25.75, 02 fruits/cluster and no negative value was found in any cluster. Values for b* scale range from 9.36 in 01 fruit/cluster to 10.39 in 02 fruits/ cluster and no accession showed negative b* value. Values for tint ranged from (-109.26) in 02 fruits/ cluster to (98.57) in control. Maximum fruit firmness (67.91 RI) was recorded in control while the minimum in 02 fruits/ cluster (65.39 RI). Maximum TSS (16°B) was recorded in 01 fruit /cluster and minimum (14.48 °B) in control. From the data it can concluded that by fruit thinning not only the fruit weight improved but the quality of the fruits also improved. Percentage fruit drop ranged from 15.88-20.88%, in cultivar Super Chief of apple under different thinning levels. The maximum fruit drop (20.88%) was recorded in control with average fruit weight of 153.71g followed by 03 fruits/ cluster (18.64) with average fruit weight of 164.22g while the minimum fruit drop (15.88 %) was recorded in 01 fruit/ cluster with average fruit weight of 183.85g. Therefore fruit thinning can not only improve the quality of fruit but can also reduce the pre harvest fruit drop percentage (Fig 9).

01 Fruits/Cluster | 02 Fruits/Cluster 2 | 03 Fruits/Cluster | Control (No thinning)

Fruits of apple cultivar Super Chief in different thinning treatments

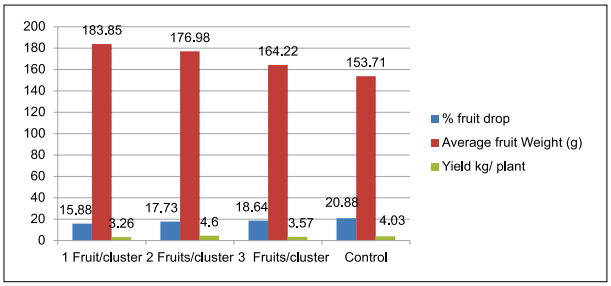


Fig. 9: Effect of fruit thinning on preharvest fruit drop percentage in apple cultivar Super Chief

Evaluation of different substrates and systems for soilless strawberry (*Fragaria x ananassa* Duch.) production in naturally ventilated greenhouse conditions.

During the year 2018, based on the findings of the first experiment, second experiment was conducted to evaluate the suitable cultivar/ genotype for soilless strawberry production under green house conditions. By employing best three substrate combinations (coco peat+ vermiculite 50:50), (coco peat+ vermiculite 25:75), and (coco peat: vermiculite: Perlite 50:25:25), nine strawberry cultivars (Chandler, Camarosa, Sweet Katrian, Douglas, Bangalore, Missionary, Addie, IC-319093 and Curaliar) were evaluated for different growth, yield and quality parameters. Based on the findings it was observed that cultivar Douglas performed best in respect of growth, yield and quality by employing substrate coco peat + vermiculite (50:50), followed by the treatment coco peat: vermiculite: perlite (50:25:25) under protected conditions. Micronutrient (Mn, Zn, Fe and Cu) analysis of leaf was performed in nine strawberry cultivars grown on different substrates revealed significant variation among the treatments and the effect of different substrates on leaf micronutrient status was confirmed in all the genotypes.

Development of almond based intercropping system involving saffron

Saffron growing under spreading, erect, semis erect type of almond varieties and as sole, there was non-significant difference for most of the floral traits of saffron. Highest saffron yield was recorded in saffron planted under erect type varieties (1.428 kg/ha) followed by spreading type (1.015 kg/ha), semi erect (0.940kg/ha) and sole (0.970 kg/ha). Highest almond yield 9.50 q/ ha was recorded in spreading type of varieties followed by semi erect (8.62q/ha) and erect (7.93 q/ha) type of varieties. Highest equivalent saffron yield (4.815 kg/ha) were recorded in saffron plants under spreading type of varieties. The crocin content were also evaluated in saffron under different systems like erect, semi erect, spreading and sole. Among all these systems maximum crocin (4.713 mg/100mg) was recorded highest in semi erect followed by sole (4.107) and spreading (3.753 mg/100mg) type of almond varieties respectively, while saffron growing under erect type of varieties showed lowest content of crocin (3.393 mg/100mg). Studies were also carried out to evaluate crocin content in saffron at different flower stages and among six stages, stage 3 recorded highest crocin content (4.64 mg/100mg) followed by stage 2 (4.2 mg/100mg), stage 5 (3.88 mg/100mg), stage 4 (3.86 mg/100mg) and stage 6 (3.67 mg/100mg) while lowest crocin content were recorded in stage 1(3.27 mg/100mg). This study is helpful to growers for harvesting the saffron even before to wait to flower open. Based on the above, the saffron –almond is best combination and there is less effect of various varieties having different growing habit on saffron, thus giving farmers additional return.

T^{10} (Douglas) T^{16} (Douglas) T^{16} (Camarosa) T^{16} (Camarosa)

Fruiting of strawberry under different growing media

Saffron – almond intercropping

Divulging the adept mode of fertilizer application to optimize saffron yield

Carbon builds up rate as influenced by various modes of N application in saffron growing soils

Impact of various modes of nitrogen fertilization on carbon build up rate in saffron growing soils, (based on five years data), was revealed (Fig 10). It was observed that maximum carbon build up rate per year was in soils where nitrogen was applied as mid rib placement upper to corms in two splits (*MRPU-2S)*. This was a significant finding as carbon depletion can be reduced by this method of N application in saffron growing soils.

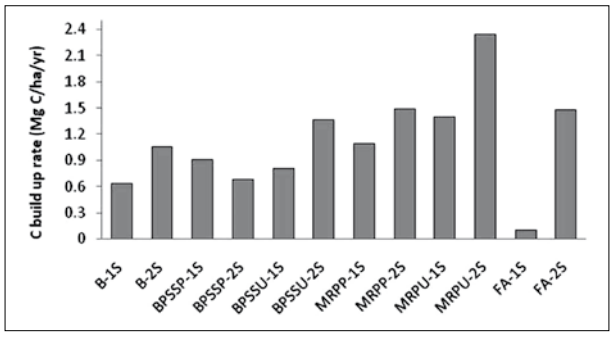


Fig 10: Carbons build up rate as influenced by various modes of N application in saffron growing soils

C :Control; B-1S: Broadcasting in one split (conventional method I); B-2S: Broadcasting in two splits (conventional method II); BPSSP-1S: Band placement single sided parallel to corm in one split; BPSSP-2S: Band placement single sided parallel to corm in two splits; BPSSU-1S: Band placement single sided upper to corm in one split; BPSSU-2S: Band placement single sided upper to corm in two splits; MRPP-1S: Midrib placement single sided parallel to corm in one split; MRPP-2S: Midrib placement single sided parallel to corm in two splits; MRPU-1S: Midrib placement single sided upper to corm in one split; MRPU-2S: Midrib placement single sided upper to corm in two splits; FA-1S: Foliar application in one split; FA-2S: Foliar application in two splits

Besides carbon build up rate, relationship amongst nitrogen lost, after N fertilization, and nitrogen use/accumulation efficiency (NUE/NAE), yield and apocarotenoid contents were also worked out (Table 8). Saffron yield was significantly and positively related to NUE (r=0.821**) and NAE (r=0.822**). N_2O-N emission (r=-0.852**) and nitrate leaching (r=-0.798**) were significantly and negatively related to NUE. A significant and negative correlation of N_2O-N emission (r=-0.852**) and nitrate leaching (r=-0.798**) with NAE was also observed. All other parameters did not show any significant correlation amongst them. A positive correlation of saffron yield with NUE explains that supplied nitrogen was taken and used efficiently for enhancing the vigour of stigma which is the only part that constitutes the yield of saffron. A negative relation of saffron yield with N losses explains the fact that lost nitrogen, which otherwise had played its role in various metabolic activities to optimize yield, escaped from root zone and could not be utilized by the plant.

Table 8. Correlation coeficient (r) between various parameters in saffron growing cold humid region of North West Himalayas

	Yield	Crocin	Safranal	NUE	NAE	N_2O-N emission	Nitrate leaching
Crocin	0.115						
Safranal	0.433	0.317					
NUE	0.821**	0.198	-0.008				
NAE	0.822**	0.197	-0.005	1.000**			
N_2O-N emission	-0.138	-0.023	0.255	-0.852**	-0.852**		
Nitrate leaching	-0.090	0.004	0.291	-0.798**	-0.798**	0.916**	
Nitrate as surface runoff	0.015	-0.235	-0.187	-0.198	-0.203	0.318	0.488

Fertigation: An efficient stratagem to enhance apple yield

Effect of various fertigation treatments on nutrient uptake and accumulation was worked out. For total macronutrient content of leaf and fruits, all the fertigation treatments performed significantly better than control with respect to each nutrient (Table 9). The treatments 100% RF in two splits [100%RF (2S)] and 75% RF in two splits [75% RF (2S)] performed better in all three cases. As regard to N, P and K in leaf+fruit, the respective values were 24.3, 3.5 and 28.7 g kg^{-1} in case of 100% RF through fertigation in two splits and 24.1, 3.3 and 28.5 g kg^{-1} in treatment where 75% RF was applied through fertigation in two splits. While calculating nutrient accumulation efficiency (%) in leaf and fruits collectively, all fertigation treatments were found to differ significantly in their effectiveness. In all cases, 50% RF in two splits [50% RF (2S)] was found to be best, except that in phosphorus accumulation

Table 9. Nutrient accumulation efficiency and total nutrients concentration in leaf + fruit as influenced by fertigation in apple

	Total macronutrient (leaf+fruit) (g kg^{-1})			Nutrient accumulation efficiency (%) (leaf+fruit)		
	N	P	K	NAE	PAE	KAE
Control (C)	14.53 (±0.17)	1.80 (±0.08)	17.90 (±0.67)	-	-	-
BA	16.10 (±0.15)	2.13 (±0.09)	19.40 (±0.31)	3.03 (±0.03)	0.98 (±0.04)	2.05 (±0.05)
100% RF (1S)	17.50 (±0.17)	2.27 (±0.09)	22.17 (±0.09)	3.29 (±0.03)	1.04 (±0.04)	2.35 (±0.01)
100% RF (2S)	24.30 (±0.06)	3.53 (±0.09)	28.73 (±0.14)	4.57 (±0.01)	1.62 (±0.04)	3.04 (±0.02)
75% RF (1S)	19.30 (±0.21)	2.43 (±0.07)	20.83 (±0.19)	4.84 (±0.05)	1.49 (±0.04)	2.94 (±0.03)
75% RF (2S)	24.07 (±0.20)	3.33 (±0.05)	28.50 (±0.29)	6.03 (±0.05)	2.04 (±0.03)	4.02 (±0.04)
50% RF (1S)	17.17 (±0.24)	2.24 (±0.08)	21.60 (±0.06)	6.45 (±0.09)	2.05 (±0.07)	4.57 (±0.01)
50% RF (2S)	17.93 (±0.03)	2.37 (±0.07)	22.50 (±0.01)	6.74 (±0.01)	2.17 (±0.07)	4.76 (±0.01)
CD (5%)	*0.53*	*0.25*	*0.96*	*0.14*	*0.16*	*0.07*
SE (d)	*0.24*	*0.12*	0.44	0.06	0.07	0.03
SE (m)	0.17	0.08	0.31	0.04	0.05	0.02
CV	1.58	5.68	2.39	1.57	5.55	1.22

efficiency, 50% RF in single application [50% RF (1S)] and 75% RF in two splits [75% RF (2S)] were at par with this treatment in case of all three *i.e.* N, P and K accumulation efficiency.

Fertigation significantly affects the yield. So the relationship between yield and yield fertilizer ratio (YFR), in fertigation, can prove to be a significant tool in planning fertigation treatments for apple. In order to understand the relationship between yield and YFR, best fit model, *i.e.* polynomial model, was identified (Fig 11). Fruit yield increased initially with widening YFR and then started decreasing. The relationship between yield and YFR can be explained by following equation:

$$\text{Yield} = -0.10\ (\text{YFR}^2) + 3.11\ (\text{YFR}) + 3.37$$

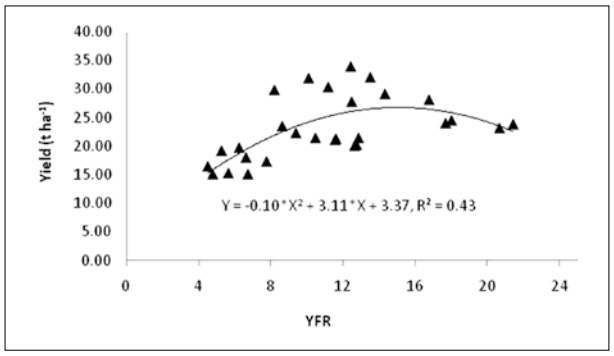


Fig. 11. Apple yield as influenced by YFR in apple-growing cold humid regions of north-west Himalayas

Standardization of integrated nutrient management of vegetables as intercrop in apple orchard.

An experiment was conducted in ICAR-CITH, regional station, Mukteshwar, Uttarakhand on effect of vegetable intercropping on the fruit quality of apple. Data on effect of intercropping on fruit quality *i.e.* fruit length, fruit diameter, fruit weight, fruit firmness and yield of apple were recorded during the year 2013 to 2018. Effect of pea and cauliflower as inter crop for quality and yield of apple was statistically found significant. According to five year data treatment comprising FYM + vermicompost + biofertilizer + inorganic was found best in terms of highest fruit length (63.06 mm and 63.90 mm), fruit diameter (71.13 mm and 71.59 mm), fruit weight (151.94g and 156.35g), fruit firmness (12.43 lb/ inch^2 and 13.35 lb/ inch^2) fruit TSS (13.46 °B and 12.39 °B) and yield (32.83 kg/tree and 29.38 kg/tree) of apple per tree as compared to other treatments intercroped with pea and cauliflower respectively. Effect of integrated nutrient management (INM) on different growth parameters of intercrops such as plant height, number of leaves, curd diameter, curd weight and yield in cauliflower was also studied and plant height, number of branches, pod length and yield in pea were also statistically found significant. Highest (77.07 cm) height, number of branches/plant (13.34), pod length (9.30 cm) and yield (51.37 q/h) were recorded in treatment comprising of FYM + vermicompost + biofertilizer + inorganics in pea intercrop in apple orchard followed by FYM + vermicompost + inorganics treatment. Maximum (44.90 cm) height, leaves per plant (17.51), curd diameter (19.41 cm), curd weight (427.41) and yield (163.09 q/ha) recorded in cauliflower intercropped and treated with FYM + vermicompost + biofertilizer + inorganics in apple orchard. Conclusively, treatment FYM + vermicompost + biofertilizer + inorganics with intercrops pea and cauliflower was found best for improving the apple quality and treatment FYM + vermicompost + biofertilizer + inorganics also found effective to improve the growth parameters and yield of pea and cauliflower. Moreover fruit quality and yield of apple was found best under intercrop with pea as compared to cauliflower.

Enhancement in multiplication rate of clonal rootstocks of apple for production of quality planting material under protected conditions.

During the year 2018 for enhancing the multiplication rate in clonal rootstocks of apple a trial was conducted at ICAR-CITH, Srinagar. The rootstocks were planted at an angle of 15° angle (Slanting) in a green house followed by pinching to select the vigorously growing laterals. When these laterals attained the size of 10-15 cm, treatment of 2500 ppm IBA were applied after giving the incision at the base of the these laterals to initiate rooting followed by covering these lateral up to 10cm with suitable substrates like cocopeat, vermiculite and perlite. The multiplication rate

Multiplication of clonal rootstock of apple under protected conditions.

of these rootstocks from the first year in stool beds in polyhouse conditions has increased to 5-8 rooted graftable size plants (depending upon the rootstock).The rootstocks produced through this technique were healthier with caliper size (4.5-5.5 mm) at graftable height and well developed root system.

Crop diversification technology for round the year vegetable production under protected conditions in mid and high hills of Uttarakhand

In this project, six vegetable crops viz. tomato, cucumber, capsicum, broccoli, Chinese cabbage and lettuce were taken as components of diversification. These rops were grown under polyhouse conditions in high hills (Mukteshwar) and mid hills (Pokhrad) of Nainital district of Uttarakhand state. The cost of cultivation and benefit ratio was calculated during the year. The total cost of cultivation was Rs. 3450.00 for capsicum, Rs. 3300.00 for tomato, Rs. 3250.00 for broccoli, Rs. 3050.00 for Chinese cabbage, Rs. 2950.00 for lettuce and Rs. 2600.00 for cucumber for 200 m2 area of polyhouse. Gross return and net returns along with B:C ratio were worked out for both the situations, high hills and mid-hills of Nainital districts. Under high hills agro-climatic conditions, maximum average fruit yield of 703.70 kg/200m2 was obtained for capsicum crop and minimum in broccoli (63.64 kg). Cucumber yielded next (279.27 kg) with lettuce as close performance (277.10 kg) and Chinese cabbage produced 220.57 kg. As viewed from the angle of net returns and B:C ratio, capsicum provided profit of Rs. 31735.00 (9.20) whereas the next was lettuce with Rs. 10905.00 (3.70). Other crops in succeeding crops were Chinese cabbage giving a net return of Rs. 7978.50 (2.62), cucumber Rs. 5778.10 (2.20), tomato Rs. 4478.10 (1.36) and broccoli gave least profit of Rs. 568.40 only with a B:C ratio of 0.17. Under mid hills situation the profit and B:C ratio was comparatively of smaller magnitude. Capsicum crop giving a profit of Rs. 12105.50 with B:C ratio of 3.51 was on the top and broccoli with Rs. 404.60 (mere 0.12) was poorest earner and cucumber gave Rs. 389.20 only but with a slightly higher B:C ratio of 0.15 than that of broccolli. Lettuce gave a net return of Rs. 9231.00 (3.13) stood second, tomato (Rs. 6112.00, 1.85) as third and Chinese Cabbage (Rs. 3931.00, 1.29) fourth. Thus, a polyhouse grower can rely upon capsicum for best earning under both situations whereas lettuce may be second and Chinese cabbage as next choice from B:C ratio point of view. The case with tomato and cucumber is different. Tomato can earn more (Rs. 6112.00) in mid hills whereas only Rs. 4478.00 in high hills whereas cucumber is quite different earning more (Rs. 5778.10) in high hills contrary to Rs. 389.20 only in mid hills. Broccolli was last and discouraging option

Standardization of growing/nutrients media and growing conditions for cost effective production of quality vegetables and their seedlings

In this experiment, fourteen media were tried for production of seedlings of vegetables like tomato, capsicum, cucumber, broccoli, Chinese cabbage and lettuce. The cost benefit ration was calculated for each crop. In tomato, based on B: C ratio criterion, a seed sown in soil media proved best giving maximum of 3.82 B:C ratio and FYM+FL media was next (3.48), other followers were in descending order like soil + FYM (3.38), FYM (3.31), Soil + FYM+ FL (3.19), soil + FL (3.18) and, forest litter (3.01), FYM+ VC + FL (2.73), Soil+ FYM+ VC + FL (2.73), VC+FL (2.39), soil + VC (2.26), FYM + VC (2.15), soil + FYM + VC

Field view of trials in different crops

(2.15), and vermi compost (1.98). The inclusion of vermi compost in growing media tends to decrease returns B:C ratio and consequently vermi compost alone as media gave the minimum benefit. In capsicum, highest B:C ratio of 3.18 in FYM media was followed by soil (3.09) while least of 1.29 with VC. Thus FYM proved best media, soil second and VC the poorest one for raising capsicum seedlings in terms of B:C ratio and profit as well. In cucumber, FYM was found best media with a B:C ratio of 3.09 followed by soil (2.93), soil + FYM (2.86), FYM+FL (2.84). Likewise, Soil + FL provided a B:C ratio of 2.83. The minimum B:C ratio (1.10) was exhibited by vermi compost media. Under polyhouse conditions, for growing broccoli seedlings was most beneficial giving a B:C ratio of 4.30 in FYM media followed by Soil + FL with a B:C ratio 4.0. Similarly, Soil+ VC also gave a B:C ratio of 3.44 only. FYM+VC also gave a B:C ratio of 2.58. Likewise, vermi compost media gave a net income of Rs. 50151.68 but with poorest B:C ratio of 1.61 probably due to the fact that vermi compost cost high thereby increasing the total cost of production of seedlings. In Chinese cabbage,soil media was found best with B:C ratio of 2.20, followed by Soil+ FYM with B:C ratio of 2.14, Soil+FL (2.14) and FYM (2.10), respectively. Media of vermicompost was found poorest with a B:C ratio of 1.10. Soil+ FYM+ FL and FYM + FL gave B C ratio 2.03 and 2.00. In lettuce, FYM media proved best for lettuce seedling production under poly house conditions which gave 2.72 B: C ratio followed by Soil media (2.49) and FYM+FL (2.02) Among gainer media, however, FYM+VC and FYM+VC+FL were found poor performers with relative figures of (0.76) and (0.44), respectively. This can be attributed by variable germination per cent obtained in different media and cost of media components which largely rely upon number of total seedlings obtained and income generated. Conclusively, soil, farm yard manure and locally available resources of forest litter singly or and a judicious combination thereof, may be useful as seeding media for obtaining seedlings successfully and profitably. However, due consideration to seed size, nature/ease of germination (germ inability) and after care of crop along with component costs involved need to be given for better results.

Seedlings and crop production in tomato

Cucumber Lettuce

Field view of trials conducted during the year 2017-18

iii. Crop Protection

Characterization of pathogen(s) associated with apple canker disease and evaluation of botanicals against most prevalent canker in Kashmir valley

Morpho-molecular characterization of Diplodia spp. associated with apple canker disease

In order to characterize the pathogen and species associated with the disease, 40 infected diseased samples were collected and fungus was isolated from the 8-10 mm size infected tissue. 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. The pycnidia immersed in the culture medium became partially erumpent, produced after 20-25 days. Conidiophores were hyaline, smooth, cylindrical, somewhat swollen at base and measured about 9–17 × 2–5 µm, producing a single apical conidium. Conidia initially hyaline and later becomes pale brown, aseptate, few developing a central transverse median septum, smooth, thick walled, oblong to ovoid, apex and measured 20.0-28.0X9.0-14.5 µm. Based on morphological characters, three morphological groups were formed and the fungus was identified as *Diplodia*. To confirm the identity of genus and species at the molecular level, the internal transcribed spacer (ITS) region was amplified in ten isolates from all the three groups using ITS1 as forward and ITS4 as reverse primer and the amplicon of 650bp obtained after PCR amplification was sequenced. The sequence data showed three species having 97%, 99%, 99% sequence homology with *Diplodia mutila, Diplodia bulgarica* and *Diplodia seriata* respectively. The generated sequences were submitted to NCBI Gen Bank for obtaining accession numbers. The Phylogenetic analysis (Fig 12) clustered the three species in different clusters along with the isolates from other regions of world of same species. The pot experiment was conducted with three replication to confirm the pathogenicity on two-year-old potted plants of apple cv. Red Delicious. The symptoms of canker on stem of the inoculated plants were similar to those observed in the field after 30

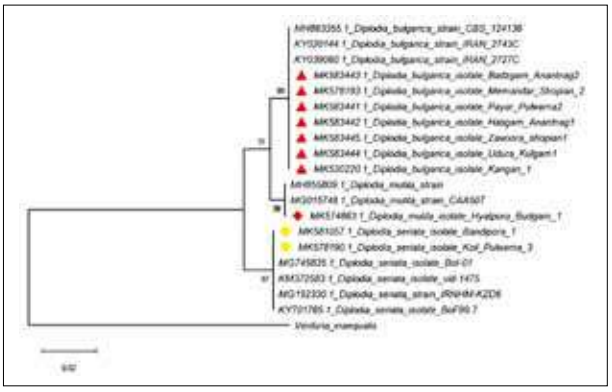


Fig 12: Phylogenetic tree of three Diplodia spp. in three different clusters along with the isolates from other regions of world of same species

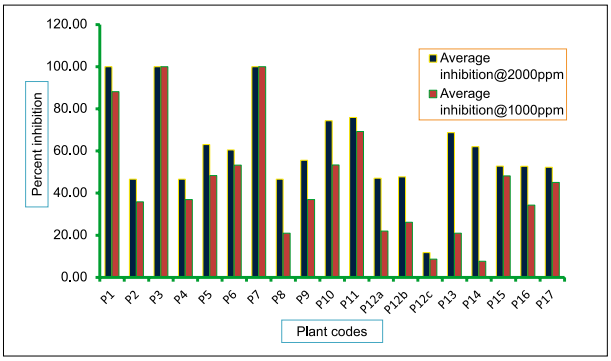


Fig 13. Average inhibition of methanolic plant extracts at 1000 and 2000ppm

days of inoculation. In conclusion three species were identified and to the best of our knowledge, among the three species *Diplodia bulgarica* and *Diplodia mutila* are two new reports from India.

Bioactivity of various methanolic plant extracts under *in vitro* conditions on inhibition of *Diplodia bulgarica*

Seventeen botanicals of medicinal value with codes P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11 ,P12 (a, b, c), P13, P14, P15, P16 and P17 were collected, shade dried and grinded into a fine powdered material. The methanolic extracts were prepared and evaluated (*in vitro*) using poisoned food technique at two different concentrations 1000ppm (C_1) and 2000ppm against, *Diplodia bulgarica*. Each treatment was replicated three times in completely randomized design (CRD) and inoculated with 3mm diameter mycelia disc taken from 20 days old culture. The relative efficacy of different treatments was ascertained by taking the radial mycelia growth inhibition of fungi over control by using the formula as:

Per cent growth inhibition=(C-T)/C×100, Were, C = Mycelial growth in control, T = Mycelial growth in treatment

The results showed that the plants with codes P1, P3, P7 and P11 showed better inhibition of *Diplodia bulgarica* under *in-vitro* conditions (Fig 13).

Determination of Minimum inhibitory concentration

The extract from plant P1 showing 100% inhibition of growth of fungus at 2000ppm, hence minimum inhibitory concentration was determined and it was observed that actual 100% inhibitory concentration at 1500 ppm. Similarly extract from plant P7 showing 100% inhibition at 1000 ppm , hence to determine the minimum inhibitory concentration it was observed that actual 100% inhibition at 500ppm.

Development of Spray schedules for Almond, Pear and Walnut

Spray schedules for various crops viz., almond, pear and walnut are under evaluation from post harvest season of 2018-19.

Spray schedule for Almond

During 2018-19, total 7 different spray schedules along with one control (T8) were evaluated against almond diseases (Shot hole, Blossom blight and Gummosis). Highest disease control (88.46%) was achieved in following treatment:

- (Hexaconazole + Captan) - (Myclobutanil) - (Metiram + Pyraclostrobin) - (Carbendazim + Mancozeb) - (Ziram) - (Hexaconazole) - (COC)

Spray schedule for pear

During 2018-19, different spray schedules were evaluated against pear disease, Fabrea leaf spot. Highest disease control (83.5%) was achieved in following treatment:

- (Hexaconazole + Captan) - (Propineb) - (COC) - (Difenconazole) - (Carbendazim + Mancozeb) - (Metiram + Pyraclostrobin)

Spray schedule for walnut

During 2018-19, among different spray schedules tried following schedule gave highest disease control (84.1%) in walnut:

- Hexaconazole + Captan - Metiram + Pyraclostrobin – Myclobutanil

Diagnosis and prognosis of apple viral diseases – Spatial and temporal variation in virus infection in apple

Seasonal variation of virus infection as detected by DAS-ELISA

Last year's experiment on studying seasonal variation in virus title in infected plant in different parts of plant was repeated and it was confirmed that there is seasonal variation and also variation with respect to tissue and thus temporal and spatial variation in virus infection was revalidated during 2018-19 through DAS-ELISA testing. Four season's spring, summer, and autumn/fall and winter/dormant were used to study periodic detection of all the four viruses in different plant parts. The virus titer varied from one season to another in the same plant. It was observed that all four viruses showed seasonal variation with respect to infectivity in different tested tissues. During spring maximum infection was detected in leaves followed by buds, flowers, bark and pollen. In spring flowers and pollen were found infected with the viruses which can be threatening because pollen flow can transfer the viruses to the healthy plants. During fall ACLSV and ASPV was detectable both in leaves and bark. During winter season ASPV & ASGV infection was observed in bark. ASPV and ASGV were detected in bark and leaf tissue during spring and summer while low detection was done in buds and flowers. Overall infection level was significantly higher in 2018-19 than in 2017-18 which may be due to infection buildup within the same host.

Optimization of tissue and time for rapid serological and molecular detection of apple stem pitting virus and apple stem grooving virus in apple'

Majority of the apple trees are known to be infected by two latent viruses, Apple stem grooving virus (ASGV) and Apple stem pitting virus (ASPV). The importance of ASGV and ASPV is due to their non-expression of symptoms, worldwide occurrence and wide host range on pome and stone fruits. Due to their latent nature in apple, early and rapid diagnostics plays important role for production of virus free quality planting material. The present investigation was conducted to detect and quantify ASPV & ASGV from different plant parts (spatial) in apple trees during different seasons (temporal) for optimization of tissue and time for their rapid and early detection. Detection and relative quantification using immuno-molecular diagnostic techniques like, Double Antibody Sandwich ELISA, Reverse Transcription-PCR and Real Time RT-PCR in various plant parts (leaf, whole flower, sepal, petal, anther, stigma with style, bark, fruit, seed and root) during different seasons was done. The DASELISA based detection revealed infection in all plant parts except root and fruit with ASGV and ASPV, showing more expression in leaves followed by bark and whole flower. Similar results were also observed on RT-PCR based detection. Quantitative real time PCR analysis showed variation in expression of ASGV and ASPV in different parts during different seasons. Results confirmed that the ASGV and ASPV expression is higher in leaves followed by bark and whole flower. Periodic detection of these viruses in different plant parts during all the four seasons revealed varied virus titer from one season to another in the same plant. During all the seasons, both ASPV and ASGV were detected in bark in measurable titer using immuno-molecular detection tools, however via DAS-ELISA, ASGV remained undetected during dormant season. Hence leaves and bark except leaf during fall, can be directly used as detection material for their

early and rapid detection leading to production of virus free planting material.

Immunodiagnostic assay using DAS-ELISA confirmed the presence of ASGV and ASPV in all plant parts, except root and fruit. The DAS-ELISA values indicated virus titer was more in leaves, bark and whole flower compared to other parts of apple tree. In all the four seasons, i.e., spring, summer, and autumn/fall and winter/dormant, the virus titer varied from one season to another in the same plant in different tested tissues. During winter season only ASPV infection was observed in bark, while ASGV, was not detected. During spring maximum infection of both the viruses was detected in leaves followed by bark, whole flower. In summer, leaves and bark were found infected. During fall both viruses were detectable both in leaves and bark. Based on the DAS-ELISA results regarding virus titer in various plant parts, the greatest accumulation of ASPV and ASGV was recorded in leaves at the beginning of the vegetation season, followed by flowers and bark.

Results obtained through DAS-ELISA were validated through RT-PCR and it was observed that the specific primers of coat protein gene of ASPV amplified ~ 370 bp and replicase gene specific primer of ASGV amplified ◦ 200 bp amplicon from all tested samples except roots, fruits and healthy controls. Both the viruses were detected in leaves for the whole vegetation period. Round the year dtetectability was also confirmed from bark. RT-PCR amplified products of ASPV and ASGV from different parts along with positive control (Fig. 14 & 15).

Relative Quantification

The RT-qPCR method reliably detected ASPV & ASGV in all tested plant tissues, excluding roots throughout the year during which samples were assessed. Both the viruses in leaves, showed the highest titer at the beginning of the vegetation period (from March to June), then slowly decreased in the following at the end of vegetation (in October). In the inner bark, the virus loads reached their peak in June and then decreased in the following months to the lowest value in December. Relative quantification of ASPV and ASGV in different tissues revealed that, 11.1%, 15.05%, 8.31%, 5.2%, 72.9% , 27.7%, 6.2% and 9.3%, 8.7%, 12.6%, 7.2%, 76.79%, 26.8%, 9.2% expression in sepals, anther, petals, anther, bark, whole flowers and seed respectively with respect to leaf as positive calibrator (Fig. 16) during spring (April-June) season when all plants parts along with flowers were present (Table 10).

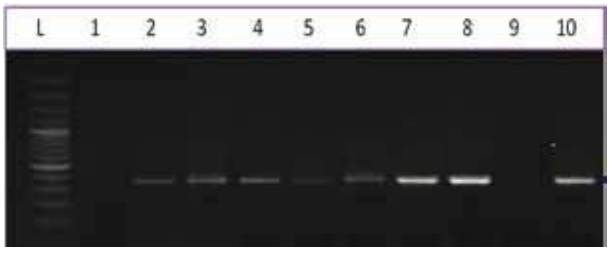


Fig.14 Amplicon size (370bp) of ASPV from various parts, L-Ladder (100bp), 1-Root, 2-Leaf, 3-Flower, 4-Anther, 5-petal, 6-sepal, 7-seed, 8-Bark, 9-Fruit, 10-Positive Control

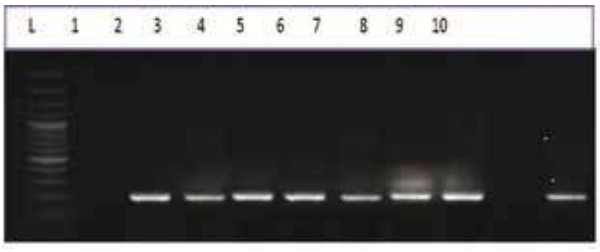
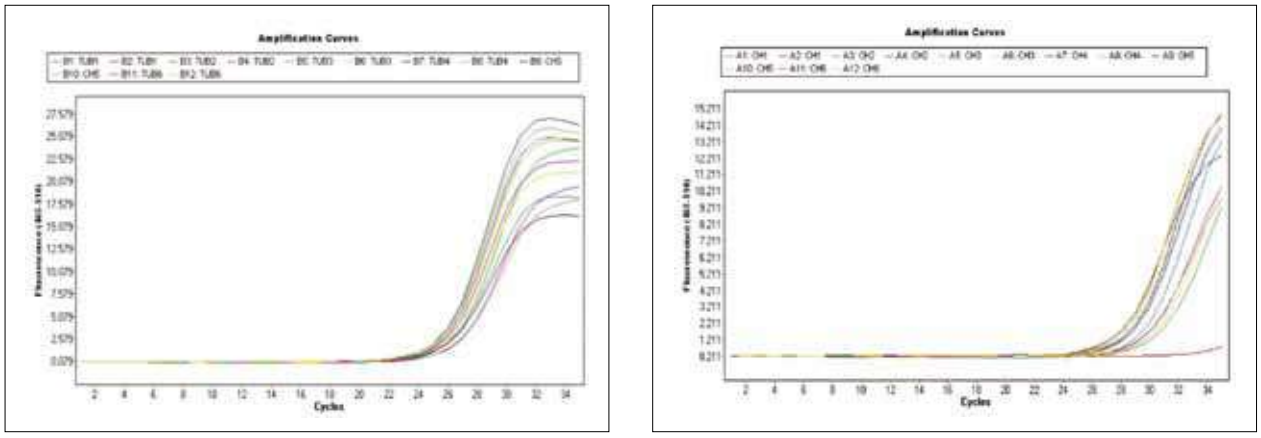


Fig.15-: Amplicon size (200bp) of ASGV from various parts, L-Ladder (100bp), 1-Root, 2-Leaf, 3-Flower, 4-Anther, 5-petal, 6-sepal, 7-seed, 8-Bark, 9-Fruit, 10-Positive Control

Table 10-: Relative quantification of ASPV and ASGV in different tissues in different seasons

Tissue	Virus	Quantification during Dormant Season (%)	Quantification during Spring Season (%)	Quantification during Summer Season (%)	Quantification during Fall Season (%)
Leaves	ASPV	-	100	100	100
	ASGV	-	100	100	100
Anther	ASPV	-	15.05	-	-
	ASGV	-	8.7	-	-
Flower	ASPV	-	27.7	-	-
	ASGV	-	26.8	-	-
Sepal	ASPV	-	11.1	-	-
	ASGV	-	6.2	-	-
Petal	ASPV		8.31	-	-
	ASGV		12.6	-	-
Bark	ASPV	45.3	72.9	61.8	43.6
	ASGV	24.23	76.79	62.9	34.9
Fruit	ASPV	-	-	-	-
	ASGV	-	-	-	-
Seed	ASPV	-	6.2	7.3	7.79
	ASGV	-	9.2	11.6	12.8



(a) (b)

Fig. 16. Amplification curves of amplification of ASPV (a) and ASGV (b) from different parts of apple tree during Real Time PCR

iv. Post-Harvest Technology

Biochemical evaluation of chilli germplasm for estimation of oleoresin content and pungency

The entire phenolic composition of the Chilli extract ranged from 4.31 mg/g GAE in genotype KA2 to 8.56 mg/g GAE in SEL1065-E. The complete phenolic composition of varied extracts were determined as milligram gallic acid equivalent (mg GAE/g) dry weight of plant extract via the subsequent formulae from the calibration curve: Y=0.001x+0.046; R2=0.997, where Y is the absorbance and x is the gallic acid equivalent in mg/g. The total capsaicin and dihydrocapsicin content of the chilli extract of 22 chilli breeding lines showed significant variation. Capsaicin content ranged from 1000 µg/g (SEL-1052-11) to 4010 µg/g (CITH-HP-92-13). Dihydrocapsaicin content varies from 489µg/g to 1863µg/g in SEL-1052-11 and CITH-HP-92-13 respectively. Based on capsaicinoid content Scoville Heat Units (SHU) was estimated. Highest pungency was observed in genotype CITH-HP-92-13 with 64160 SHU and lowest pungency (16000 SHU) was observed in SEL1052-11. Out of 22 genotypes eleven genotypes showed pungency higher than 40000 SHU while as eleven genotypes have lower pungency in the range of 16000 – 40000. Free radical scavenging potential deciphered through DPPH assay revealed significant variation across the 22 chilli genotypes. Percent inhibition ranges from 28.44% in CITH-HP-91/13 to 78.61% in sel-836-1-2. Fifteen genotypes showed more than 50 percent inhibition and thus possess significantly higher scavenging activity. FRAP observations ranged from 87.41 µM Fe^{2+}/g DW to 394.294 µM Fe^{2+}/g DW. On the basis of the estimated FRAP values, chilli breeding lines were classified into two categories; sixteen superlative breading lines exhibiting 200-394.29 µM Fe^{2+}/g DW and seven good breading lines exhibiting FRAP values in the range of 87.41-200 µM Fe^{2+}/g DW. The observations were determined as µmol Fe (2)/g dry weight of plant extract via subsequent formulae determined on calibration curve: Y=0.001x-0.007; R^2=0.998 in which Y stands for absorbance and x is the µM Fe^{2+}/g FW. The highest FRAP value was shown by the genotype CITH-HP-92/13 which also showed highest percent inhibition (78.16%).

Development of processing technology for making quince candy: A novel value added product

Quince is a minor but important fruit crop and has aromatic, astringent and cooling properties and acts as a tonic for heart and brain.

Candy prepared from quince fruit

The mucilage is used as an external application for scald and ulcers. The dried pits of its fruit are used as remedy for soreness of throat and relieving cough. I the indigenous system of medicines the quince is used in treating diarrhea, dysentery and constipation. Quince juice proves to be very effective against diabetes and urinary problems. It also helps against respiratory disorder and cough, cold and asthma. Quince is used to make jam, jelly and puddings in many parts of the world. Therefore efforts were made to study the nutritional composition of quince being grown in the Kashmir valley and standardization of processing technology for making various novel value added products. Nutritional study shows that this fruit is rich in malic acid and ascorbic acid and good quantity of minerals like potassium, phosphorus and calcium (Table 11). Processing technology was standardized for making quince candies. The product was studied for their nutritional, anti oxidant and quality parameters. The finish product was subjected to sensory evaluation at different intervals stored at ambient conditions and the product was found acceptable in terms of colour, anti oxidant quality, texture, taste and quality up to 9 months.

Table 11. Composition of quince fruit (CITH-Q-20)

Parameters	Mean Values
Fruit Weight (g)	193
Fruit length (mm)	79
Fruit dia.(mm)	72.14
Firmness (RI)	69
Seed (%)	4.88
Peel (%)	4.78
Edible portion/pulp (%)	90.35
Moisture %)	85
Total Soluble Solids (B°)	20.33
Titrable Acidity (%)	0.98
Ascorbic acid (mg/100g)	17.75
Reducing sugar (%)	5.09
Total sugar (%)	10.12
Pectin (g/100g)	1.12
Crude fibre (%)	1.6

v. Externally Funded /Network projects

DUS Centre for temperate fruits and nuts

During 2018-19 on-site DUS testing was done for apricot and walnut. Forty farmers varieties of apricot were tested by on-site testing at different locations in Ladakh region of Jammu and Kashmir and their description as per the DUS descriptor was noted and send to PPV&FRA for further processing for their registration. Along with DUS testing data as per the DUS descriptor developed by ICAR-CITH Srinagar, their commercial and agronomic traits were also send to PPV&FRA. Among farmers varieties one walnut variety was tested at Kishtwar district of Jammu Division and the data pertaining to its DUS characters and commercial *viz a viz* agronomic traits was recorded to communicated to PPV&FRA. Five new walnut varieties submitted by the Institute were evaluated again in 2018-19 for DUS characters, agronomic and commercial traits for their registration through PPV&FRA, New Delhi. Inspection visit was made on 30th October, 2018 by PPV&FRA for inspecting five walnut candidate varieties under testing at ICAR-CITH, Srinagar.

On-site DUS testing of apricot varieties at Ladakh

Inspection and monitoring visit for monitoring five walnut candidate varieties at ICAR-CITH, Srinagar

Development of an Electronic Nose Sensor to Determine the Optimum Harvesting Time for Apple and Papaya

The samples of four apple cultivars (Vista Bella, Shireen, Red Delicious and Golden Delicious) were collected and send to IIT, Roorkee for volatile profiling. Apple samples were collected on 10 different harvest dates during ending June to September. From each collection, three different groups of 20 pieces each were made and measured in parallel on a daily basis for three weeks during their ripening cycle (from the day after harvest and until the fruits were overripe) and analysis of nutritional profile under different conditions was done. Fruits were evaluated at pre-harvest stage, harvest stage and during different phases of storage (S1 to S3). Storage was done under two temperature conditions (2oC and 4oC with relative humidity of 90 %). For nutritional/quality analysis these varieties were evaluated at both the temperatures at different stages for TSS, ascorbic acid content, acidity, firmness, colour parameters, DPPH assay, FRAP assay, quercetin, rutin, catechin and epicatechin contents. Quercetin, rutin, catechin and epicatechin were estimated through RP-HPLC. Free radical scavenging and anti-oxidative potential was estimated through DPPH and FRAP assays. Four varieties showed significant variation with respect to all the parameters studied. The storage conditions also influence the level of these compounds and it was found that phenolic compounds like catechin and rutin were stable under low temperature conditions but there are little changes in other parameters (Table 12 & Table 13).

Red Delicious **Golden Delicious** **Vista Bella** **Shireen**

Fruits of apple varieties used for experimentation

Table 12: Physicochemical analysis of apple cultivars at pre-harvest, harvest and during storage conditions at different temperatures.

Cultivars	Temperature	Stage	Weight (g)	TSS (%)	Acidity (%)	Ascorbic Acid (mg/ 100g FW)	Firm-ness (RI)	Colour			
								L	A	B	tint
Vista Bella	Ambient	PH1	58.12^{T}	15.2^{N}	0.19^{HI}	5.06^{B}	67.8^{D}	28.82^{X}	17.23^{N}	5.32^{X}	-83.5^{FCGDHE}
	Ambient	H2	67.32^{Q}	17.8^{JK}	$0.31CFD^{BE}$	6.21^{B}	62.1^{I}	42.63^{W}	28.91^{F}	20.56^{P}	-101.23^{FGHE}
	4°C	S13	61.23^{S}	$19.5F^{DE}$	0.25^{HFGE}	5.93^{B}	54.2^{Q}	60.73^{L}	15.16^{O}	43.1^{B}	-61.75^{FCDBE}
		S24	56.4^{U}	21.2^{C}	0.2^{HIG}	5.82^{B}	52.6^{S}	65.4^{H}	17.2^{N}	42.2^{C}	-59.79^{FCDBE}
	2°C	S15	63.52^{R}	$18.6IG^{H}$	0.35^{CADB}	6.1^{B}	60.5^{J}	52.87^{N}	20.45^{L}	13.5^{U}	-91.18^{FGDHE}
		S26	60.16^{S}	20^{D}	0.3^{CFDBE}	5.93^{B}	58.2^{N}	65.45^{H}	22.57^{J}	15.11^{T}	-82.59^{FCGDHE}
		S37	58.23^{T}	22.5^{B}	0.27^{HFDGE}	5.32^{B}	53.9^{Q}	69.92^{B}	14.76^{P}	39.18^{G}	-50.21^{CADBE}
Shireen	Ambient	PH8	100.13^{O}	10.6^{Q}	0.19^{HI}	8.61^{B}	71.2^{B}	27.15^{Y}	12.68^{R}	6.34^{W}	-59.93^{FCDBE}
	Ambient	H9	$152.2G^{H}$	15.2^{N}	0.38^{AB}	9.45^{B}	67.1^{E}	48.12^{T}	31.82^{C}	19.52^{R}	-129.21^{GH}
	4°C	S10	139.2^{K}	19.2^{FGE}	0.33^{CADBE}	9.23^{B}	47.5^{W}	55.11^{M}	30.31^{D}	29.14^{K}	-109.17^{FGH}
		S211	123.6^{N}	23.2^{A}	0.28^{CFDGE}	8.96^{B}	32.1^{Y}	65.56^{G}	10.8^{U}	41.76^{D}	-50.69^{CADBE}
	2°C	S112	141.6^{J}	17.2^{LK}	0.41^{A}	9.41^{B}	63.5^{H}	47.31^{U}	28.19^{H}	20.25^{Q}	-106.57^{FGH}
		S213	136.2^{L}	19.9^{DE}	0.36^{CAB}	9.36^{B}	58.6^{M}	51.37^{P}	33.44^{B}	23.84^{N}	-119.65^{GH}
		S314	130.6^{M}	21.8^{C}	0.31^{CFDBE}	9.2^{B}	52.1^{T}	63.42^{J}	11.67^{T}	28.13^{L}	-58.62^{FCDBE}

Red Delicious	Ambient	PH15	150.96^{IH}	11^{Q}	0.15^{I}	8.91^{B}	64.2^{G}	16.2^{Z}	27.21^{I}	33.51^{I}	-55.21^{FCADBE}
	Ambient	H16	170.52^{A}	14.2^{O}	0.31^{CFDBE}	10.79^{B}	56.1^{P}	50.08^{R}	22.13^{K}	15.12^{T}	-77.55^{FCGDE}
	4°C	S117	158.2^{E}	17^{L}	0.28^{CFDGE}	10.52^{B}	52.8^{S}	48.93^{S}	34.61^{A}	27.55^{M}	-132.61^{H}
		S218	149.5^{I}	19.5^{FDE}	0.23^{HFIG}	10.23^{B}	45.2^{X}	52.16^{O}	20.29^{M}	13.16^{V}	-91.62^{FGDHE}
	2°C	S119	161.7^{C}	16.2^{M}	0.38^{AB}	10.69^{A}	64^{G}	50.95^{Q}	29.45^{E}	21.6^{O}	-125.89^{CADB}
		S220	155.6^{F}	18.3^{IJH}	0.3^{CFDBE}	10.41^{B}	59.2^{L}	65.26^{I}	12.37^{S}	29.23^{K}	-48.76^{CADBE}
		S321	150.3^{I}	19.7^{DE}	0.25^{HFGE}	10.29^{B}	50.1^{V}	67.1^{E}	8.39^{V}	30.62^{J}	-32.16^{CAB}
Golden Delicious	Ambient	PH22	90.12^{P}	12.1^{P}	0.21^{HIG}	10.69^{B}	90.1^{A}	43.58^{V}	28.81^{G}	19.21^{S}	-104.93^{FGH}
	Ambient	H23	169.56^{A}	15.6^{MN}	0.36^{CAB}	11.25^{B}	69.5^{C}	62.73^{K}	13.87^{Q}	42.21^{C}	-61.75^{FCDBE}
	4°C	S124	159.91^{D}	17.2^{LK}	0.34^{CADB}	11.05^{B}	59.9^{K}	68.18^{D}	-5.36^{Y}	39.84^{F}	-4.39^{A}
		S2 25	150.53I^{H}	19.2 ^{FGE}	0.3^{CFDBE}	10.79 ^{B}	50.5^{U}	69.56^{C}	-0.05 ^{W}	43.92^{A}	-21.06^{AB}
	2°C	S126	164.68^{B}	16.2^{M}	0.4^{A}	11.11^{B}	64.6^{F}	65.74^{F}	-6.27^{A}	42.26^{C}	-12.69^{AB}
		S227	157.71^{E}	17.9^{IJK}	0.36^{CAB}	10.93^{B}	57.7^{O}	67.18^{E}	-4.26^{X}	38.52^{H}	-19.65^{AB}
		S328	153.26^{G}	18.8^{FGH}	0.33^{CADBE}	10.8^{B}	53.2^{R}	72.67^{A}	-5.91^{Z}	40.95^{E}	-23.38^{AB}
Pr<F			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

- PH: Preharvest (15 days before harvest); H:Harvest (Vista Bella: 28th June, Shireen: 5th September, Red Delicious :26th September, Golden Delicious: 28th September); S1: 25 days after harvest; S2:50 days after harvest and S3: 75 days after harvest
- Means followed by the same letter within the columns are not significantly different (P=0.05) using Duncan's multiple range test.

Table 13: Estimation of bioactive compounds and biological activities of apple cultivars at pre-harvest, harvest and at different storage conditions

Cultivars	Temperature	Stage	Phenols (mg GAE/ 100g FW)	Flavo-noids (mg QE/100g FW)	Flavanols (mg CE/g FW)	DPPH (µmol AAE/g FW)	FRAP (µmol FeSO4 E/100g FW)	Qurce-tin (µg/g FW)	Cat-echin (µg/g FW)	Epicat-echin (µg/g FW)	Rutin (µg/g FW)
Vista Bella	Ambient	PH	143.6^{o}	552^{e}	0.92^{8f}	12.08^{j}	100.8^{f}	171^{jk}	21^{j}	111^{L}	2.5^{ml}
	Ambient	H	184.8^{f}	600^{a}	1.248^{ef}	12.96^{j}	117.6^{ef}	180^{ghij}	38^{cde}	120^{kl}	4^{h}
	4°C	S1	173.6^{j}	574.4^{cd}	1.136^{ef}	12.48^{j}	112.8^{ef}	160^{k}	32.5^{fgh}	118^{kl}	3.8^{hi}
		S2	164.1^{k}	562.4^{de}	1.065^{ef}	12.12^{j}	103.75^{ef}	158^{k}	28.6^{hi}	96^{m}	2.9^{kl}
	2°C	S1	183.2^{fg}	595.2^{ab}	1.208^{ef}	12.64^{j}	116.4^{ef}	182^{fghij}	42^{bc}	132^{k}	4.2^{gh}
		S2	177.6^{hi}	592^{ab}	1.128^{ef}	12.24^{j}	113.6^{ef}	178^{hij}	40.8^{bcd}	126^{kl}	3.6^{hij}
		S3	172^{j}	581.6^{bc}	1.06^{ef}	11.84j	110.4^{ef}	176^{ij}	36.5^{def}	112.5^{l}	2.6^{kl}
Shireen	Ambient	PH	141.2^{o}	216.8^{qr}	0.9^{6f}	24.96^{efgh}	61.2^{f}	216^{b}	29^{ghi}	246^{b}	3.3^{ijk}
	Ambient	H	174.4^{ij}	345.6^{f}	1.34^{def}	28.24^{d}	78.4de^{f}	240^{a}	48^{a}	268^{a}	6.2^{ab}
	4°C	S1	152.8^{m}	302.4^{h}	1.08^{ef}	26.16d^{efg}	71.2e^{f}	216^{b}	41.5^{bc}	211^{ef}	5.2^{def}
		S2	142^{o}	292^{hi}	0.92^{f}	24.4^{fgh}	61.6^{f}	192^{defghi}	36.2^{def}	162^{j}	5^{ef}
	2°C	S1	163.6^{k}	336.8^{f}	1.24^{ef}	27.3^{6de}	75.2^{ef}	232^{a}	45^{ab}	232^{bcd}	6.8^{a}
		S2	156.4$_{1}$	322.4^{g}	1.07^{ef}	26.72^{def}	69.2^{ef}	190^{defghi}	38.5^{cde}	198^{fg}	5.4^{cdef}
		S3	147.7^{n}	305.6^{h}	0.95^{f}	26^{efgh}	62.8^{f}	182^{efghij}	26^{i}	180^{i}	5^{ef}

Red Delicious	Ambient	PH	212.8^{e}	154.4^{t}	1.57^{bcde}	17.52^{i}	188.8^{bcde}	189^{defghi}	31^{gh}	228^{cd}	2.8^{kl}
	Ambient	H	253.6^{a}	238.4^{nop}	2.25^{ab}	24.4^{fgh}	257.2^{ab}	210^{bc}	40^{cde}	240^{bc}	5.6^{bcde}
	4°C	S1	244^{c}	223.2^{pqr}	0.16^{g}	23.68^{gh}	252.4^{g}	202^{bcde}	38.5^{cde}	196^{fgh}	4.2^{gh}
		S2	241.2^{c}	210.4^{r}	1.96^{abcd}	22.4^{h}	246.4^{abcd}	196^{cdefg}	32.6^{fgh}	182^{hi}	3.1^{jkl}
	2°C	S1	253.2^{a}	228.8^{opq}	2.23^{abc}	24.24^{fgh}	249.2^{abc}	206^{bcd}	42^{bc}	220de	6.2^{ab}
		S2	243.6^{c}	216.8^{qr}	2.11^{abc}	23.6^{gh}	242.8^{abc}	194^{cdefgh}	38.5^{cde}	192^{ghi}	5^{ef}
		S3	237.2^{d}	208^{r}	2.04^{abc}	22.56^{h}	241.2^{abc}	190^{defghi}	36.6^{def}	168^{i}	4.8^{fg}
Golden Delicious	Ambient	PH	180.8^{gh}	172.8^{s}	1.56^{cdef}	35.6^{c}	123.2^{cdef}	192^{bc}	30^{ghi}	192^{ghi}	1.9^{m}
	Ambient	H	254^{a}	277.6^{ij}	2.49^{a}	44^{a}	196^{a}	210^{bcde}	40^{cde}	218de	6^{bc}
	4°C	S1	248^{b}	264^{jkl}	2.43^{a}	42^{ab}	189.6^{a}	202^{bc}	36.8^{def}	192^{ghi}	4.2^{gh}
		S2	243.6^{c}	248.8^{lmn}	2.24^{abc}	40.56^{b}	183.2^{abc}	194^{bcde}	30.2^{ghi}	160^{j}	2.8^{kl}
	2°C	S1	252^{a}	270.4^{jk}	2.46^{a}	42.64^{ab}	192.4^{a}	204^{cdefgh}	39.6^{cde}	210^{ef}	5.8^{bcd}
		S2	241.4^{c}	256^{klm}	2.32^{ab}	42^{ab}	185.2^{ab}	198^{cdef}	35.6^{ef}	190^{ghi}	3.1^{jkl}
		S3	240.4^{cd}	240.8^{mno}	2.12^{abc}	42.18^{ab}	177.2^{abc}	194^{cdefgh}	33.2^{gf}	162.5^{j}	2.9^{kl}
			<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001

- PH: Preharvest (15 days before harvest); H:Harvest (Vista Bella: 28th June, Shireen: 5th September, Red Delicious :26th September, Golden Delicious: 28th September); S1: 25 days after harvest; S2:50 days after harvest and S3: 75 days after harvest
- Means followed by the same letter within the columns are not significantly different (P=0.05) using Duncan's multiple range test.

National Agriculture Innovation Fund/ Intellectual Property Management and Transfer/Commercialization of Agriculture Technology

During 2018-19, technologies and varieties developed by the Institute were documented. Passport data for new collections was prepared and send to NBPGR for allotment of IC numbers and IC numbers were allotted. All these new collections are being maintained at field gene bank of ICAR-Central Institute of Temperate Horticulture, Srinagar. Registration of germplasm through NBPGR has been initiated and six accessions of walnut have been submitted for online registration. In addition protection of plant varieties through PPV &FRA, New Delhi is being done in coordination with DUS Centre. Compilation of technology inventory and germplasm inventory is being done for documentation of all the available germplasm and technologies developed by the Institute. Three MoUs were signed with Directorate of Horticulture Kashmir for establishment of mother orchards of CITH walnut varieties, BASF for evaluating phytotoxicity of BASF 75101F and PPV&FRA for conducting DUS testing of temperate horticultural crops.

Walnut propagation for production of quality planting material

To promote the walnut cultivation in Uttarakhand, the project walnut propagation for production of quality planting material was initiated during 2017-18. The demand of grafted planting material is increasing day by day but due to less success in propagation in open conditions. ICAR-CITH, Srinagar is playing a vital role for supplying the quality material of walnut. The time, method and environment for propagation plays very important role in production of quality planting material. The method and time of propagation may vary from location to location and year to year. During 2018-19, trial was laid out at Srinagar to standardize the time and method of vegetative propagation having more success in

walnut because the production of quality planting material is a major constraint in walnut industry in India. So to standardize the time and method of propagation in walnut under polyhouse conditions, cleft, tongue ,wedge grafting and chip budding were tried.

Based on the overall performance of different methods and dates, it was concluded that wedge grafting gave better success (63.33 %) during February especially in 3rd week, while chip budding gave better success rate (70 %) during 2nd week of March.The cleft grafting gave better success rate (60%) during 2nd week of February while the tongue grafting gave maximum (30%) but lower success rate during 2nd week of March. The propagation success is dependent on many factors and one of the reason for lower success rate during the year is due to late planting of rootstocks. In overall, keeping in view the scarcity of scion wood of standard cultivars chip budding was found best for walnut and can serve a better alternate in future after further evaluation during next year.

During 2018-19 in the month of December, 5000 grafted plants of walnut were supplied to UFRMP-JICA, Dehradun for promotion of walnut in Uttarakhand. This planting material was planted for establishment of mother blocks and orchards in farmers field in Garhwal and Kumaun region of Uttarakhand. The grafting / budding were performed during February and March, 2019 at ICAR-CITH, Srinagar for supply in next year. The rootstock was also planted in the polyhouses at Mukteshwar and grafted was performed in some polyhouses. Two study visits of 2 and 3 days duration were organized at ICAR-CITH, Srinagar for officers from URFMP- JICA in which 5 and 25 officers participated. Two training/ demonstration programmes of two days duration were organized at Magra and Sony while one day training programme was organized at Silalekh on walnut propagation in Uttarakhand. The staff from Deptt of Forest Uttarakhand, progressive farmers, NGO and staff from Deptt of Horticulture, Uttarakhand participated in the training programmes.

Supply of grafted plants to Uttrakhand during December 2018

Officers from UFRMP Uttarakhand getting tips on walnut propagation during study tour


Grafting and budding of walnut for supply in next year



Training cum demonstrations on walnut propagation at Magra, Silalekh and Sony (Uttarakhand)

Validation and Development of DUS guidelines in olive

During 2018-19 data was recorded for different tree and fruit characters of 18 olive varieties as per the UPOV descriptor. The aim of the study is to validate the VPOU guidelines of olive under Indian conditions and develop DUS guidelines of olive as per the validated data recorded from UPOV guidelines. All reference varieties of olive are maintained at ICAR-CITH, Srinagar farm and one replica of these varieties is also available at Ramban, Jammu and ROCL, Rajasthan. Characterization of reference varieties and data recording as per the UPOV descriptor will be done at all the three sites in coming season to check the uniformity and stability of the characters mentioned in UPOV guidelines.

Challenge Programme on Canopy Management and Plant Architectural Engineering in Temperate Fruits

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. Project was implemented in 8 centres initially & seven centres during 2018-19 with different temperate fruit crops of their regional importance. At Srinagar center, six training systems consisting of four rootstocks and two varieties were taken for experimentation. The 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. In fruit colour parameters viz. "L" was found highest in espalier system on MM-106 in Red Delicious (65.69), "a" in vertical axis on seedling rootstock in Oregon Spur (23.58) and "b" 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 (52.41t/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). Highest light interception was recorded in Red Delicious-Seedling combination on spindle bush training system.

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 (64.53g). Training system (Y-Shape) recorded highest TSS in William Bartlett on Q-C in modified central leader system(19.76 ^{0}B) where as lowest TSS was recorded in Kashmiri Nakh on espalier system in BA-29-C (10.66 ^{0}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.

Espalier System | Cordon System | Vertical Axis | Head and spread

Spindle Bush | Modified central leader | Fruiting in vertical | Fruiting in Espalier

Flowering and fruiting under different training system in apple at Srinagar

Flowering and fruiting in pear at Srinagar

At Meghalaya center, in peach, highest fruit yield was recorded in Partap trained on Y shape (12.9kg/plant) followed by Flordaprince on Y Shape (11.2 kg/plant), while yield efficiency was recorded highest in Florda Prince on Central leader system (0.71 kg cm^2 TCSA). In ICAR Research Complex for NEH Region, A P Centre, Basar, Arunachal Pradesh, peaches trained on Y shape trellis recorded highest growth attributes and found significantly superior over others. Interaction effect (V x T) was found significant for plant height and scion girth.

At ICAR-National Organic Farming Research Institute (formerly ICAR Research Complex for NEH Region, Sikkim Centre), Tadong,Gangtok, Sikkim,two kiwifruit varieties *viz.* Hayward and Allison along with respective pollinator's *viz.*Tomuri and Allison male were planted during February, 2016 on four training systems *viz.*Extended T-Bar, Pergola, Tatura Trellis and Traditional system. Further, two more training systems *viz.* Double Square Trellis and DoubleCircle Trellis were also added in the experiments. Kiwifruit plants trained on Extended T-Bar systems are the first one to turn out in to reproductive phase. This year first flowering has been started in Hayward cultivar and Tomuri male simultaneously. However, Allison male and female trained on Extended T-Bar systems is still in vegetative stage.

At Ludhiana center,training systems have been established in both pear and plum crops. . In pear, three varieties viz; Punjab Beauty, Nijjiseki, and Punjab Soft are being trained on Kainth and Quince C rootstocks. The vegetative growth of pear plants on Kainth rootstock is greater than grafted on the Quince C rootstock. All pear varieties grafted on Quince C rootstock showed overgrowth on the union as evidenced by higher union diameter values as compared to either stock or stem diameter. Similarly, height of pear plants grafted on Kainth rootstock is considerably higher than on Quince C rootstock. Various stionic combinations showed some fruit set. In case of plum, maximum diameter of rootstock was recorded in plants being trained on Tatura Trellis system while stem girth was maximum in modified leader system. Plant height was recorded higher in vertical axis system, while fruit number per plant was maximum in Tatura Trellis system of planting.

Peaches grown on different training systems at ICAR, Umiam, Meghalaya

Flowering in Hayward Cultivar trained on Extended T-Bar systems


Tatura-Trellis system in pear


Espalier system in pear


Vertical axis system in pear


MLS in plum


Plum fruiting on Espalier system

View of various systems at Ludhiana

At Solan center the crop is peach with cv Redhaven and Nectarine cv. Snow Queen. Maximum plant height (2.72 m) was observed in Tatura system of training which was statistically at par (2.43 m) with central leader system. The minimum plant height (1.83 m) was recorded in espalier system which was at par (2.16m) with open centre system of training. Significantly highest plant stock girth (10.76 inch) was recorded in Tatura-system which was at par with open centre system and central leader system. The maximum plant scion girth (9.76 inch) was recorded in Tatura system of training, which was on par (9.56 and 9.50 inch) with open-system and central leader system, respectively. The highest annual extension growth (0.64 cm) was recorded in central leader system which was at par (0.43 cm) with tatura system of training. The lowest annual extension growth (0.24 cm) was recorded in espalier system which was statistically at par (0.43 cm) with Tatura system. Different systems of training were found to have non-significant effect on plant leaf area.The training systems were found to have a non-significant effect on various growth parameters of nectarine cv. Snow Queen except for plant scion girth. The maximum plant scion girth (11.16 inch) was recorded in central leader system of training, which was at par (9.56 and 9.78 inch) with Tatura system and open centre system of training, respectively. However, the minimum plant scion girth (8.28 inch) was recorded in espalier system, which was at par (9.56 and 9.78 inch) with Tatura system and open-system of training, accordingly.

In Bajaura- Kullu center the crops are apple and plum with different training systems**.** In apple cv Jeromine , maximum plant height (238.69 cm), plant girth(8.73 cm) highest rootstock girth (15.42 cm) and numbers of branches (9.77) was recorded in vertical axis. Maximum shoot length was recorded in espalier system (35.42 cm). The highest shoot length (34.35 cm) of Red Velox was observed in espalier system of training whereas, the lowest (8.74 cm) was observed on cordon system of training. The highest plant girth (8.70 cm) of Red Velox was recorded on head and spread system whereas, the lowest (6.93 cm) was observed on cordon System of training. The highest rootstock girth (17.49 cm) was recorded on head and spread system whereas, the lowest rootstock girth (12.65 cm) was observed on vertical axis system of training.


Tatura system


Espalier system


Open system


CenterLeader system


Profuse fruiting in 'Snow Queen' nectarine on Tatura Trellis system

Field view of various training systems at Solan

The highest plant height (217.31 cm) of Super Chief was recorded on vertical axis whereas highest number of branches (6.80) was observed on modified central leader system followed by vertical axis (6.23). The highest shoot length (29.00 cm) of Super Chief was observed on spindle bush system. The highest plant girth (10.50 cm) was recorded on head and spread system, whereas the highest rootstock girth (14.52 cm) was observed on cordon system of training. The vegetative growth parameters of Scarlet Spur were recorded on various training systems. The maximum plant height (220.00 cm) was observed on modified central leader system followed by head and spread system of training. The highest number of branches (9.29) was recorded on spindle bush system of training. However, the highest shoot length (31.20 cm) was recorded in modified central leader system. The highest plant girth (10.31 cm) was recorded in Spindle Bush system while, the highest rootstock girth (14.58 cm) was observed in cordon system followed by spindle bush system (14.17 cm) of training. The highest plant height (318.33 cm) was observed in head and spread system of training. While the highest number of branches (12.50) was observed in spindle bush system of training. The highest shoot length (34.00 cm) was recorded in espalier system while, the lowest shoot length (14.06 cm) was observed in cordon system of training. The highest plant girth (14.46 cm) was recorded in head and spread system whereas, the highest rootstock girth (15.51 cm) was recorded in cordon system of training. In plum, experiment was laid out in the year 2017 at Bajaura with four planting densities and training systems are being developed as per requirement. The plants are in initial stage of growth and fruiting was not observed yet.

At Mukteshwar centre, crops are apple and peach and plants are in growing stage and data on growth parameters was recorded. The significant variations in plant height while the plant diameter and number of branches per plant was found non-significant among the different training systems. In apple trial, the highest plant height (82.32 cm) was recorded in cordon System while, the lowest (58.23 cm) in espalier System. Among the cultivars highest plant height (78.88 cm) was recorded in CITH Lodh Apple-1 on MM-106 rootstock while, the lowest in Oregon Spur on M-9 rootstock (54.53 cm). Similarly, the highest (1.06 cm) plant diameter was recorded in vertical axis system and the lowest (0.93 cm) in cordon system and modified leader system. Maximum plant diameter (1.03 cm) was recorded in Oregon Spur on MM106 rootstock while, the minimum (0.93 cm) in CITH Lodh Apple-1 on MM-106. The highest (1.92) number of branches/plant was recorded in modified leader System while the lowest (1.17) in vertical axis system. The cultivar CITH Lodh Apple-1 on M-9 rootstock recorded the highest (1.50) number of branches/plant while, the lowest (1.33) in CITH Lodh Apple-1 on MM-106.

In peach trial, the highest (100.00 cm) plant height was recorded in central leader system while, the lowest (72.00 cm) in espalier System. Similarly, the highest (2.24 cm) plant diameter was recorded in tatura trellis system and the lowest (1.73 cm) in open centre system. The highest (4) number of branches/plant was recorded in open centre system while the lowest (2.67) in espalier System.


Cordon system of Training


Vertical Axis system


Temporary Tatura Trellis system in Plum

View of training systems in apple and plum at Bajaura- Kullu

All India Network Project on Outreach of Technologies on Temperate Fruit Crops

This project aims for testing and dissemination of new varieties and technologies in different agro-climatic conditions of North Western Himalayas through outreach programme. At Srinagar centre where mostly the planting has been done at farmers fields for early adoption of technologies. The performance of varieties was excellent especially in apricot, almond and apple. In 2018-2019 under high density plantation of apple, six varieties were evaluated under different training systems on M 27 rootstock and it was observed that in vertical Axis, fruit weight & diameter was highest in Coe Red Fuji (125.16 g) & (66.89mm) respectively while fruit length was highest in Oregon Spur (56.71 mm).The TSS (18.73 ^{0} B) was found highest in Gala Mast. In other experiment six varieties of apple were evaluated on Tatura Trellis System and highest fruit length and diameter was recorded in Starkrimson (55.88 & 66.24mm) respectively. Maximum fruit weight (123.6g) was found in Fuji whereas maximum TSS (19.13 ^{0} B) was recorded in Gala Mast. Besides these, CITH Lodh was evaluated under different training systems and it was found that head & spread recorded highest value for fruit parameters i.e. fruit weight, length and diameter (222.86g, 70.80mm & 83.19mm) respectively. In almond, moisture plays important role especially during fruit developmental stages. Different moisture conservation techniques were evaluated and all water harvesting techniques gave better kernel traits as compared to control.

In Solan center, under Productivity enhancement of elite apple cultivars through high density planting system, the data on growth parameters was recorded and maximum plant height (5.03 m), stock girth (18.07 inch), annual extension growth (1.18 cm) was observed in Mayan. The maximum pruning wood weight (1.75 kg) was observed in Mayan which was statistically at par (1.47, 1.53, 1.08 and 1.10 kg) with Red Delicious, Lal Ambri, Vista Bella and Gala Mast cultivars, respectively. However, the minimum pruning weight (0.30 kg) was recorded in Mollies Delicious which was statistically on par (0.80 and 1.08 kg) with Golden Delicious and Vista Bella, accordingly. In Multi-location testing of elite apricot genotypes under medium density, it was found that different apricot varieties didn't showed any consistent change in respect of plant height and plant girth as observed in CITH-A-1. The highest stock girth (16.76 inch) was observed in CITH-A-3; however, the lowest plant stock girth (13.66 inch) was observed in New Castle. The highest scion girth (15.52 inch) was observed in CITH-A-3, whereas, the lowest scion girth (13.02 inch) was observed in New Castle which was significantly lower than all other cultivars under study. In Multi-location testing of elite walnut genotypes under medium density under mid hill conditions, maximum plant height (4.93 m) was observed in CITH-W-5 which was statistically at par with CITH-W-2 (4.65 m). The minimum plant height (1.95 m) was recorded in CITH-W-6 which was at par with CITH-W-1 (2.59 m), CITH-7 (2.38 m) and Hamdan (2.89 m).

Fruiting in Fuji, Oregon spur and Starkrimson under different training systems

Significantly highest plant stock girth (18.83 inch) was recorded in CITH-5 which was on par with CITH-W-2 (16.70 inch), CITH-W-4 (15.23 inch) and CITH-9 (16.33 inch). While lowest plant stock girth (8.08 inch) was in CITH-W-7 which was statistically at par (10.43 inch) with Hamdan. The maximum plant scion girth (17.53 inch) was recorded in CITH-5, which was at par with CITH-W-2 (15.13 inch), and CITH-W-4 (14.57 inch) and CITH-W-9 (14.40 inch). However, the minimum plant scion girth (6.83 inch) was recorded in CITH-W-1, which was statistically at par with CITH-W-6, CITH-W-7 and Hamdan. The highest annual extension growth (1.72 cm) was recorded in CITH-W-9 which was on par with CITH-W-5 (1.42 cm) and Hamdan (1.45 cm); while the lowest (0.90 cm) was recorded in CITH-1 which was statistically at par (1.24 cm) with CITH-W-2.

Evaluation of various varieties/ technologies was also carried out at Bajaura (Kullu). In Productivity enhancement of elite apple cultivars through high density planting and efficient water and pollination management on MM 106 rootstock**,** different varieties of apple viz., Oregon Spur, Red Chief, Silver Spur, Royal Delicious, Red Delicious and Lal Ambri tested through high density plantings with spacing of 2.5X2.5m. Lal Ambri variety of apple showed maximum plant

Nut and fruits of CITH walnut and aprioct genotypes at Kullu

height and plant spread whereas Silver spur showed maximum plant girth and growth. The maximum fruit length, fruit breadth, fruit weight and TSS were observed with Oregon Spur. In almond varieties namely Non Pariel, Merced, Pramijay, Pramoskaij, Waris, IXL and Mukhdoom, cv. IXL showed maximum plant height and plant spread whereas, Makhdoom showed the maximum plant girth. So, IXL and Mukhdoom have performed well in terms of growth parameters. In Walnut varieties viz., CITH Walnut-1 to CITH Walnut -5, CITH Walnut-1 showed maximum nut length, breadth, nut weight and kernel weight as well. Although the maximum kernel percentage 64 % was recorded in CITH Walnut -4. Later 5 more cultivars CITH Walnut -6 to CITH Walnut-10 were also introduced but these cultivars are in juvenile stage and still come into bearing. It can be concluded that CITH Walnut -1 and CITH Walnut-4 have been observed promising and can be recommended for conditions, however studies are needed to evaluate 5 cultivars which have not come into bearing. In Multi-location testing of elite apricot genotypes under medium density, apricot varieties namely CITH A-1, CITH Apricot-2 and CITH A-3 were tested and CITH A-2 showed maximum fruit weight, fruit length, fruit breadth and TSS. Out of three CITH Apricot cultivars, CITH A-2 has been observed best as compared to CITH A-1 and CITH A-3. CITH A-2 can be recommended for mid hill conditions of H.P.

In Mukteshwar, total ten sub projects on evaluation/ assessment of different varieties of temperate fruit crops namely apple, almond, walnut, apricot, cherry, kiwi fruit and technologies viz. different pruning systems in apple, apricot, walnut, almond, in-situ water harvesting and mulching techniques in apple/ almond, grafting techniques in walnut and survey of disease-pest incidence in these crops were conducted. In apple, among the ten apple cultivars planted under project, Productivity enhancement of elite cultivars through high density planting and efficient water and pollination management, the cv. Oregon Spur attained maximum plant height (2.32 m), stem diameter (5.61 cm), and canopy spread(E-W, 1.41m and N-S, 1.49 m). However, maximum flowering duration (17 days) was observed in cv. Golden Delicious and Royal Delicious. Likewise, under medium density almond orchard, the cv. Merced exhibited highest plant height (1.61 m) and N-S canopy spread (0.80 m). However, maximum stem diameter (3.10 cm) as well as E-W canopy spread (0.83m) was recorded with cv. Waris. In case of almond, flowering had taken place only in Merced among seven varieties during the year.

Among the seven genotypes of walnut, CITH-W-3 recorded maximum plant height (2.55 m), stem diameter (5.95 cm), canopy spread (1.91 m E-W and 1.74 m N-S) under medium density plating system. Similarly, the apricot cv. CITH-A-1 recorded maximum plant height of 3.10m and N-S canopy spread (1.27m) whereas CITH A-3 recorded maximum stem diameter (6.99 cm) and E-W canopy spread (1.33 m). In a trial on architectural engineering for higher energy harvesting vis-à-vis productivity in apple, different training systems on various varieties grafted on various rootstocks were planted and observed that the maximum plant height of 1.40 m exhibited in Oregon Spur, grafted on seedling rootstock under trellis system of planting followed by Red Delicious on clonal rootstock under vertical axis training system (1.08 m), while as stem diameter found maximum (2.50 cm) in Red Delicious on clonal root stock planted under spindle bush planting system. The varieties Oregon Spur on seedling and Red Delicious on clonal rootstock spread maximum in E-W (0.80 m) and N-S (1.13 m) directions, respectively, when planted under cordon system. Among two genotypes of Cherry planted, CITH-C-2 was found superior in terms of plant height (1.87 m) and plant girth (5.10 cm). However, maximum canopy spread (E-W, 0.57m and N-S, 0.43m) was found in CITH-C-1. Similarly, performance of walnut (5) and kiwifruit genotypes (3) were also studied. Among the walnut genotypes CITH-W-7 was found superior in terms of plant height (0.85m), stem diameter (2.78 cm), E-W (0.35 m) and N-S (0.36m) canopy spread. In case of kiwi fruit, Hayward attained maximum values for plant

height (3.00 m), stem diameter (7.00cm) as well as canopy spread of 2.67m (E-W) and 3.20m (N-S).

Survey of major pest and disease of temperate fruits recorded in different month of the year 2018-19. During the year 2018 the powdery mildew disease incidence 5.5 % recorded in second week of May and Alternaria leaf spot disease 70 % in first week of september month in Apple. In walnut, leaf blotch 90 % recorded in month of September. In apricot, highest gummosis infection 50 % recorded in June-July month. In peach, the highest 46.66 % disease incidence of peach leaf curl recorded in April-May month. In plum, plum leaf curl (60 %) was observed in month of August-September. However, pear leaf spot was 90 % in August-September month, whereas, 60 % leaf spot was recorded in kiwi fruit during the month of August-September. In Strawberry, 5 % leaf spot was recorded in August month.

In water harvesting and moisture conservation technique the 15 treatments were made in apple tree basin where the soil type is sandy loam, clay loam at the site. The highest soil moisture content (12.80 %) recorded in cup & plate with black polythene mulching in the month of April in Apple tree basin. Whereas, in May month the highest moisture content 7.59 % recorded in control and without mulching. In June month, moisture content 10.83 % in control and without mulching. In August month, moisture content 13.75 % in control and without mulching because of soil clay loamy soil of the tree basin. In September month, moisture content 18.32 % in control and without mulching because soil is clay loam of the tree basin. In October and November months, moisture content 9.07 and 9.08 %, respectively in cup & plate with black polythene mulching. In December and January months, moisture content 11.23 and 16.22 %, respectively in control might be due to clay loamy soil of the tree basin. In February month, moisture content 14.89 % in control & black polythene mulching. However, the highest % increase in plant height 45.34 % recorded in half moon+ black polythene mulching and the maximum % increase in plant diameter 25.06 % recorded in trench system+ without mulch. Likewise in almond, highest soil moisture content (11.11 %) recorded in full moon with black polythene mulching in the month of April in Almond tree basin. Whereas, the highest moisture content of 10.08, 13.00 and 17.50 % recorded in control + dry grass mulching system, in May, June and July months, respectively. In August month, maximum of 17.55 % moisture content was estimated in trench + black polythene mulching system whereas September, October and January months, it is observed 14.84, 9.78 and 16.35%, respectively in control+black polythene system. In December month, the highest moisture content of 10.03 % recorded in cup & plate + dry grass mulching system whereas it was found maximum (17.31) in February month under trench + without mulching system. The highest % increase in plant height and stem diameter 3.70 %, 12.30 % recorded in full moon + dry grass mulching.

All India network research project on onion and garlic

This project was implemented at ICAR-CITH, Srinagar and its Regional Station Mukteshwar. At Srinagar, under sub-project Crop Improvement (germplasm collection, evaluation and maintenance) two new collections in onion (CITH-O-108 and CITH-O-109) and one in garlic (CITH-G-80) were done from Srinagar district and added to institute's *Allium* germplasm. Evaluation and maintenance of already existing onion and garlic germplasm was also done. Under sub-project Crop production experiment was conducted on fertilizer scheduling through drip irrigation system in onion in which treatment T2 that involved fertigation with 100% RDF at 100% pan evaporation exhibited highest marketable yield, field water use efficiency (45.79), crop water used efficiency (76.70) and benefit cost ratio (1.95). Under sub-project Crop protection experiment was conducted on evaluation of new molecule and its combination for insect pests and disease complex of onion in which treatment T4 (fipronil) was most effective for controlling thrips population and per cent damage in onion, whereas, Treatments T5 (propiconazole) was most effective for controlling Stemphylium blight and Purple blotch intensities. Thus none of the new molecule

Symptoms of IYSV on onion plant

and its combination could perform better than established pesticides. Another experiment under the same sub-project was conducted on incidence and intensity of Iris yellow spot virus (IYSV) at ICAR-CITH, Srinagar and were found 30.82 % and 11.5%, respectively.

At Mukteshwar, in varietal evaluation of long day garlic genotypes, a total of nineteen genotypes (9 in IET and 10 in AVT-I trials) of garlic were evaluated under field conditions. Among the genotypes, GN-15-78 of AVT- I, exhibited highest bulb yield of 128.55 q/ha followed by GN-15-85(103.10 g/ha) of AVT-I trial and GN-17-14 (88.78 g/ha) of IET trial. In varietal evaluation of long day onion genotypes, fifty onion genotypes in various trials namely IET (13), AVT-I (22) and long day onion hybrid AVT-II (15) were evaluated for their growth, yield and quality. Among, the genotypes/ hybrids evaluated in various trials, highest bulb yield of 508.08 q/ha was recorded in ON-16-48 of AVT-I trial followed by 317.10 q/ha in ON-15-33 of long day hybrid AVT-II trial.

All India Coordinated Research Project (Vegetable Crops)

This project was implemented at ICAR-CITH, Srinagar and its Regional Station, Mukteshwar. The brief findings of different projects are summarized under different heads below:

ICAR-CITH, Srinagar

Collection, evaluation, conservation and utilization of germplasm

Two new collections in chilli and one in paprika were added.

Bhut Jolokia

Kashmir Chilli-1

Kashmir Paprika-1

Chilli and paprika collections added in germplasm

Varietal and hybrid trials

The following trials were conducted during the reporting year (Table 14):

Table 14. Number of trails conducted in different crops

Crop	Trial	Number of entries tested
Chilli	IET (hybrid)	11
	AVT-I (hybrid)	7
	AVT-II (hybrid)	8
	AVT-I (variety)	8
Capsicum	AVT-II (variety)	6
Determinate tomato	IET (hybrid)	10
	AVT-I (hybrid)	10
	AVT-II (hybrid)	7
	IET (variety)	13
	AVT-I (variety)	15

Cherry tomato	AVT-I (variety)	5
Round brinjal	IET (variety)	9
	AVT-I (variety)	9
Long brinjal	IET (variety)	8
	AVT-I (variety)	9
Small round brinjal	IET (variety)	7
Broccoli	No head formation occurred	

ICAR-CITH, Mukteshwar

French bean

Total of 9 genotypes of French been (AVT-I) were evaluated for growth and yield performance in IET and AVT-I trial. Among the genotypes, genotype 2016/FBBVAR-2 recoded highest of 94.16 gm pod yield/plant (117.70 q/ha) in AVT-I trial followed by 2016/ FBBVAR-1, 2016/FBB VAR-2 and 2016/FBB VAR-3 of IET trials which registered 109.70, 101.70 and 100.10 q/ha pod yield, respectively.

Garden Pea

Fourteen genotypes of garden pea including five of snow/ edible podded pea were evaluated in IET early pea was evaluated during 2018-19. Highest of 156.00 q/ha pod yield was recorded in genotype 2018/PED AVR-6 followed by 145.00 q/ha in 2018/PM VAR-2 under IET mid-season pea trial and 142.00 q/ha and 135.00 q/ha in 2018/PEDAVR-1 and 2018/PED AVR-8, respectively under IET edible podded trial.

Cherry Tomato

Total of thirteen lines of cherry tomato were evaluated under polyhouse during summer-kharif 2018. Significant differences in the genotypes for various traits under study were observed. The genotype CITH-M-CT-4 produced tallest plant (2.67 m) followed by CITH-M-CT-6 (2.56 m). Average maximum and minimum fruit weight was recorded in genotype 2016/TOCVAR-1 (10.40 g) and in CITH-M-CT-3 (4.22 g), respectively, whereas maximum fruit length (38.35 mm) and fruit width (28.61 mm) were exhibited in the genotype CITH-M-CT-5 and CITH-M-CT-2 Yellow, respectively. The genotype namely CITH-M-CT-6 recorded highest of 2.87 kg fruit yield/plant (1062.96 q/ha) followed by 2.85 kg/plant (1055.55 q/ha) in CITH-M-CT-7, which was at par with highest yielding one (Table 15).

CITH-M-CT-2 Yellow

Table 15. Performance of cherry tomato genotypes

S. No.	Genotypes	Plant height (m)	Av. Branch length (m)	No. of branches /plant	Fruit length (mm)	Fruit breadth (mm)	Av. fruit weight (g)	Total no. of fruits/ plant	Total fruit yield/ plant (Kg)	Fruit Yield (Q/ha)
1.	CITH-M-CT-1	1.43	0.928	4.62	30.23	25.91	6.59	177.00	1.17	435.18
2.	CITH-M-CT-2-Red	1.52	0.950	3.62	35.06	20.93	5.70	266.50	1.51	561.29
3.	CITH-M-CT-2-Yellow	1.27	0.776	3.25	35.21	28.61	5.94	394.50	1.46	541.48
4.	CITH-M-CT-3	1.49	1.086	5.75	28.46	26.65	4.22	313.00	1.28	474.26
5.	CITH-M-CT-4	2.67	1.765	7.00	23.25	23.23	4.78	572.00	2.34	869.26
6.	CITH-M-CT-5	2.15	1.465	6.62	38.35	24.03	6.00	273.00	1.70	629.81
7.	CITH-M-CT-6	2.56	1.685	5.87	22.30	23.64	7.18	388.50	2.87	1,062.96
8.	CITH-M-CT-7	2.09	1.475	5.00	27.09	27.93	5.71	481.00	2.85	1,055.55
9.	2016/TOCVAR-1	2.04	1.420	4.60	33.63	23.23	10.40	381.00	2.02	748.15
10	2016/TOCVAR-3	2.39	1.660	5.20	22.97	23.99	7.70	532.00	2.42	898.15
11.	2016/TOCVAR-4	1.26	0.865	4.70	21.50	21.61	7.20	267.00	1.21	448.14
12.	2016/TOCVAR-5	1.30	0.730	4.65	33.03	18.85	5.40	320.50	1.30	483.33
13.	2016/TOCVAR-6	2.35	1.640	5.35	33.52	18.84	5.10	263.00	1.39	516.57
	CD at 5%	**0.425**	**0.26**	**1.25**	**3.40**	**3.40**	**1.13**	**38.87**	**0.726**	**268.78**

Parthenocarpic Cucumber

Five genotypes of parthenocarpic cucumber namely Pant Parthenocarpic Cucumber -2, Pant Parthenocarpic Cucumber-3, Multistar, Fadia and Hilton were evaluated under polyhouse during summer-Kharif of 2018. Among the genotypes, Pant Parthenocarpic Cucumber-3 produced highest fruit yield (6.65 kg/plant, 665.25 q/ha) followed by Multistar (6.57 kg/ plant, 657.43 q/ha), but it was at par with the fruit yield of Pant Parthenocarpic Cucumber-3. Maximum vine length and number of branches/ plant of 262.59cm and 5.94 were recorded in Fadia and Pant Parthenocarpic Cucumber -2, respectively. However, variety Multistar and Pant Parthenocarpic Cucumber -3 exhibited maximum number of fruits and plant (34.44) and highest fruit weight (307.00 g), respectively.

Fruiting in Parthenocarpic Cucumber

National Mission for Sustainable Himalayan ecosystem (TF-6)

This project was implemented at Srinagar and Mukteshwar center. At Srinagar, surveyed almond and walnut growing areas of Kashmir valley particularly district Budgam for germplasm having superior traits with respect to nut and kernel characteristics. Twelve almond and 4 walnut genotypes were collected and budded at ICAR-CITH, Srinagar field gene bank. Analysis of mother tree nut and kernel quality parameters of different selections of almond was completed. Sensitivity of apple crop to climatic variable was analyzed. Sensitivity analysis of apple productivity with annual T_{Mi} showed positive rate of 0.684

every year which indicated that with unit increase in temperature, the yield will increase. Further, the apple yield showed an increasing sensitivity rate of 0.050 and 0.051 per year with annual T_{mi} andT_{Av}. Similarly, sensitivity of T_{Mi} and T_A was done for four months (Nov. to Feb.) which indicated that with an increase in T_{Mi} and T_{Av}, the productivity showed a decreasing trend. Sensitivity analysis of apple productivity with annual rainfall revealed a positive rate of 0.048 every year which reflected that with the unit increase in annual rainfall, the yield of apple crop will increase. Further, sensitivity analysis of walnut productivity with annual T_{Mi} showed positive rate of 4.220 every year which indicated that with unit increase in temperature, the yield will increase. Likewise, the walnut yield showed an increasing sensitivity rate of 2.352 and 0.259 per year with annual T_{mi} and T_{Av}. Moreover, sensitivity of T_{Mi} and T_{Av} was done for four months (Nov. to Feb.) which indicated that with an increase in T_{Mi} and T_{Av}, the productivity showed an increasing trend. However, decreasing trend of the order of -0.049 was reported with increase in the minimum temperature (Nov. to Feb.). During 2018-19 two training programme were organized under NIMSHE project in which 63 farmers participated.

At Mukteshwar centre, activities were taken at Sunkiya and Jurkafun villages of Uttarakhand as well as Kumbhali village of Himachal Pradesh. A total 1200 plants of different temperate fruit crops were planted in approximately 4.124 ha area at field of 85 farmers in selected villages (Sunkiya, Jurkafun) in UK and Kumbhali (HP) during the year 2016-17, 2017-18 and 2018-19. Total 32 extension programmes including field visits were conducted in the selected villages during the year 2018-19 in which 309 farmers participated.Demonstration programmes on various horticultural crops viz., tomato (VL-4, Manisha, Laxmi, Avtar, Badshah, Himsona, Navin, Avinash), capsicum (Indam Supar, Tanvi, Yellow Wonder, Indam Bharat, Laxmi, Sel-4, Sel-5), parthenocarpic cucumber (PC-2 &PC-3), onion cv. Bhima Dark Red, Bhima Raj, Bhima Red, Bhima Super, Bhima Shubhra, Bhima Safed, Bhima Shakti, Bhima Kiran, Bhima Light Red, VL Piyaz 3 and Bhima Shweta; garlic (CITH-M-G-1, Bhima Purple and Bhima Omkar) and Potato (Kufri Girdhari) were conducted at 66 farmers' fields covering an area of 1580 and 2050 m^2 area at selected site i.e. Sunkiya and Jurkafun, respectively, during the year 2018-19. Likewise, total 70 fruit plants (Malta and Kagzi Lemon) were planted in approximate 560 m^2 area of 18 farmers in the selected village i.e. Sunkiya and Jurkafun during the year 2018-19. Fourteen demonstrations were conducted on various technologies viz., disease diagnosis in tomato and capsicum and their management, demonstration and planting in Malta and Kagzi lime, Management of thrips in beans under polyhouse, demonstration of field preparation in which 87 farmers are participated in the programmes.

National innovations on climate resilient agriculture

The phenological stages of five apple varieties viz., Red Delicious, Golden Delicious, Royal Delicious, Oregon Spur and Coe Red Fuji and two walnut varieties Viz., CITH-W-1 and CITH-W-2 were studied under this project (Table 16). The results of the study revealed a significant impact of climate change on the phenological stages of both the crops (Fig 17 and 18). This may be due to the varying weather parameters Viz., temperature and precipitation which have affected these growth stages. This impact of climate change has also affected various physical characteristics of both the crops and ultimately the yield of tree.

Table 16. Different phenological stages of apple and walnut studied during the year

Apple		Walnut	
54	Mouse-ear stage	01	Initiation of catkin growth
55	Flower buds visible (still closed)	02	1st male bloom
56	Green bud stage	03	Peak male bloom
57	Pink bud stage	04	Last male bloom
59	Most flowers with petals forming a hollow ball	05	Initiation of female flowering
60	First flowers open	06	1st female bloom
65	Full flowering	07	Peak female bloom
67	Flowers fading: majority of petals fallen	08	Last female bloom
69	End of flowering: all petals fallen	09	Leaf out
71	Fruit size up to 10 mm; fruit fall after flowering	10	Complete leaf development
72	Fruit size up to 20 mm	11	Hull splitting stage
74	Fruit diameter up to 40 mm	12	Harvesting stage
75	Fruit about half final size	13	Leaves began to discolour
76	Fruit about 60% final size	14	50 per cent leaf discolour
77	Fruit about 70% final size	15	All leaves fallen
78	Fruit about 80% final size		
79	Fruit about 90% final size		
87	Fruit ripe for picking		
89	Fruit ripe for consumption		
92	Leaves begin to discolour		
93	Beginning of leaf fall		
95	50% of leaves discoloured		

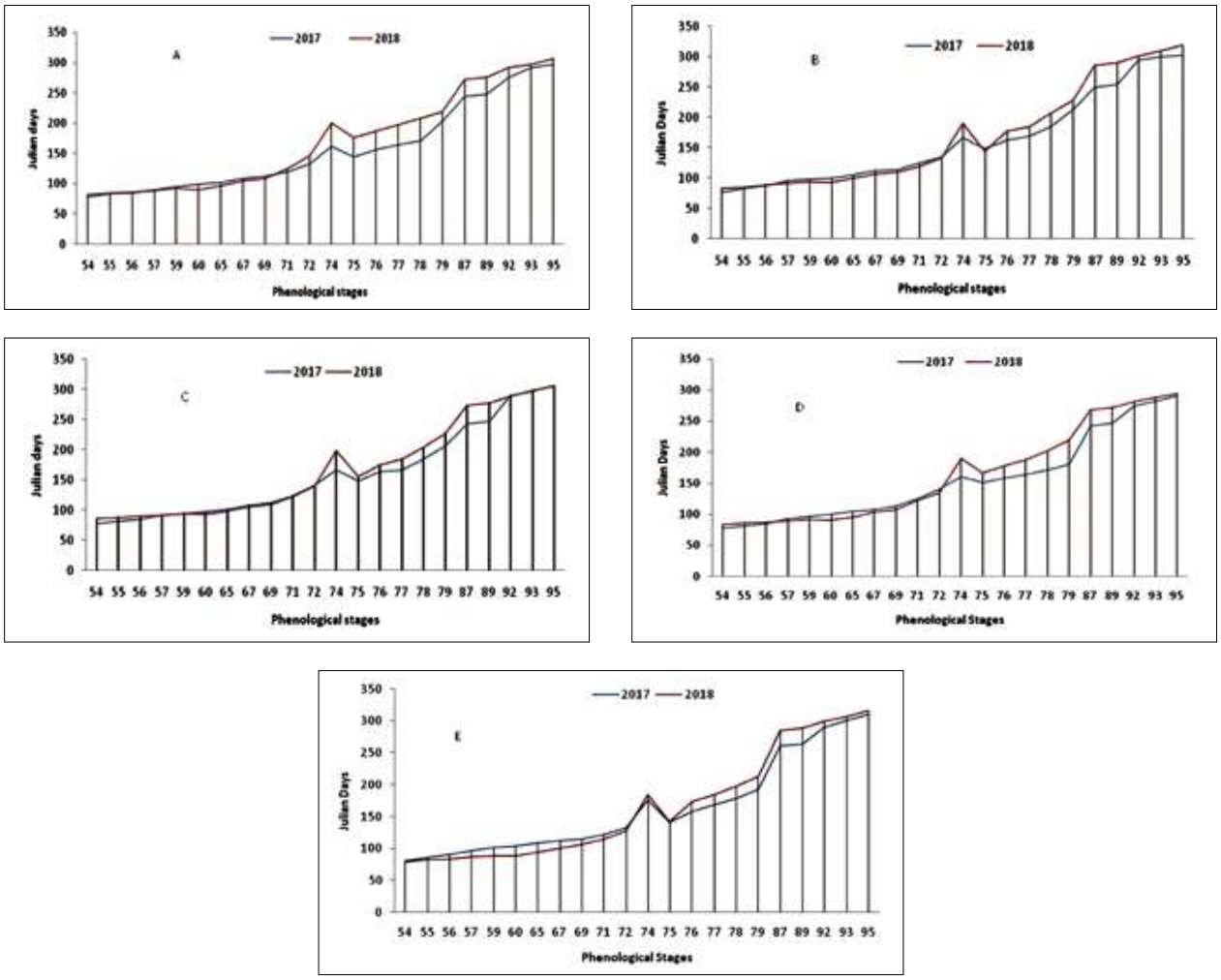


Fig 17. Advancement/ Delay in Phenological stages in (A) Red Delicious, (B) Golden Delicious, (C) Royal Delicious, (D) Oregon Spur and (E) Coe Red Fuji

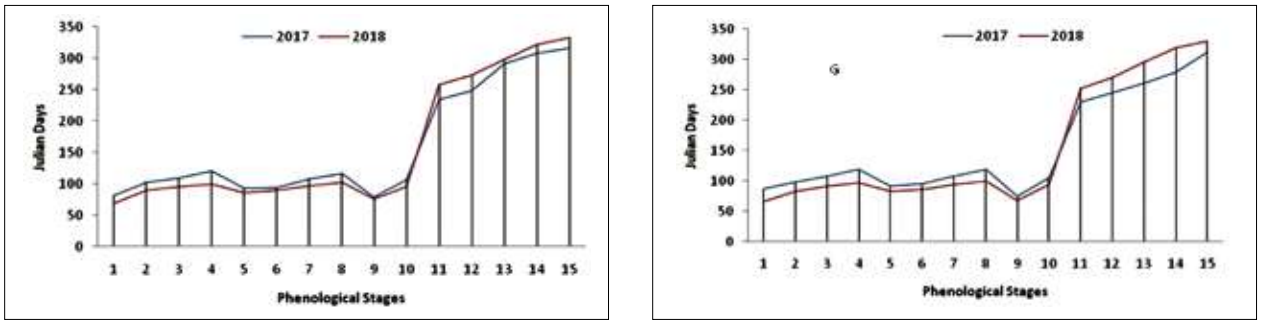


Fig 18. Advancement/ Delay in Phenological stages in CITH-W-1 and CITH-W-2.

Meetings and Events

4

During the year 2018-19, ICAR- CITH, Srinagar and its Regional Stations viz. Mukteshwar and Dirang organized many events and meetings which are presented below and summarized in the Table 17.

Walnut Propagation Centre Inaugurated

Dr. Trilochan Mohapatra , Hon'ble Secretary (DARE) & Director General (ICAR), New Delhi in presence of Shri Chhabilendra Roul, Special Secretary (DARE) & Secretary (ICAR) and Dr Anand Kumar Singh, Deputy Director General, Horticulture & Crop Sciences, ICAR, New Delhi inaugurated Walnut Propagation Centre on 10th June, 2018. Three new poly houses were constructed under Uttrakhand Forest Resource Management Project (UFRMP) for walnut promotion in Uttrakhand. Now the production capacity of walnut plants at this Institute will reach up to 15, 000 plants per year under polyhouse conditions. The polyhouse facility was also established at Regional Station , Mukteshwar for production of quality planting material. Dr. Trilochan Mohapatra , Hon'ble Secretary (DARE) & Director General (ICAR), stressed upon quality planting material production of best varieties at mega scale to cater the need of farmers.

Dr. Trilochan Mohapatra , Hon'ble Secretary (DARE) & Director General (ICAR), New Delhi inaugurating walnut propagation centre in presence of Shri Chhabilendra Roul, Special Secretary (DARE) & Secretary (ICAR) and Dr Anand Kumar Singh, Deputy Director General, Horticulture & Crop Sciences, ICAR, New Delhi

Table 17. List of various events organized during the year 2018-19

Sr. No	Event	Date	Organizers/ Coordinators
1.	Model training course	15th to 22nd December 2018	O C Sharma, J I Mir and W H Raja
2.	Brainstorming meeting on Technological Interventions for Enhancing Productivity and Quality in Apple	11th September, 2018	Dr Javid Iqbal Mir, Dr O C Sharma and Dr W H Raja
3.	ICAR-Regional Committee Meeting -1	11 to 12th June, 2018	All scientists

4.	14th Institute Research Council Meeting	1st to 2nd October, 2018	O C Sharma
5.	15th Research advisory committee meeting	12 to13th October, 2018	O C Sharma
6.	Study tour for Divisional and sub Divisional officers of Uttarakhand	7th to 8th August, 2018	O C Sharma
7.	Study tour cum awareness programme for Officers from UFRMP-JICA,Uttarakhand	18th to 20th February, 2019	O C Sharma, J I Mir, K L Kumawat and W H Raja
8.	Inter-institutional Sports Meet	14th to 16th November, 2018 at CCSHAU, Hisar.	J I Mir
9.	Farmers producers organization campaign	5th September, 2018	J I Mir
10.	International Yoga Day	21st June, 2018	K L Kumawat
11.	Vigilance awareness week	29 October to 3rd November	O C Sharma
12.	*Rastriya ekta diwas*	31st October, 2018	Mukul Raj Singh
13.	Communal harmony campaign week	19 to 25th November,2018	Selvakumar R
14.	World soil day	5th December, 2018	Anil Sharma
15.	*Swachh Bharat Abhiyan (SBA)*	15th Sept to 2nd October, 2018	W H Raja
16.	*Swachhta Pakhwada*	16th to 31st December, 2018	W H Raja
17.	National Productivity week	12th to 18th Feb 2019	W H Raja
18.	Radish Festival	16th January, 2019	Selvakumar R
19.	Leafy Vegetables Day	16th January, 2019	Geetika Malik and Sajad Un Nabi
20.	*Hindi Pakhwara*	14 to 28th September, 2018	O C Sharma
21.	Work shop on apple scab disease, cause and management	21st to 22nd April 2018 at Bomdila in Arunachal Pradesh	S U Nabi and K L Kumawat
22	International Women day	8th March, 2019	Geetika Malik
22.	Apple day	22nd September, 2018 at CITH, Mukteshwar	Raj Narayan and Arun Kishore

Model Training Course (MTC) organized

The 8 day-long National Level Model Training Course (MTC) on "Technological interventions in temperate horticulture for doubling farmer's income" organized by ICAR-Central Institute of Temperate Horticulture, Srinagar from 15th to 22nd December - 2018. The training programme was sponsored by Directorate of Extension Education, Ministry of Agriculture & Farmers Welfare, Government of India, New Delhi. A total of 16 officials from 3 temperate states viz., Himachal Pradesh, Uttarakhand and Jammu & Kashmir of the cadre of Chief Horticultural Officers, HDOs, NROs, etc participated in the programme. The training provided a platform to the officials from different states to get hands-on-training in using the technologies to enhance the productivity and income of farmers. During the programme, the gaps in skill and understanding between the horticulture officials of all states were also discussed. During the programme, an exposure and demonstration on HDP in temperate horticulture crops was also held at ICAR-CITH, Srinagar and SKUAST-K, Shalimar. This training course was very useful for Development Department Officers in Horticulture Department working at field level in improving their knowledge, skills and understanding of use and application of new technologies for enhancing productivity and quality of horticultural produce with enhanced returns.

Brainstorming Meeting on Apple

ICAR-Central Institute of Temperate Horticulture, Old Air Field Srinagar, J&K organized Brainstorming Meeting on Technological Interventions for Enhancing Productivity and Quality in Apple on 11th September, 2018 at its main campus Srinagar. Experts from different states participated in the event. Prof. Nazeer Ahmed, Hon'ble Vice Chancellor, SKUAST, Kashmir, Dr Wasakha Singh Dhillon, ADG (Horticulture Science), ICAR, New Delhi, Dr Desh Beer Singh, Director, ICAR-CITH, Srinagar, Dr K. K. Jindal, Former, ADG (Horticulture), ICAR-New Delhi, Dr Manzoor Ahmad Qadri, (KAS), Director Horticulture Kashmir, Dr A. A. Sofi, Former Director, ICAR-CITH, Srinagar, Prof. F. A. Zaki, Dean, FoH, SKUAST, Kashmir, Prof. Sheikh Bilal Ahmad, Dean FoA, Wadura, SKUAST, Kashmir, faculty members from SKUAST, Kashmir, Scientists from ICAR-CITH, Srinagar, ICAR-NBPGR (RS), Srinagar, ICAR-IGFRI (RS), Srinagar, Horticulture officers from Development Departments and Progressive farmers from different apple growing districts of Kashmir took part in the meeting and discussions. During the brainstorming meeting different areas for apple improvement were identified which can play a key role in improvement in its quality and productivity in Jammu and Kashmir, Himachal Pradesh, Uttarakhand and North Eastern states. Important issues like optimization

Lectures,discussion,practical exposure to trainees and participants under MTC at ICAR-CITH, Srinagar

of packages for newly established HDP in apple with respect to water and nutrient scheduling, pollination management and development of new policies for bee keeping with special reference to pollination, breeding for development of scab resistance varieties and revival of indigenous varieties like Ambri, rootstock breeding and quality multiplication to overcome the burden of import, niche specific crop diversification, technological interventions for kerewa areas, development of technologies for reducing post-harvest losses, special policy for apple cultivation in Ladakh with respect to coddling moth insect which is under quarantine, production of quality planting material through PPP mode in state to reduce or stop import of planting material from outside the country, diversification of varieties and crops through zonalization, use of early-mid-late maturing varieties together to maximize the returns, optimization of harvesting standards for both table purpose and storage for all the varieties under cultivation, development of variety wise recommendation for CA storage etc. A special discussion was made on role of HDP in improvement of apple fruit quality and productivity and the areas to address upon due to commercialization of HDP like water & nutrient management, canopy management, support system, pollination management, marketing etc. After the thorough discussion the recommendation on all the aspects were compiled and will form the road map for improving the quality and productivity of apple.

Discussion during brainstorming meeting on apple

ICAR-Regional Committee Meeting -1

ICAR-Central Institute of Temperate Horticulture, Srinagar, SKUAST-K, Shalimar and ICAR-IISWC Dehradun organized 25th meeting of ICAR Regional Committee-1 at SKUAST-K, Shalimar, Srinagar on 11th-12th June, 2018. During the Inaugural session Shri N. N. Vohra, Hon'ble Governor, Jammu and Kashmir in His address urged the State Farm Universities and Central Agriculture Institutions to share their findings and technologies in terms of varieties and other agricultural technologies. He encouraged the scientists working in KVK to meet the technical needs of small farmers and demanded more number of scientists for the state, keeping in view of the geographical terrain of J&K. Dr. Trilochan Mohapatra, Secretary DARE & Director General of ICAR stated that the agricultural technologies and its expansion have resulted in thirteen times more yield in cereals. We are proud of our programs and demonstrations in solving agricultural problems and we have reached 280 million tonnes of grain production level. Through continuous efforts of ICAR and State Agricultural Universities, now

Inaugural Address by Chief Guest Shri N. N. Vohra, Hon'ble Governor, Jammu and Kashmir

Release of publications during inaugural session

we are in position to export grain to China. He reviewed the action taken report by different State Development Departments, Universities and Institutes in J&K, HP and Uttarakhand. Functionaries of Agriculture Institutions, VCs of AUs, Directors of ICAR Institutes, Deans of State Agriculture Universities, officers of the Developments Department from HP, J&K and Uttarakhand participated in the meeting to discuss the agenda of agriculture development in the region

Two days workshop on apple scab disease, cause and management at Bomdilla, Arunachal Pradesh

ICAR-Central Institute of Temperate Horticulture, Srinagar in collaboration with Department of Horticulture, Government of Arunachal Pradesh organised two days workshop on, apple scab disease, cause, symptoms and management from 21st-22nd of April 2018, at Bomdila, West Kameng District for Horticulture officers/officials and progressive farmers of West Kameng and Tawang districts of Arunachal Pradesh. On 21st April 2018, lectures on different aspects of apple scab were delivered by scientists (Dr Sajad un Nabi and Dr K.L. Kumawat) from ICAR-CITH, Srinagar and Horticulturist Shergaon (Mr. N. Lobsang). On 22nd of April, participants were taken to Wanghoo village for field demonstration cum training on identification and management of apple scab disease. Around 45 participants including horticultural officials and progressive farmers from both the districts attended the workshop. The participants were made well acquainted with different aspects like symptomatology, integrated management and good horticultural practices in relevance to scab disease in apple growing regions of Arunachal Pradesh.

14th Institute Research Council Meeting

The 14th Institute Research Council meeting was held on 1st & 2nd October, 2018 under the chairmanship of Dr D B Singh, Director CITH, Srinagar. All the scientists participated in the meeting. Project wise presentations were made by different PI's and results/outcomes along with the activities to be taken up in next year were discussed in detail. The presentation on research projects from Regional Station, Mukteshwar was made by Dr Raj Narayan, Principal Scientist and In charge of the Station. The Chairman gave critical inputs on experimentation for obtaining realistic and reproducible results. More time was also given in some projects to obtain reproducible results.

Discussion during IRC meeting

Glimpses of two days workshop on apple scab disease, cause and management at Bomdilla, Arunachal Pradesh

15th Research Advisory Committee Meeting

The 15th meeting of RAC was held on 12-13th October, 2018 at ICAR-CITH, Srinagar under the Chairmanship of Dr. K. R. Dhiman, Former-Vice Chancellor, Dr. YSPUHF, Nauni, Solan. The members of RAC Dr. W. S. Dhillon, Dr. J. C. Rana, Dr B V Singh, Dr. A. Das Munshi, Dr. M. K. Verma, Dr. Hina Shafi, Shri Desh Kumar Nehru, Dr. Desh Beer Singh, Dr. O. C. Sharma and the scientists of CITH attended the meeting. On 12th October,2018, Dr D B Singh, Director CITH made a presentation on action taken report followed by presentation on the progress reports of various research programmes under Crop Improvement, Crop Production, Crop Protection and Post Harvest Management and Externally Funded Projects at ICAR-CITH Main campus by scientists/PIs of the Projects. On 13th October, 2018 different projects going on at Regional Station, Mukteshwar were presented.

Lecture, field visit and discussion during study tour for Divisional and sub Divisional officers

Presentation and discussion during RAC meeting

Study tour organized for Divisional and sub Divisional officers

A study tour was organized for five member team of UFRMP- JICA from 7th to 8th August, 2018 at ICAR-CITH, Srinagar. The Divisional and Sub Divisional Officers participated in this programme. The presentations on various aspects of walnut production and propagation were discussed in detail. The participants were also made aware of various research activities and technologies generated in walnut at the Institute. They were also exposed to mother block, orchards and propagation units of walnut. The walnut plantation at farmer's field was also shown to the participants.

Study tour cum awareness programme for officers from UFRMP-JICA,Uttarakhand

To promote the walnut cultivation in Uttarakhand a study tour was organized from 18th - 20th February, 2019 by UFRMP-JICA, Uttarakhand and ICAR- CITH, Srinagar under the project walnut propagation for production of quality planting material. Four members from PMU, project director, advisors from JICA, technical coordinator, five DFO/SDO, six ranger/deputy ranger, three marketing specialist, three forester and three forest guard from Uttarakhand attended the training programme. In this programme officers were introduced to CITH, Srinagar by Director, Dr. D.B. Singh and

Glimpses of Study Tour at ICAR-CITH and other Places at Srinagar

theoretical and practical demonstrations were given by different scientists on various aspects of walnut production especially walnut propagation. Visit to other institutions was also organized. They appreciated the research work going on at ICAR-CITH, Srinagar and were satisfied with the visit.

Vigilance Awareness Week

ICAR-CITH, Srinagar observed a vigilance awareness week w.e.f. 29th Oct. to 3rd Nov., 2018. The theme of the week was Eradicate Corruption-Build a New India. The programme was started on 29th Oct., 2018 in which Vigilance Officer, CITH briefed about the importance of the week in our daily life and its contribution towards building a new India. Director, ICAR- CITH, Dr D B Singh highlighted the importance in day to day work and participation of public in promoting integrating and eradicating corruption. The various measures for eradicating corruption were also highlighted and responsibility of all the staff to check corruption through various ways was elaborated. Twenty five employees of ICAR-CITH took pledge in the programme. Besides this 28 members also took e pledge in this week. Besides organizing vigilance week, 21 employees including Director ICAR- CITH, Srinagar also participated in the programme organized by ICAR-IGFRI, RS Srinagar at ICAR-CITH campus. Detailed discussions were made on position of country in world and different states in the country. Many staff shared their views on this occasion. During this week the posters were also displayed at various locations at CITH, Srinagar campus to encourage the people participation to Eradicate Corruption-Build a New India.

Pledge ceremony during Vigilance week

Hindi Pakhwara

Hindi Pakhwara was observed by ICAR-Central Institute of Temperate Horticulture, Srinagar and its Regional Station, Mukteshwar from 14 to 28th September, 2018 for compliance of official language policy. Institute organized many competition like essay writing, word translation,

Glimpses of Prize distribution during Hindi Pakhwara and address by Director ICAR-CITH, Srinagar

poster writing, quotation writing, ex tempo completion and antakshari. Many staff members of ICAR-CITH, Srinagar, IGFRI-RS Srinagar, NBPGR RS Station Srinagar and school children participated in various events. The participants were felicitated with cash prizes.

Inter-Institutional Sports Meet

ICAR-CITH, Srinagar participated in inter-institutional sports meet from November 14-16, 2018 organized by CCSHAU, Hisar. During the event contingent participated in different events like race (s), long jump, high jump, carom, chess, badminton, table tennis, volley ball etc. The performance of the participants was very good.

Farmers Producers Organization Campaign

ICAR-CITH, Srinagar organized one day training programme/exposure visit under capacity building training (CAT) for farmers of district Ganderbal in collaboration with KVK, Ganderbal on 5th September, 2018. This programme was organized in context with farmer's producer's organization campaign. The farmers of district Ganderbal were exposed to different schemes of NABARD and role of ICAR institutes in extending the technological support to the farmers. The meeting was chaired by Dr Javid Iqbal Mir, Senior Scientist, ICAR-CITH, Srinagar who gave detailed

Participation in Inter-Institutional Sports Meet

Discussion during Farmers Producers Organization Campaign

presentation on technological achievements of ICAR-CITH, Srinagar and their role in enhancing farmer's income.

Swachh Bharat Mission

Two programmes under Swachh Bharat Mission were organized in the institute during the year 2018-19. Three week programme of **"Swachhta Hi Seva"** from "15th Sept to 2nd October, 2018" and 16 days programme "**Swachhta Pakhwada"** from "16th December to 31st December, 2018" was organized at ICAR-CITH, Srinagar. During these programmes along with routine Swachhta activities, for foresting healthy competition among the participant's activities like wall painting, debates, discussions, poster competition, seminars, expert's talks, quiz, essay and drawing competitions were also organized. Swachhta Awareness at local level (organizing sanitation campaigns) involving local farmers and villagers, technology demonstrations on agricultural waste management and safe disposal of all kinds of wastes were also organized. During these programmes all the participants showed great zeal and enthusiasm while performing this duty in making our country cleaner and beautiful. The participants were also rewarded at the end of the programmes.

Other Programmes

Besides above mentioned events, the other events/ programmes organized by ICAR-CITH, Srinagar during the year were Rastriya Ekta Diwas (31st October, 2018),Communal Harmony Campaign Week (19 to25th November, 2018), World Soil day (5th December,2018), National Productivity Week (12 to 18th February, 2019), International Women Day (8th March, 2019), Apple Day (22nd September, 2018 at Mukteshwar), Radish Festival and Leafy Vegetable day (16th January, 2018).

Pledge and other activities carried out under Swachh Bharat Mission

Glimpses of International Women Day, Leafy Vegetable Day, Root Festival and National Productivity Week

Extension and other programs

Extension Activities

The ultimate aim of any research work in agricultural sciences is to benefit the farmers by generating farmer friendly technologies which will increase the productivity of their farm which ultimately lead to uplift their socioeconomic status. The horticulture is one of the enterprise which can boost productivity and income by adopting latest technologies. The research institutes are continuously generating technologies but the adoption of technologies by farmers is still not upto mark. The temperate regions of country like J&K, Himachal Pradesh, Uttarakhand and parts of North-Eastern states like Arunachal Pradesh, Sikkim etc are hub of temperate fruit cultivation. The major challenges in horticulture sector include sustainability, higher levels of production, competitiveness to stay in market, regular production, land, water and more importantly threat of climate change.

The temperate fruit industry in India is associated with many production problems and lack of knowledge of latest technologies which leads to low productivity in these crops as compared to other countries. There is a great scope to increase the productivity of quality produce in temperate horticultural crops if farmers/ stakeholders are made aware of latest and scientific technologies generated by various institutions. The Central Institute of Temperate Horticulture, Srinagar and its regional stations are putting continuous efforts to make the farmers/ officers of line departments aware of various new technologies generated in temperate horticultural crops for improving productivity and quality. The Institute has tried to disseminate various technologies by organizing number of programs for human resource development. For the quick adoption of technologies, ICAR-CITH is continuously organizing vocational trainings, model training courses, crop days, on campus and off campus trainings as well as demonstrations, ghoshtis, farm visits, diagnostic visits, supply of quality planting material, publication in local language, participation in farmer fairs, radio talk, TV shows and display of exhibits on various occasions/ farmers fair etc. The details of various programmes organized at ICAR-CITH during 2018-19 are presented below:

Training programmes organized for officers

The training programmes organized during 2018-19 for officers of line department are given in Table 18 and details of programmes are presented below:

Table 18. List of training programmes organized for officers

Sr No.	Name of programme	Venue	Date	Participants	Organizer/ coordinators
1.	High Density Plantation in Temperate Fruit Crops	ICAR-CITH, Srinagar	17th April to 23rd April, 2018	19	O. C. Sharma, J.I.Mir, Shiv Lal and W.H.Raja.
2.	High Density &Canopy Architectural Engineering in Temperate Fruit Crops (for officers of H P)	ICAR-CITH, Srinagar	29th May to 4th June, 2018	16	O.C. Sharma, Anil Sharma, K.L. Kumawat and S U Nabi.

3.	Walnut propagation techniques (for officers of H P)	Magra, Jonpur Range, Mussoorie Forest Division, Uttarakhand	4th and 5th February, 2019.	36	O C Sharma
4.	Walnut propagation techniques (for officers of Deptt Forest, Uttarakhand)	Deptt of Forest Nursery, Sony, Tadi Forest Range, Soil Conservation Division Ranikhet, Uttarakhand	7th and 8th February, 2019	23	O C Sharma
5.	Walnut propagation techniques (for officers of Deptt Forest, Uttarakhand)	Forest Nursery, Silalekh, Mukteshwar Forest Range, Soil Conservation Division Nainital, Uttarakhand	9th February, 2019.	10	O C Sharma
6	Tall Spindle System in Apple	officials of Horticulture Department, Pruners, HDOs etc at Zainapora, Farm, Shopian	25th Feb 2019	30	J I Mir

Seven days training programme on high density plantation in temperate fruit crops

A seven day training programme on high density plantation in temperate fruit crops was organized for officers from department of horticulture, Himachal Pradesh at ICAR- CITH, Srinagar w.e.f .17th April to 23rd April, 2018, in which 19 officers participated. The programme was sponsored by Department of Horticulture, Himachal Pradesh. In this programme the participants were made aware of various technologies generated by Institute and across the globe through lectures, practical demonstrations and exposure visits to high density orchards. The various aspects of high density plantation were discussed in detail by scientist of ICAR-CITH Srinagar and other organizations. The participants were highly satisfied with the course and assured to implement the technologies at ground level to increase the productivity of temperate horticultural crops in the country. The programme was coordinated by Dr. O. C. Sharma, Dr. J.I.Mir, Dr. Shiv Lal and Dr. W.H.Raja.

Glimpses of lectures and field visit during training programme

Seven days training programme on high density &canopy architectural engineering in temperate fruit crops

A seven day training programme on high density &canopy architectural engineering in temperate fruit crops was organized for officers from department of horticulture, Himachal Pradesh at ICAR- CITH, Srinagar w.e.f. 29th May to 4th June, 2018, in which 16 officers participated. The programme was sponsored by Department of Horticulture, Himachal Pradesh. In this programme, main stress was given on production of quality produce of temperate horticultural crops through adoption of available technologies in the Institute and across the globe. In this training, main attention was given on canopy architectural engineering, pruning, rootstocks, varieties suitable for various planting densities, pollination management, orchard management practices, insect, pest, diseases and post harvest management. Besides lectures practical demonstrations were also provided to the participants. The participants were highly satisfied with the training and assured to implement the most ignored otherwise most significant aspect in temperate fruit crops *i.e.* canopy management and high density planting in fruit crops at farmers field to boost the production of quality produce. The programme was coordinated by Dr. O. C. Sharma, Dr. Anil Sharma, Dr. K.L.Kumawat and Dr. Sajad-un-Nabi.

Training Programmes on walnut propagation techniques at various locations in Uttarakhand

To promote the walnut cultivation and production of quality plating material of walnut in Uttarakhand, three training programmes of one to two days duration were organized at various locations in Uttrakhand. The main aim of these programmes was to impart training to officers from department of forest on walnut propagation techniques, so that they can become self sufficient for production of quality planting material in future. The first two days training programme on walnut propagation was organized at Deptt of Forest Nursery, Magra (Jonpur Range, Mussoorie Forest Division, Uttarakhand) on 4th and 5th February, 2019. A total 36 participants including officers from department of forest, department of horticulture, NGO and progressive farmers from Uttarakhand participated in the programme. The training programme consisted of theoretical deliberation and practical demonstrations on selection of rootstock, scion wood, different grafting and budding techniques. In the training programme, chip budding, wedge grafting, tongue grafting and cleft grafting were demonstrated in detail. The second two days training programme on walnut propagation was organized at Deptt of Forest Nursery, Sony, Tadi Forest Range, Soil Conservation Division Ranikhet, Uttarakhand on 7th and 8th February, 2019. A total 23 participants including officers from department of forest,

Glimpses of lectures by scientist during training programme

Training and demonstration on walnut propagation at Silalekh- Mukteshwar – Nainital Division, Magar - Mussoori Division and Sony- Ranikhet Division (Uttarakhand)

department of horticulture, and progressive farmers from Uttarakhand participated in the Programme. The third one day training programme on walnut propagation was organized forest nursery, Silalekh, Mukteshwar Forest Range, Soil Conservation Division Nainital, Uttarakhand on 9th February, 2019. A total 10 participants consisting of officers from department of forest, participated in the programme. In these training programmes, chip budding, wedge grafting, tongue grafting and cleft grafting were demonstrated in detail by Dr O C Sharma and Basir ahmad Ganai.

Two days training organized for BSF Ladies club

A two days training programme was organized for BSF ladies club, unit Humhama, Srinagar on value addition in fruits and vegetables from 10-11 July, 2018. Total 20 ladies participated in the training programme and were trained on home scale preservation and value addition in horticultural crops. This programme was coordinated by K L Kumawat and Geetika Malik and assisted by Dr Danish Bashir

Farm visit and value addition of horticultural crops

Training on protection of farmers varieties under PPV&FRA at Garkon village, Kargil

Awareness cum training programme to the farmers of Garkon village, Kargil was given on 29th July, 2018. This programme was organized in context with protection of farmer's varieties through PPV&FRA, New Delhi. Since most of the applications filled by the farmers did not qualify the merit for protection due to many limitations. Detailed criteria for filling of applications and eligibility of the variety for protection were discussed. In addition procedure for varietal registration through NBPGR was also discussed. The programme was organized by Dr O C Sharma and Dr J I Mir, ICAR-CITH, Srinagar.

Training on protection of farmers varieties at Garkon village, Kargil

Scientists/ officers visit/ training

- A group of 20 scientists, who were the participants of ICAR Sponsored short course on physiological approaches for improving shelf life of fruits and vegetables organized at SKUAST-K w.e.f.9th to 18th July, 2018 visited ICAR-CITH Srinagar on 11th July, 2018. The participants were exposed to various technologies generated at ICAR-CITH and field visit was also conducted. The programme was facilitated by Dr O C Sharma and Dr Geetika Malik.

Lecture and farm visit of participants of short course

- A group of 26 scientist who were the participants of ICAR Sponsored 21 days summer school on Recent developments in organic vegetable production system under changing climatic scenario organized by Division of Vegetable Science, SKUAST-K, Shalimar from 24 July to 13 August, 2018 visited ICAR-CITH Srinagar on 3rd August, 2018 and were made aware of various technologies available at Institute. The programme was facilitated by Dr Geetika Malik and J I Mir.
- A group of eight officers from line department of Afghanistan who were under training at SKUAST- K visited ICAR-CITH, Srinagar on 13th December, 2018 and were made aware of various technologies especially almond and walnut cultivation. The programme was facilitated by Dr O C Sharma.

Training Programmes/Visits for students

Besides well established orchards and experimental fields of various horticultural crops, ICAR-CITH, Srinagar has well equipped laboratories facilities which has made the Institute as centre of learning and attraction for students and scholars. During the year 11 students groups visited the Institute and were trained on various aspects of temperate horticultural crops. The detail of various visits/ trainings is presented in Table 19.

Training programme/ farm visits for farmers

During the year several groups of farmers sponsored by various agencies from different areas visited the Institute and were made aware of various technologies generated at ICAR-CITH. The details of various campus programmes are presented in the Table 20.

Table 19. List of schools/colleges who visited the ICAR-Central Institute of Temperate Horticulture during the year 2018-19

Date	Name of School/ College/ University/ Institute	Number	Facilitated By
24-04-2018	Spring Field Secondary School, Mehjoor Nagar, Srinagar, J&K	50	Dr. O. C. Sharma Dr. Sheeba Varma Mrs Saima Zahoor
25-04-2018	Spring Field Secondary School, Mehjoor Nagar, Srinagar, J&K	50	Dr. Shiv Lal Dr. Wasim Hassan Raja Dr. Danish Bashir Mrs Saima Zahoor
26-04-2018	Orbit Girls school, Peerbagh Hyderpora, Srinagar, J&K	40	Dr. Geetika Malik Mrs Saima Zahoor Dr. Danish Bashir
30-05-2018	Visit Of Students B.Tech (Agriculture Engineering) 2nd Year, SKUAST-K, Shalimar, Srinagar, J&K	25	Dr. O. C. Sharma Dr. J.I. Mir
27-06-2018	Foundation World School, Srinagar, J&K	100	Dr Shiv Lal Dr W.H.Raja Dr. Danish Bashir Eshan Ahad
18-08-2018	Students of SKUAST-K for entrepreneurship development programme, Srinagar, J&K	25	Dr. J.I. Mir
20-09-2018	Degree College, Tral Srinagar, J&K	20	Dr. Wasim Hassan Raja
24-09-2018	Foundation World School, Srinagar, J&K	100	Mr. Eshan Ahad Ms. Iqra Qureshi
26-09-2018	Students from S.P. College, Srinagar, J&K	40	Dr. J.I. Mir
11-10-2018	JACKLI BEACON School, Rangreth, Srinagar, J&K	50	Mrs Saima Zahoor
02-02-2019	Faculty of Forestry,Benihama SKUAST-K, Srinagar (JK)	25	Dr. Wasim Hassan Raja

Visit of various student groups to ICAR-CITH.


24-04-2018


24-04-2018


25-04-2018


25-04-2018


27-06-2018


27-06-2018


20-09-2018


20-09-2018


24-09-2018


24-09-2018


02-02-2019


02-02-2019

Table 20. List of visits organized for farmers at ICAR-Central Institute of Temperate Horticulture during the year 2018-19.

Date	Department/ Organization	Zone/District	Number	Facilitator/ Coordinator
02-08-2018	Farmers from Baramulla	Baramulla,J&K	14	Dr. J.I. Mir
13-08-2018	Farmers from Bunniyar	Baramulla,J&K	10	Dr. W.H.Raja
05-09-2018	Farmers (Sponsored by NABARD)	Ganderbal,J&K	25	Dr. J.I. Mir
25-09-2018	Farmers from Nyoma	Leh,J&K	11	Dr. O.C.Sharma
06-12-2018	Horticulture, Agriculture	Pulwama& Srinagar, J&K	190	Dr. D.B.Singh Dr. O.C.Sharma Dr. W.H.Raja
10-12-2018	Agriculture	Shogapora Budgam,J&K	18	Dr. Geetika Malik Dr. W.H.Raja
11-12-2018	Horticulture	Kreeri, Shogapora,J&K	25	Dr. W.H. Raja Mr. Sajad-Un-Nabi Dr. Geetika Malik
12-12-2018	Agriculture	Shogapora, Soibugh, Khan Sahib, Yarikha, Budgam,J&K	130	Dr. O.C. Sharma Dr. K.L. Kumawat Dr. W.H. Raja

13-12-2018	Agriculture	Wussan, Lokpora, Pattan, Shogapora, Nehalpora, Hanjiwara, Nagam,J&K	160	Dr. D.B.Singh Dr. Geetika Malik Dr. W.H.Raja
15-12-2018	Horticulture, Agriculture	Ganderbal, Shogapora, Budgam, Soibugh,J&K	110	Dr. O.C. Sharma Dr. Geetika Malik Dr. W.H.Raja Mr. Sajad-Un- Nabi
19-12-2018	Agriculture	Zoohama, Soibugh, Chadoora,J&K	75	Dr. O.C. Sharma Dr. Geetika Malik
20-12-2018	Agriculture production Department, Agriculture	Khanda, Budgam,J&K	30	Dr. Geetika Malik Dr. Muneer Ahmad Sheikh
22-12-2018	Agriculture	Sangrama Sopore,J&K	35	Dr. D.B.Singh Dr. Geetika Malik Dr. W.H.Raja Mr. Sajad-Un-Nabi
26-12-2018	Agriculture	Soibugh Budgam, Tujjar Sopore,J&K	60	Dr. O.C. Sharma Dr. Geetika Malik Dr. W.H.Raja
27-12-2018	Agriculture	Soibugh Budgam, Dangerpora Sopore,J&K	66	Dr. Geetika Malik Dr. W.H.Raja
28-12-2018	Agriculture Department, Pulwama	Noorpora, Pampore, Tral Kakpora, Newa, Pulwama,Tahab,J&K	50	Dr. Geetika Malik Dr. Muneer Ahmad Sheikh Mr. Sajad-Un-Nabi
29-12-2018	Agriculture Department, Budgam	B.K Pora Budgam,J&K	28	Dr. K.L. Kumawat
31-12-2018	Horticulture	Budgam, Kanir, Kremshore, Chadoora, Nagam, Loolipora, B.K. Pora, Magam, Khansahib Waterhal, Soibugh, Narbal Khag, Beerwa, Arizal, Kanidajam, Char e shareif,J&K	150	Dr. D.B.Singh Dr. O.C.Sharma Dr. K.L. Kumawat Dr. W.H.Raja Mr. Sajad-Un-Nabi
15-01-2019	Agriculture	Sopore Baramulla ,J&K	24	Dr. W.H.Raja
06-03-2019	KVK Baramulla, Progressive Farmers	Baramulla,J&K	20	Dr. O.C.Sharma Dr. J.I.Mir Dr. Geetika Malik Mr. Sajad-Un-Nabi Dr. Shoaib Nissa Kirmani
20-03-2019	Agriculture	Tangmarg Baramulla,J&K	20	Dr. W.H.Raja Dr. Geetika Malik
23-03-2019	Agriculture	Pattan,J&K	10	Dr. W.H.Raja
25-03-2019	Farmers from Rohama	Rohama Baramulla,J&K	20	Dr. W.H.Raja

Glimpses of different groups of farmers at ICAR-CITH


12-12-2018


13-12-2018


13-12-2018


15-12-2018


15-12-2018


19-12-2018


19-12-2018


22-12-2018


22-12-2018


31-12-2018


26-12-2018


27-12-2018

Extension programmes at ICAR-CITH, RS, Mukteshwar

The training programmes and demonstrations were also carried out at ICAR-CITH, regional station Mukteshwar and presented in Table 21 below

Table 21. Training, Demonstration, awareness programmes performed at RS, Mukteshwar

Training/Demonstration/Day etc	No. of days	Date & Venue	No of participants	Nodal Person
Scientific method of planting of potato and training program	01	12/04/18, Sunkiya, UK	05	Dr Raj Narayan Dr ArunKishor,
Protected cultivation ofcapsicum and orchard management	01	20-04-2018, Sunkiya,UK	07	Dr Raj Narayan Dr ArunKishor
Animal health cum awerness programme in coloboration with ICAR-IVRI Mukteshwar	01	27-04-18 Sunkiya,UK	18	Dr Raj Narayan Dr ArunKishor
Seedling planting method of tomato and capsicum	01	05-05-2018 Sunkiya,UK	05	Vivek Kumar Tiwari
Seedling planting method of tomato and capsicum	01	08-05-2018 Jurkafun, UK	02	Vivek Kumar Tiwari
To demonstrate training poring tomato at farmer field	01	16/05/2018 Sargakhet,UK	02	Raj Narayan
Demonstration of application of fungicide	01	17-05-2018 Jurkafun,UK	10	Vivek Kumar Tiwari

Demonstrated scientific method of capsicum planting	01	19-05-2018 Jurkafun,UK	02	Vivek Kumar Tiwari
Advanced horticultural practices for temperate fruit crops in collaboration with BAIF Champawat	01	10.05.2018 CITH RS, Mukteshwar,UK	20	Raj Narayan ArunKishor
Aware the farmers about temperate fruit orchard management and intercropping of vegetables	01	28/05/2018 Dhanachuli,UK	05	Raj Narayan ArunKishor
Demonstrated pollination management and honey production. Efficient Water management for crop production. Nutrient management and Dignosis of disease/ pest in tomato.	01	07-06-2018 Sunkiya,UK	05	Raj Narayan ArunKishor
Women empowerment through horticulture, in collaboration with BTM, ATMA, Okhalkada	01	30.06.2018 CITH RS, Mukteshwar,UK	22	Raj Narayan ArunKishor
Demonstration on training and pruning in tomato and capsicum	01	25-07-2018 Jurkafun,UK	03	Raj Narayan
Training on Scientific cultivation method of Malta and Kagzi Lime	01	20-8-2018 Jurkafun,UK	8	Dr ArunKishor
Apple day/show cum FAP on climate resilient apple production technologies for doubling farmer's income	01	22.09.2018 CITH RS, Mukteshwar,UK	135	ArunKishor Raj Narayan
Training on Scientific cultivation method of Malta and Kagzi Lime	01	25-08-2018 Sunkiya,UK	10	Dr Raj Narayan Dr ArunKishor
Demonstration of field preparation for planting of temperate fruits	01	27-09-2018 Jurkafun,UK	4	ArunKishor
Demonstration on preparation of field for tamperate fruit planting and planting of onion & garlic	01	01/10/18 Sunkiya,UK	16	Dr ArunKishor
Off Season Production Technology of speciality melon under protected cultivation, in collaboration with Div. of Veg. Sci., ICAR-IARI, New Delhi	01	30.11.2018 CITH RS, Mukteshwar,UK	66	Raj Narayan ArunKishor
Scientific cultivation method of long day onion and garlic	01	19-12-2018 Jurkafun,UK	16	Dr Raj Narayan
Training and pruning system in stone fruits	01	20.12.2018 Dhanachuli,UK	13	Raj Narayan ArunKishor
FAP- Cultivation of long day onion and garlic and Cleanliness and disinfection of animal sheds in collaboration with ICAR-IVRI, Mukteshwar	01	22-12-2018 Sunkiya,UK	32	Dr Raj Narayan

Organized one day training cum on field demonstration on training and pruning in apple and pear on village in which total 9 farmers were participated and their problems related with training and pruning were sorted out during the demonstration.	01	01.02.2019 Dhanachuli,UK	9	ArunKishor Vinod Chandra
Training on garden pea cultivation and its seed production technology Orchard management of temperate horticultural crops and Demonstration of grafting and budding technologies in walnut	01	02/03/2019 Sukiya,UK	13	Dr Raj Narayan Dr ArunKishor

Glimpses of extension activities carried out at ICAR- CITH, RS Mukteshwar

Activities at ICAR-CITH, RS, Dirang

During 2018-19 land survey and demarcation of ICAR-CITH, Regional Station, Dirang was done. Furthermore, process of land possession has been initiated. One two day workshop on apple scab and 3 one days training programmes were conducted on different aspect of temperate fruit production. In addition four demonstrations were laid out at different locations of West Kameng District on medium density planting using elite varieties of apple, pear, peach, plum, apricot, almond and walnut.

Training organized at West Kameng district of Arunachal Pradesh during 2018-19

S. No.	Title	Location	No. of participant	Duration
1	"Layout, Planting and Orchard Management at Formative Stage"	Cher, Hamlet, West Kameng District	10	30-01-2019 (One day)
2	"Layout, Planting and Orchard Management at Formative Stage"	Duwangba, Dirang, West Kameng District	09	31-01-2019 (One day)
3	"Canopy management in new and old orchard of apple and peach"	Namthung village, West Kameng District	15	02-02-2019 (One day)

Demonstration laid-out at West Kameng district of Arunachal Pradesh during 2018-19

Title	Name of Beneficiary	Address	Location of field	Detail
Performance evaluation of elite varieties of temperate fruit crops at different location of West Kameng district of Arunachal Pradesh	Sh. Sonam Gyatso Merakpa s/o Lt. Leiki Drakpa Merakpa	Dirang Basti, Dirang, West Kameng District, Arunachal Pradesh	Duwangba, Dirang, West Kameng District Latitude-27°28'46''N Longitude-92°6'38''E	Crop: Apple (8 cvs), pear (1 cv), peach (2 cvs), plum (1 cv), apricot (2 cvs), almond (3 cvs) and walnut (2 cvs) No. of trees-139 Date of planting-31-01-2019
	Shri TsewangTashi s/o Shri Gombu	Namthung village, Dirang, West Kameng District, Arunachal Pradesh-India	Cher, Hamlet Latitude-27°36' N and Longitude 92°29' E	Crop: Apple (8 cvs), pear (1 cv), peach (2 cvs), plum (1 cv), apricot (2 cvs), almond (3 cvs) and walnut (2 cvs) No. of trees-109 Date of planting-30-01-2019
	Shri PemKhandu s/o Lt. Konju	Dirang Basti, Dirang, West Kameng District, Arunachal Pradesh- India	Cher Yang Latitude-27°36' N and Longitude 92°24' E	Crop: Apple (8 cvs), pear (1 cv), peach (2 cvs), plum (1 cv), apricot (2 cvs), almond (3 cvs) and walnut (2 cvs) No. of trees-131 Date of planting-01-02-2019
	Shri Bodumba s/o Lt. Sang Phuntso	Namthung village, West Kameng District, Arunachal Pradesh-India	Walnut- Namthung village Latitude-27°22'40'' N and Longitude 92°16'14'' E Other fruits- Latitude-27°36'40'' N and Longitude 92°24'14'' E	Crop: Apple (9 cvs), pear (1 cv), peach (2 cvs), plum (1 cv), apricot (2 cvs), almond (3 cvs) and walnut (2 cvs) No. of trees-202 Date of planting-29-01-2019 and 02-02-2019

Glimpses of extension activities carried out at ICAR- CITH, RS Dirang

Implementation of Mera Gaon Mera Gaurau Programme

Jammu & Kashmir

Anantnag

For implementation of Mera Gaon Mera Gaurav programme planting material of apple, peach, apricot, almond, cherry and vegetable seeds were distributed among 50 beneficiaries at Hatigam village of district Anantnag, Jammu & Kashmir on 29th March, 2019. Team led by Dr Javid Iqbal Mir, Senior Scientist and Mr Sajad Un Nabi, Scientist, ICAR-CITH, Srinagar implemented this programme at Hatigam village under which various visits were made during 2018-19 for generating awareness among the farmers of the village about MGMG scheme. Under this programme two demonstrations were laid down on high density plantation in apple in the village in collaboration with horticulture department of the district. ICAR-CITH, Srinagar in collaboration with ICAR-IGFRI (RS), Srinagar conducted training programme on "Training programme on orchard floor management through grass legume management in horticultural crops" on 29th March, 2019. The training programme was coordinated by Dr Javid Iqbal Mir, Dr Sajad Un Nabi, Dr Suheel Ahmad (ICAR-IGFRI) and Dr Sheeraz Ahmad (ICAR-IGFRI). During the visit awareness was also given regarding protection of farmers varieties through PPV&FRA.

Mukteshwar

ICAR- CITH RS, Mukteshwar has adopted Sunkiya village under Mera Gaon Mera Gaurav. The village is situated at 1750 meter above

Training programme on Orchard Floor Management through grass legume management in horticultural crops

Awareness on farmers variety protection through PPV&FRA given to farmers of Hatigam village

Distribution of seed and planting material under MGMG programme at Hatigam

mean sea level (29° North latitude and 79° East longitudes) in Dhari tehsil of Nainital district. A horticulture based integrated farming system was developed in the Sunkiya village in which farmers were provided with training/demonstration of scientific/ technical knowhow of different components of IFS model like cultivation of different horticultural crops such as fruits (apple, peach, plum, apricot, malta, kagzi lime, kiwi fruit, walnut); vegetables (tomato, capsicum, chines cabbage, lettuce, broccoli, cucumber, pea, French bean); medicinal and aromatic plants (rosemary and lemon grass); animal husbandry (cow and goat); poultry (hen breed RIR and Uttara Fowl), bee keeping (*Apis indica*), fish farming (Silver carp, Grass carp and Common carp), vermin-composting (*Eisenia foetida*) and water harvesting. Total of 22 demonstrations on various horticultural crops such as broccoli (KTS-1), Chinese cabbage (Solan Band Sarson), Lettuce (Solan Kirti), Tomato (VL-4, Manisha, H-86, Laxmi, Aman, Shahansha, Dev, Badshah, PS-2225, Naveen, Abhimanyu), Capsicum (California Wonder, Orobelle, Yamuna, Bombey, Bharat, Lucky Star, CITH Lodh Apple-1, Mayan, Fenny, Tydeman's Early, Red Delicious, Red Gold, Chaubattia Anupam, Ambri, Star Krimpson), plum (Santa Rosa, Satsuma, Satluj Purple and Kala Amritsari), apricot (Gola and CITH-A-3), kiwifruit [Allison, Hayward, Monty, Bruno, Abbot and Tomuri (P)] and walnut (CITH-W-1, CITH-W-3) and technologies at 43 farmers' field were conducted in an area of 1.22 ha in Sunkiya and Sunkiya Naveen Village. Besides, the various components of Integrated Farming Systems namely poultry, goatry, cattle, cold water fisheries, vermi-composting, water harvesting bee keeping, protected cultivation, gravity irrigation, solar energy harvesting etc. were also demonstrated in association with ICAR-IVRI, Mukteshwar, ICAR-VPKAS, Almora, ICAR-DCFR, Bhimtal, ICAR-IISWC, Dehradun and State Line Departments and NGOs. Also conducted three trainings and ten diagnostic/field visits in which 42 farmers participated. Four farmers' meetings -cum-awareness programmes were also conducted. The farmers of the village were also supported with two technological literatures on temperate fruits and vegetables. Further, mobile based advisory also provided to the farmers of the village as and when approached.

Tribal Sub Plan (TSP)

District Ganderbal

Implementation of Tribal Sub Plan Scheme for district Ganderbal was done by Dr Javid Iqbal Mir, Senior Scientist, ICAR-CITH, Srinagar and his team on 2nd March, 2019 during which planting material of apple, pear, peach, walnut, apricot and vegetable seeds were distributed among 50 tribal farmers of Babanagri, Kangan (J&K). Also a visit was made to the area for checking the performance of plants distributed during previous years under the scheme. Like in previous year again correction pruning and training was done to the plants which were not properly managed. On-spot guidance was provided to the farmers for proper pruning, training, nutrition management, irrigation etc for obtaining higher productivity. Details were provided about the season and method of seed sowing in vegetables and also guidance was given about nursery raising in vegetables. Awareness was provided regarding high density plantation in apple and their management with respect to nutrient and irrigation scheduling.

Distribution of seed and planting material under MGMG programme at Hatigam

Exhibitions

ICAR- CITH, Srinagar use to participate in various occasions organized by various agencies time to time and displayed its technologies. During the year, institute has participated in two exhibitions (Table 22) and displayed exhibits.

Radio/ TV Talks

To disseminate the technologies for their adoption in larger scale, scientists of ICAR-CITH, Srinagar and its Regional Station are continuously delivering talks on various topics beneficial for farmers and line departments. Total 25 talks were delivered by various scientists during the year is presented in Table 23 .

Table 23. Radio/ TV talks delivered by scientist during 2018-19

Sr No	Name of Scientist	No. of talks
1	Dr D B Singh	2
2	Dr O C Sharma	1
3	Dr J I Mir	4
4	Dr Geetika Malik	3
5	Dr K L Kumawat	3
6	Dr W H Raja	6
7	Sh Sajad Un Nabi	4
8	Dr S N Kirmani	2
	Total	25

Table 22. List of exhibitions displayed during various occasions

Occasion	Venue and organizing agency	Date	Participating staff
One day Exhibition on ECO Awareness on Indigenous Cuisine Development and Phasing out Junk foods	Department of Ecology, Environment and remote sensing a Nation Institute of Hotel management Rajbagh, Srinagar	2nd August 2018.	Dr Geetika Malik Dr W.H.Raja Mr.Istiyaq Ahmad Shiekh
Three days Exhibition "Rise in Jammu and Kashmir	Termeh events foundation, at Bhagwati Nagar, Jammu	1st, 2nd, and 3rd Nov, 2018	Dr W.H.Raja Mr.Istiyaq Ahmad Shiekh

Exhibition of ICAR-CITH varieties and technologies during different events

Trainings and Capacity Building

Participation in trainings

Trainings attended by Scientific Staff

Dr. K.L.Kumawat, Scientist (Fruit Science)

- Attended 3 days orientation training of the trainers w.e.f. 30th Aug to 1st Sept. 2018 organized by Agriculture Skill Council of India (ASCI) at ATARI, Ludhiana , Punjab.

Dr. Wasim Hassan Raja, Scientist (Fruit Science)

- Attended one day training programme on Swatch Bharat Abhiyan on 30th July , 2018 at ISTM , New Delhi.

Mr. Sajad Un Nabi, Scientist (Plant Pathology)

- Attended twenty one days training programme on Modern Statistical Techniques in Genetics w.e.f 1 – 21st Feb.2019 at ICAR-IASRI , New Delhi.

Trainings attended by Technical Staff

- Sh Farman Ali, STA (Driver) attended Training on Automobile at CIAE, Bhopal w.e.f 15 to 25th July, 2018

Trainings attended by Administrative Staff

- Sh. Mukul Raj Singh, Administrative Officer attended training on RTI for Appellate Authority, on 16th Nov. 2018 at ISTM , New Delhi.
- Sh. Fayaz Ahmad Dar, AF&AO attended two days training on GST w.e.f. 28 to 29th January, 2019 at ISTM, New Delhi.
- Sh. Ramesh, Assistant Administrative Officer attended workshop on Pay Fixation w.e.f 28th to 30th Jan, 2019 at ISTM , New Delhi.
- Sh. Showkat Ahmad Mir, Assistant, attended training on Procurement & PFMS related issues w.e.f 26th -28th Sep.2018, at ICAR – IIPR, Kanpur.
- Sh. Reyaz Ahmad Mir, Assistant, attended training on Procurement & PFMS related issues w.e.f 26th -28th Sep.2018, at ICAR – IIPR, Kanpur.
- Sh. Reyaz Ahmad Mir, Assistant, attended workshop on Pay Fixation w.e.f 28th - 30th Jan, 2019 at ISTM , New Delhi.
- Sh. Mukhtar Ahmad, Assistant, attended training on Procurement & PFMS related issues w.e.f 26 th -28th Sep.2018, at ICAR – IIPR, Kanpur.
- Sh. Tariq Ahmad Mir, Junior Stenographer, attended training on Procurement & PFMS related issues w.e.f 26th -28th Sep.2018, at ICAR –IIPR, Kanpur.
- Sh. Tariq Ahmad Mir, Junior Stenographer, attended training on Enhancing Efficiency & Behavioral Skills w.e.f. 7th -12th Jan, 2019 at NBSS & LUP, Regional Centre, Kolkata.
- Sh Mohd. Muzafer Lone, LDC attended training programme on Public Procurement programme at NIFM, Faridabad w.e.f.10 th -15th December, 2018.
- Sh. Diwan Chandra, Assistant attended training programme on Administrative and Financial rules held at ICAR-IIPR, Kanpur w.e.f. 26-28th Sept., 2018

Table 24. HRD Fund Allocation and Utilization

Rs in Lakhs

Head	Allocation	Expenditure
Unified Budget	1.71	1.71

Awards/ Rewards/ Recognition

7

Dr Raj Narayan (Principal Scientist)

- Received ISNS Fellowship 2019 during the annual general body meeting held at University of Madras, Guindy campus, Chennai on 23 March, 2019.

Dr Raj Narayan receiving ISNS Fellowhip during meeting

Dr J I Mir (Sr. Scientist)

- Received outstanding achievement award 2018 during International Conference on Worldwide Research Initiatives for Agriculture, Science and Technology organized by National Agriculture Development Cooperative Ltd. in collaboration with SKUAST-K, Shalimar at University of Kashmir on October 24-26, 2018.
- Received Best paper award during International Conference on Worldwide Research Initiatives for Agriculture, Science and Technology Organized by National Agriculture Development Cooperative Ltd. in collaboration with SKUAST-K, Shalimar at University of Kashmir on October 24-26, 2018.

Dr K L Kumawat (Scientist)

- Received young scientist award in the field of fruit science on the occasion of International conference on emerging issues in agriculture, environmental and applied sciences for sustainable development organized by Agro Environmental Development Society held at SHUATS, Allahabad, U.P. from 27-29th November, 2018.
- Received best research paper presentation award in 7th International conference on agriculture, horticulture and plant sciences, organized by the Society of Tropical Agriculture held at Shimla H.P. from 28th to 29th June, 2018.

Dr W H Raja (Scientist)

- Received young scientist award-2018 from Society for Scientific Development in Agriculture and Technology during International Conference GRISAAS-2018 held at Rajasthan Agriculture Research Institute, Jaipur from 28-30 October 2018.
- Received young scientist award 2018 on occasion of International Conference on Emerging Issues in Agriculture, Environmental and Applied Sciences for Sustainable Development (EIAEASSD-2018) during Nov 27-29, 2018 held at Sam Higginbottom University of Agriculture Technology and Sciences (SHUATS) Allahabad Uttar Pradesh, India.
- Received best poster award entitled Characterization of strawberry genotypes for flowering, fruiting and fruit physico chemical attributes under temperate conditions during Indian Horticulture Congress held from 17-21st January 2019 at Raipur Chhattisgarh.

Dr Selvakumar R (Scientist)

- Received Jawaharlal Nehru award for outstanding PhD thesis during 90th ICAR-Foundation Day and Award Ceremony organized by Indian Council of Agricultural Research at New Delhi, on July 16, 2018.

Dr Selvakumar R receiving Jawaharlal Nehru Award for outstanding PhD thesis

Sh Sajad Un Nabi receiving Young scientist Award during GRISAAS conference at Jaipur

- Received best review article of the Issue-2018 for advances in genetics and molecular breeding for nutritional quality in carrot: a review by EC Cronicon Editorial Office.

Sh Sajad Un Nabi (Scientist)

- Received M.J.Narshiman Medal from Indian Phytopathological Society for best paper published in Indian Phytopathology vide letter No. IPS/Sec/2018/0092 at Annual meeting and national symposium of the Society held at Varanasi (U.P) from 26 to 28th February 2019.
- Received Young achiever Award-2018 from Agricultural Technology Development Society in 2nd International conference on advances in agricultural, biological and applied sciences for sustainable future (ABAS-2018) held from October 20-22, 2018 at Swami Vivekanand Subharti University, Meerut (Uttar Pradesh).
- Received best poster award for paper entitled Enrichment of vermicompost by bioagent Trichoderma harzianum for management of soil borne diseases in Kashmir valley during International conference GRISAAS-2018 held from 28-30 October 2018 at Rajasthan Agriculture Research Institute, Jaipur
- Received excellence in Plant Pathology Award 2018 by International association of research and development organization (IARDO) at International Center Panjim, Goa on 28th of October 2018 (In absentia)
- Received Young Scientist Award-2018 from Society for Scientific Development in Agriculture and Technology during International Conference on Global research initiative for sustainable agriculture and allied sciences (GRISAAS-2018) held from 28-30 October 2018 at Rajasthan Agriculture Research Institute, Jaipur (Rajasthan)

Dr Muneer Ahmad Sheikh (Technical Officer)

- Received best poster presentation award during International Conference on Global Research Initiative for Sustainable Agriculture and Allied Sciences (GRISAAS-2018) held from 28-30 October 2018 at Rajasthan Agriculture Research Institute, Jaipur (Rajasthan)
- Received best thesis award during International Conference on Global Research Initiative for Sustainable Agriculture and Allied Sciences (GRISAAS-2018) held from 28-30 October 2018 at Rajasthan Agriculture Research Institute, Jaipur (Rajasthan)

Dr Muneer Ahmad Sheikh receiving best thesis award during GRISAAS-2018

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- D B Singh, O C Sharma, J I Mir, S Lal and W H Raja 2018. Compendium of model training course on Technological Interventions in Temperate Horticulture for Doubling Farmers Income, held at ICAR-CITH, Srinagar w.e.f. 1^{5th} to 2^{2nd} December, 2018, 256p
- D B Singh, O C Sharma, J I Mir and W H Raja 2018. Compendium of 7 days training programme on High density plantation in Temperate fruit crops, held at ICAR-CITH, Srinagar w.e.f. 17th to 23rd April, 2018, 205p.
- O C Sharma, Anil Kumar,K L Kumawat and S U Nabi 2018. Compendium of 7 days training programme on High density plantation and canopy architectural engineering in temperate fruit crops, held at ICAR-CITH, Srinagar w.e.f. 29th May to 4th June, 2018, 229p.

Book chapters

- Singh D B, Mir J I, Sharma O C, Sharma A, Raja W H and Kumawat K L.2018. Research and Development for increasing productivity and quality in apple at ICAR-CITH, Srinagar *In*: Apple : production and value chain analysis, edited by N Ahmed, S A Wani and W M Wani, New Delhi, Daya Publishing House a division of Astral International Pvt Ltd, pp : 133-153.
- Mir J I, Singh D B, Ahmed N, Sharma O C, Sharma A, and Raja W H 2018.Role of biotechnology in apple crop improvement. *In*: Apple : production and value chain analysis edited by N Ahmed, S A Wani and W M Wani, New Delhi, Daya Publishing House a division of Astral International Pvt Ltd, pp : 189-208.
- Yousuf N, Nabi S U, Singh A and Sheikh A A 2018. Cisgenesis: an alternate approach for crop improvement and protection. *In*: Research trends in agriculture sciences, edited by R K Naresh, Vol 8, New Delhi, AkiNik Publications, pp:61-78.
- Nabi S U and Mohiddin F 2018. Natural plant products: Ecofriendly approach for the management of plant diseases. *In:* Ecofriendly Agriculture Enhancing crop Productivity. New Delhi, Anu Book Publisher, pp: 212-219.,
- Lal S. and Sharma N 2018. Hazelnut *(Corylus avellana* L.) *In* : Temperate fruit crops: theory to practical, edited by Gosh, S.N., Kumar, A., Rehman MU and Sharma, R.R. New Delhi, New India Publishing Agency,pp :297-340
- Shafi W, Jan S, Fucktoo S, Mir J I and Sheikh M A 2018. Biology and biotechnological advances in apple: Current and future scenario. *In* : Crop Production Technologies for sustainable use and conservation- Physiological and molecular advances edited by Munir Ozturl *et al.* USA,Apple academic press, pp 197-258.

Technical bulletins/ pamphlet/folders

- J I Mir, D B Singh, O C Sharma, Shabeena Naqash, Megna Rashid, W H Raja, K L Kumawat, S U Nabi, Anil Sharma, M A Sheikh and S N Kirmani 2019. Morphological

description of apricot reference varieties —a pre-requisite for DUS testing, 4p

- J I Mir, D B Singh, O C Sharma, Shabeena Naqash, Megna Rashid, W H Raja, K L Kumawat, S U Nabi, Anil Sharma, M A Sheikh and S N Kirmani 2019. Morphological description of walnut reference varieties —a pre-requisite for DUS testing, 4p.
- Sajad Un Nabi, K.L.Kumawat, Desh Beer Singh, O.C.Sharma, W.H.Raja, Shoaib Kirmani 2018.Apple Scab Disease-Cause,Symptoms and Management. published by Director, ICAR-CITH, Srinagar, 3fold.
- Geetika Malik, Sajad Un Nabi, W. H. Raja, Anil Sharma and D. B. Singh (2018) Seed Production Technology in Major *Brassica* Vegetables of Kashmir. Extension folder published by Director, ICAR-CITH, Srinagar, 3fold.
- Geetika Malik, Sajad Un Nabi, Selvakumar R., Ambreen Hamadani, Rafiq Ahmad Shah, Anil Sharma and D. B. Singh 2019. Production Technology of Leafy Vegetables in Kashmir. Extension folder published by Director, ICAR-CITH, Srinaga,3 fold (English)
- Geetika Malik, Sajad Un Nabi, Selvakumar R., Ambreen Hamadani, Rafiq Ahmad Shah, Anil Sharma and D. B. Singh (2019) Production Technology of Leafy Vegetables in Kashmir. Extension folder published by Director, ICAR-CITH, Srinagar, 3 fold(Urdu).
- Kishor, A., Narayan, R., Singh, R.K. and Chandra, V. 2018. *Uttarakhand ke parbatiyaa shaitroon mein seb ki unaat bagvani evam prabandhan*. Leaflets No. 1/2018.
- Kishor, A., Narayan, R., Singh, R.K. and Chandra, V. 2018. *Seb mein sidhaayi evam kant chant.* Leaflets No. 2/2018.

Popular articles

- K.L. Kumawat, M.K. Verma, D.K. Singh, A.A. Sofi, N. Ahmed, D.B. Singh, S. Lal, and Lal Chand. 2018. Exploring promising almond cultivars for health and prosperity. *Indian Horticulture* 63(6): 15-17.
- Kamran Ahmad Khan, Sajad Un Nabi, Nazir Ahmad Bhat and Farooq Ahmad Bhat, 2018 Chilli wilt Disease: A serious problem in chilli cultivation in India. *Indian Farmer* 5 (09):988-991.
- Narayan, R., Singh, R.K., Kishor, A., Mer, M.S. (2019).*Uttarakhand Ke Paridrishya Mein Baghwani Sah Bakari Palan Adharit Ekikrit Krishi Pranali.In* : Smarika on *Jalvayu Parivartan Ke paridrishyamein Uttarakhand Ke Kisanon Ki Ajivika Suraksha Hetu Bakari Palan* conducted by ICAR-IVRI, Mukteshwar Campus, Nainital (Uttarkhand) on 22 February, 2019, pp. 37-42.
- R Narayan, D B Singh, S Narayan, and M S Mer 2018. *Parvatiya ksetron mein lahsun ki lambi prakashawadhi wali prajatiyon ki vaigyanik kheti. Kisan Bharati* 49 (11): 28-33.
- R Narayan, M S Mer, and R K Singh 2019. *Barani Sabji UtpadanTakaniki. Kisan Bharati* 50 (6): 29-35.
- Selvakumar R and K Ganghadhara. Vegetable Varieties for Urban Home Garden. *Indian Farmer 5*(10): 1260-1268.
- Selvakumar R and Pritam Kalia. 2018. Nutra-Rich Carrot Production in Tropical and Temperate Regions of India. *Popular Kheti 6*(4):111-116
- Selvakumar R and R B Tiwari. Osmotic dehydration of Temperate Carrot (*Daucus carota* L.). *Indian Farmer 5* (10): 1253-1259.
- Selvakumar R, D B Singh, Sajad Un Nabi, Geetika Malik Anil Sharma and K Gangadhara. 2019. Scientific Management of pests and diseases in radish cultivation. *Indian Farmer* 6(5): 296-301
- Selvakumar R., Singh D B, Sajad Un Nabi, Geetika Malik, Anil Sharma and Gangadhara K. 2019. Scientific Management of Pest and Disease in Carrot Cultivation. *Indian Farmer* 6(3): 198-202
- Selvakumar, R., Geetika Malik, Singh, D.B. Javid Iqbal Mir, Sajad Un Nabi and K Gangadhar. 2019. Protected cultivation of temperate vegetables for doubling farmer's income. *Indian Farmer* 6(5): 302-309.
- Wasim H. Raja, Sajad Un Nabi, K.L. Kumawat, O.C. Sharma, D.B. Singh (2018). Importance of pollination for temperate fruit crops production. *Indian Farmer* 5(12): 1458-1463.

Participation in Workshops/ Conference/ Meeting

Dr D. B. Singh, Director

- Attended National seminar on climate change and its impact on Himalayan ecosystem and food security from 13th -14th March 2019 at SKUAST (K), Srinagar. J &K.
- Attended brain storming meeting on Technological interventions for enhancing productivity and quality of apple on 11th September 2019 held at ICAR-CITH Srinagar, J & K.
- Meeting with DDG Hort., ADG Hort. Anup Malik (Chief Project officer Uttarakhand Forest Resource Management, Dehradun) and their officers of JICA Project at SMD KAB –II N. Delhi on Promotion of walnut in Uttarakhand on 9th Oct. 2018.
- Participated as invited guest during State level event on horticulture organized by Directorate of Horticulture on 6th Nov. 2018 at SKICC Srinagar, J & K.

Dr Raj Narayan, Principal Scientist (Horticulture)

- Attended world veterinary day organized on 28th April, 2018 at ICAR-IVRI, Mukteshwar
- Attended HMNEH (SLEC) meeting organized by Directorate of Horticulture, at Secretariat,Govt. of Uttarkhand on 3rd May, 2018.
- Attended hill consortium meeting and NMSHE (TF-6) Review Meeting at VPAKS, Almora, 17th May, 2018.
- Attended QRT meeting of AINRP (O&G) with special reference to long day onion and garlic on 30th July, 2018 at ICAR DOGR, Rajgurunagar, Pune (MS) and presented work done report of the centre.
- Attended XXV Annual zonal workshop of KVKs on 29.08.2018 at SVPUAT, Modipuram, Meerut (UP).
- Attended bi-monthly structured meeting of NABARD DDMs held at ICAR-IVRI, Mukteshwar on 27-28th September, 2018
- Attended Walnut Promotion Meeting with DDG (Hort.) on 9th October, 2018
- Attended 9th NEEC 2018 on "Climate Smart Agricultural Technologies: Innovations and Interventions", held at CAU Sikkim Campus w.e.f. 15-17th November, 2018
- Attended NMSHE review meeting at ICAR-NASC, Pusa, New Delhi on 6th December, 2018.
- Attended scientific advisory committee meeting at KVK, Jeolicot, Nainital (GBPUA&T, Pantnagar) on 17th December, 2018.
- Attended ISNS National Seminar –cum-interactive workshop on "Noni & medicinal plants in human wellness" held during 23-24th, March 2019 at Centre of advanced studies in botany, university of Madras, Guindy campus, Chennai, India.

Dr O C Sharma, Principal Scientist (Horticulture)

- Attended XXV meeting of ICAR, Regional Committee 1 held at SKUAST, Kashmir from 11th - 12th June, 2018.
- Attended brainstorming meeting on apple on 11th September 2018 at ICAR-CITH, Srinagar

Dr Anil Sharma, Principal Scientist (Soil Science)

- Attended XXV meeting of ICAR, Regional Committee No. 1 held at SKUAST, Kashmir from 11th - 12th June, 2018.

Dr J I Mir, Sr Scientist (Plant Biotechnology)

- Attended International conference on worldwide research initiatives for agriculture,

science and technology organized by national agriculture development cooperative Ltd. in collaboration with SKUAST-K, Shalimar at University of Kashmir from 24-26th October, 2018.

- Attended National conference on recent advances in understanding the role of phytochemicals in human health at Food Technology Division, University of Kashmir on 25th July, 2018.
- Attended Directors Conference at NASC, New Delhi on 31st January, 2019
- Attended National seminar on climate change and its impact on Himalayan ecology and food security at SKUAST-K, Shalimar from 13-14th March, 2019.
- Attended Agri-startup and entrepreneurship conclave at NASC complex, New Delhi on 16th October, 2018
- Attended workshop on use and assembly of foldoscope at SP College Srinagar on 11th December, 2018
- Attended meeting/workshop to discuss the proposal schemes/strategies of the cluster development at NHB, MOA, GOI at Gurugram (Haryana) on 14th December, 2018
- Attended 234rd Regional Committee Meeting-III (Mid Term Review) at ICAR-research Complex for NEH, Region, Umiam, Meghalaya.
- Attended meeting on Quality characteristics of crops/commodities and their availability for commercial scale processing and value addition in India at NASC Complex, New Delhi on 11th May, 2018.
- Attended Directors Conference and cadre review meeting at NASC, Complex, New Delhi on 16-19th July, 2018
- Attended Annual Review Meeting for Rabi Crops under DUS at NASC Complex, new Delhi on 4th October, 2018
- Attended meeting for development of roadmap for increasing production in almond and walnut" under the chairmanship of Horticulture Commissioner at Krishi Bhawan, new Delhi on 15th October, 2018
- Attended meeting for determining cost norms for HDP in apple, pear, apricot, walnut and almond chaired by MD, NHB organized by NHB at Golf Course Srinagar on 4th November 2018.
- Attended XXV meeting of ICAR, Regional Committee 1 held at SKUAST, Kashmir from 11th - 12th June, 2018.
- Attended brainstorming meeting on apple on 11th September 2018 at ICAR-CITH, Srinagar

Dr Arun Kishore, Scientist (Fruit Science)

- Attended 8th Indian Horticulture Congress (Shaping Future of Indian Horticulture) w.e.f. 17-21th January, 2019at IGKV, Raipur, Chhatisgarh, India.
- Attended workshop on *Jalvayu Parivartan key Paridrishya mein Uttarakhand key Kisano kee Ajivika surakhsa hetu Bakari* on 22nd February,2019 at ICAR-IVRI, Mukteshwar.
- Attended 2nd meeting of the hill consortium of ICAR Institutes at ICAR-VPKAS, Almora on 17th May, 2018.
- Attended NMSHE project review meeting at ICAR-VPKAS, Almora on 17th May,2018.
- Attended world veterinary day organized on 28th April,2018 at ICAR-IVRI, Mukteshwar.

Dr Geetika Malik, Scientist (Vegetable Science)

- Attended 36th annual group meeting of AICRP (VC) from 18th - 21st May,2018 at Rajasthan Agricultural Research Institute, Durgapura, Jaipur.
- Attended 9th annual group meeting of AINRPOG from 8- 10th June,.2018 at PAU, Ludhiana
- Attended QRT meeting of AINRPOG (long day) centres held on 29th July, 2018 at ICAR-DOGR, Rajagurunagar, Pune
- Attended 3rd national workshop of nodal officers for research data management' on 4th-5th Dec, 2018 at NASC, New Delhi

Dr K L Kumawat, Scientist (Fruit Science)

- Attended 7th International conference on agriculture, horticulture and plant sciences organized by The Society of Tropical

Agriculture at Shimla H.P. India from 28 - 29th June, 2018.

- International conference on emerging issues in agriculture, environmental and applied sciences for sustainable development organized by Agro Environmental Development Society. at SHUATS, Allahabad, U.P.from 27-29th November, 2018
- Attended 8th Indian Horticulture Congress-2019 (Shaping Future of Indian Horticulture) organized by Horticulture Society of India at IGKV, Raipur, Chhattisgarh from 17th-21st Jan., 2019.
- Attended 6th annual review workshop of NICRA organized by ICAR-CRIDA, Hyderabad at NASC, New Delhi from 7-8th Aug., 2018.
- Attended Review meeting of NISHE-Task Force on Himalayan Agriculture organized by NRM Division, ICAR at NASC, New Delhi from 7-8th Aug., 2018.
- Attended XXV meeting of ICAR, Regional Committee No. 1 held at SKUAST, Kashmir from 11th - 12th June, 2018.
- Attended apple brainstorm meeting" on 11th September 2018 at ICAR-CITH, Srinagar

Dr W H Raja, Scientist (Fruit Science)

- Attended International conference on emerging trends in agricultural, environment and applied sciences for sustainable development (EIAEASSD-2018) during 27-29th Nov., 2018 held at Sam Higginbottom University of Agriculture Technology and Sciences (SHUATS) Allahabad Uttar Pradesh, India.
- Attended 8TH Indian Horticulture Congress (IHC) from 17-21st January 2019 at Raipur Chhattisgarh, organized by (HSI), Horticulture Society of India and Indira Gandhi Krishi Vishwavidyalaya, Raipur Chhattisgarh.
- Attended one day training programme on Swachh Bharat Abhiyan (SBA) held at ISTM, New Delhi on 30th July 2018.
- Attended one day globil's bio entrepreneurship summit organized by Valiant at industrial estate held at Lassipora, Pulwama (J&K) 25th July 2018.
- Attended SAC meeting of KVK Bandipora, SKUAST-K on 6th April 2018.
- Attended 5th SAC meeting of KVK Budgam, SKUAST-K on 26th April 2018.
- Attended one day state level growers meet held at SKICC, Srinagar on 18th Dec 2018.
- Attended XXV meeting of ICAR, Regional Committee 1 held at SKUAST, Kashmir from 11th - 12th June,2018.
- Attended brainstorming meeting on apple on 11th September 2018 at ICAR-CITH, Srinagar
- Attended two days workshop on economic and social transformation through GPDP in Himalayan states organized by NIRDPR, Hyderabad, Ministry of Rural Development, Govt of India, and Himachal Pradesh Govt held at Hotel Peter Hoff Shimla, H.P from 11th - 12th Nov., 2018

Sh Sajad Un Nabi, Scientist (Plant Pathology)

- Attended International conference on global research initiatives on sustainable agriculture and allied sciences (GRISAAS-2018) at Rajasthan Agriculture Research Institute, Jaipur from 28-30th October 2018.
- Attended 8th Indian Horticulture Congress-2019 (Shaping Future of Indian Horticulture) organized by Horticulture Society of India at IGKV, Raipur, Chhattisgarh from 17-21st Jan., 2019.

Dr Selvakumar R, Scientist (Vegetable Science)

- Attended "XXV meeting of ICAR, Regional Committee No. 1" on 11th - 12th June 2018 at SKUAST-Kashmir.
- Attended brainstorming meeting on apple on 11th September 2018 at ICAR-CITH, Srinagar.

Dr Muneer Ahmad Sheikh, Technical Officer

- Attended International conference on global research initiatives on sustainable agriculture and Allied sciences (GRISAAS-2018) at Rajasthan Agriculture Research Institute, Jaipur from 28-30th October 2018.

List of Ongoing Projects

Institute Research Projects	
Project: Crop improvement and Biotechnology **Sub projects:**	
1	Survey, collection, characterization and documentation of temperate horticultural crops (CITH-01)
2	Breeding for development of superior varieties/hybrids in solanaceous vegetables (CITH–07)
3	Development of superior cultivars/ hybrids in temperate fruits through conventional and non conventional methods (CITH-40)
4	Characterization and diversity analysis of flowering related gene/ genes in almond (CITH-72)
5	Development of CMS lines in long day onion [Allium cepa L] (CITH-70)
6	Breeding of nutrarich varieties or hybrids in root vegetable crops. (CITH-74)
Project: Crop Production and Propagation **Sub projects:**	
1	Development of almond based saffron inter cropping system (CITH 11)
2	Enhancing feathering through plant growth regulators for high quality nursery production in apple (CITH-71)
3	Standardization of integrated nutrient management of vegetables as intercrop in apple orchard (CITH-57)
4	Divulging the adept mode of fertilizer application to optimize saffron yield (CITH 60)
5	Fertigation: An efficient soil management stratagem for escalating nutrient and water use efficiency in apple (CITH 61)
6	Aquatic dissipate management (ADM) through vermitechnology (CITH 62)
7	Characterization of soil Nutritional survey in Apple and Peach Growing Areas of Uttrakhand (CITH-64)
8	Standardization of growing /nutrients media and growing conditions for the cost effective production of quality vegetables and their seedlings (CITH-65)
9	Development of diversification technology for round the year vegetable crops under mid and high hills of Uttrakhand (CITH-66)
10	Evaluation of different substrates and systems for soilless strawberry (Fragaria x ananassa Duch.) production in naturally ventilated conditions (CITH- 76)
11	Pre harvest fruit drop management in apple (CITH-78)
Project: Crop Protection **Sub projects:**	
1	Characterization of pathogens associated with apple canker disease and evaluation of botanicals against most prevalent canker in Kashmir valley (CITH- 77)
2	Preparation of value added products in quince

	Project: Post Harvest Management **Sub projects:**
1	Studies on dried prunes in relation to cultivars and drying technology (CITH-67)
2	Assessment of Kashmiri chilli for commercial traits (CITH-69)
	Ongoing externally funded projects **Sub projects:**
1	Network project on outreach of technologies for temperate fruit crops (Main centre)
2	Network project on onion and garlic (co-operation centre)
3	All India Coordinated Research Project (Vegetable Crops)
4	Intellectual property management and transfer/ commercialization of agricultural technology scheme (NAIF)
5	National saffron Mission for economic revival of J & K saffron sector
6	National innovations on climate resilient agriculture (NICRA)
7	Challenge programme on canopy management and plant architectural engineering in temperate fruits
8	National mission for sustainable Himalayan ecosystem (TF-6)
9	DUS testing centre for temperate fruits
10	Development of an electronic nose sensor to determine the optimum harvesting time for apple and papaya
11	Walnut propagation for production of quality planting material
12	Validation and development of DUS testing guidelines for olive

Research Review and Management Committees

Research Advisory Committee of ICAR-CITH, Srinagar

1	**Dr. K. R Dhiman** Chairman, RAC, CITH, Srinagar, Former Vice Chancellor, Dr. YSPUHF, Nauni, Solan- 173230	Chairman
2	**Dr. J. C. Rana** Head, Division of Germplasm Evaluation, ICAR-NBPGR, New Delhi (Presently National Coordinator,UN Environment GEF Project, Bioversity International, New Delhi, 110012	Member
3	**Dr. D. B. Singh** Former Head, Plant Pathology, ICAR-IARI, New Delhi	Member
4	**Dr. A. Prakash** Former Head, Entomology ICAR-NRRI, Cuttack, Odisha	Member
5	**Dr. A. Das Munshi** Principal Scientist, Division of Vegetable Science, ICAR-IARI, New Delhi.	Member
6	**Dr.M.K. Verma** Principal Scientist, Division of Fruit Science and Horticutural Technology, ICAR-IARI, New Delhi	Member
7	**Dr. Hina Shafi** D/o Sh. M. S. Bhat, M.P. Lane, Kursu Rajbagh , Srinagar	Member
8	**Shri Desh Kumar Nehru** S/o Syam Lal Panjla, Teh.: Rohama, Distt.: Baramullah (J&K)	Member
9	**Dr. W. S. Dhillon** ADG (Hort-I), KAB-II ICAR, New Delhi	Member
10	**Dr. D. B. Singh,** Director, ICAR-CITH, Srinagar	Member
11	**Dr. O. C. Sharma,** Principal Scientist, ICAR-CITH, Srinagar	Member secretary

Institute Management Committee (IMC)

1	Dr. Desh Beer Singh Director, ICAR-CITH, Srinagar	Chairman
2	Director Horticulture Govt. of J&K, Raj Bagh, Srinagar	Member
3	Director Horticulture and Food Processing, Department of Horticulture, Chaubattia Ranikhet, Almora (Uttarakhand)	Member
4	Prof. & Head Div. of Fruit Science, SKUAST-K, Shalimar	Member
5	Dr. Hina Shafi Bhat D/O Sh. M.S. Bhat R/O M.P. Lane Kursoo, Rajbagh, Srinagar -190008	Member / Progressive Farmer
6	Sh. Desh Kumar Nehru S/O Sh. Sham Lal R/O Rohama, District Baramulla, J&K	Member / Progressive Farmer
7	Dr. S K Singh Head, Division of Fruit and Horticulture Technology, IARI, New Delhi.	Member
8	Dr. Subhash Chander Professor, Division of Entomology ICAR-IARI, New Delhi	Member
9	Dr. Sheikh Mohd Sultan I/C Scientist ICAR-NBPGR, Regional Station, Srinagar (J&K)	Member
10	Dr. Javid Iqbal Mir Senior Scientist (Biotechnology), ICAR-CITH, Srinagar (J&K)	Member
11	Asstt. Director General (HSII) ICAR, KAB-II, Pusa, New Delhi-110012	Member/Council representative
12	Shri Mukul Raj Singh Administrative Officer, ICAR-CITH, Srinagar (J&K)	Member Secretary

Distinguished Visitors

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- Dr. Trilochan Mohapatra, Hon'ble Secretary (DARE) & Director General (ICAR), New Delhi visited ICAR-Central Institute of Temperate Horticulture, Srinagar on 10th June, 2018. He visited various experimental blocks of different crops, polyhouses, technology centre and laboratories. He suggested scientific staff to work on breeding of apple with respect to scab resistance and emphasize upon the development of varieties with potential to challenge changing climatic conditions. He appreciated the work being carried out in the Institute and suggested the need of timely publishing the results on technologies and other achievements in the form of publications, bulletins, articles etc.

Dr. Trilochan Mohapatra , Hon'ble Secretary (DARE) & Director General (ICAR) planting chinar sapling, visiting experimental field and interaction meeting with staff

Shri Chhabilendra Roul, Special Secretary (DARE) & Secretary (ICAR) visited the Institute on 10th June, 2018 and was apprised with various activities of the Institute.

Shri Chhabilendra Roul, Special Secretary (DARE) & Secretary (ICAR) planting fir sapling during his visit.

- Dr Anand Kumar Singh, Deputy Director General, Horticulture & Crop Sciences, ICAR visited the Institute on 10th June, 2018 and was apprised with various research activities going on at the Institute.
- Dr. Joykrushna Jena, Deputy Director General (Fisheries Science), ICAR visited the Institute on 10th June, 2018 and was shown various crops and activities of the Institute.

Dr Anand Kumar Singh, Deputy Director General, Horticulture & Crop Sciences and Dr. Joykrushna Jena, Deputy Director General (Fisheries Science), ICAR planted chest nut plant during their visit

- Sh. Paban Kumar Borthakur, Joint Secretary (Extension),DAC&FW, GOI, New Delhi visited the Institute on 10th June, 2018 and was apprised with various extension activities for the welfare of farmers.

Sh. Paban Kumar Borthakur, Joint Secretary (Extension), DAC&FW, GOI, planted loquat sapling during his visit

- Dr Pradeep K Sharma, Vice Chancellor, SKUAST-J, Professor Ashok Kumar Sarial, VC CSKHPKV, Palampur, Mohinder Singh Rana, Director Horticulture, HP, Dr J P Sharma, Director Research SKUAST-J, Dr J N Sharma Director Research, UHF Solan, Dr V P Sharma, Director DMR, Solan visited the Institute on 12th June, 2018.

Visit of VC, SKUAST-J, VC CSKHPKV and Directors to ICAR-CITH, Srinagar

- Dr Vijay Singh Thakur, Former Vice Chancellor, Dr YSPUHF Solan visited the Institute on 20th July,2018 and were made aware of various research activities of the Institute which were very much appreciated by him.

Dr Vijay Singh Thakur, Former Vice Chancellor, Dr YSPUHF Solan visiting experimental farm

- Dr P L Gautam, former DDG, Director and Vice Chancellor visited the Institute on 3rd August, 2018 and appreciated the work being carried out at ICAR-CITH, Srinagar.
- Dr K K Jindal, former ADG(Hort), ICAR and Director Research, UHF Solan visited the Institute on 24th July, 2018 and was made aware of various research activities going on at field.

- Dr. Kirti Singh, Former Vice Chancellor visited ICAR-CITH, Srinagar from 29th May, 2018 to 1st June, 2018 as a Chairman for QRT of AINRPOG.
- Dr A K Srivatava, member and I/C Chairman ASRB visited the Institute on 3rd September, 2018 and was made aware of various programmes carried out at ICAR- CITH, Srinagar.
- Sh. A.C. Srivastava, CGM, NABARD, Dehradun visited ICAR-CITH, RS Mukteshwar on 25th September, 2018 and was made aware of different activities at the station.
- Mr.P.K.Agarwal, ADG, RPF visited ICAR-CITH, Regional Station, Mukteshwar on 12th June,2018.
- Mr.Anup Malik, CPD, JICA, Dehradun visited ICAR-CITH, RS Mukteshwar on 12th January, 2019.
- Dr Tej Pratap, VC, GBPUAT, Pantnager visited ICAR-CITH, RS Mukteshwar on 22nd February, 2019 and different activities going on the station were explained.

Dr Tej Pratap, VC, GBPUAT, Pantnager planting sapling of chinar and discussing various activities

Besides above mentioned distinguished visitors, many distinguished visitors from army and air force visited the institute during the year.

Personnel

CITH Head Quarter, Srinagar

RMP

- Dr. Desh Beer Singh, Director

Scientific

- Dr. O. C Sharma, Principal Scientist (Horticulture)
- Dr. Anil Sharma, Principal Scientist (Soil science)
- Dr. J.I. Mir, Senior Scientist (Plant Biotechnology)
- Dr. Geetika Malik, Scientist (Vegetable Science)
- Dr. Kishan Lal Kumawat, Scientist (Fruit Science)
- Dr. Wasim Hassan Raja, Scientist (Fruit Science)
- Dr. Selvakumar R, Scientist (Vegetable Science)
- Mr Sajad Un Nabi Naingroo, Scientist (Plant Pathology)

Administrative

- Sh Mukul Raj Singh, Administrative Officer
- Sh. Fayaz Ahmad Dar, AF &AO
- Sh. Ramesh, Asstt. Admn. Officer
- Smt. Shahida Rafiq, P.A. to Director
- Sh. Showkat Ahmad Mir, Assistant
- Sh. Reyaz Ahmad Mir, Assistant
- Sh. Mukhtar Ahmad, Assistant
- Sh. Tariq Ahmad Mir, Jr. Stenographer
- Sh. Mehraj-ud-Din Meer, UDC
- Sh. Mohd. Muzafer Lone, LDC
- Sh. Rouf Ahmad Sheikh, LDC

Technical

- Dr. Shoaib Nissar Kirmani, Senior Technical Officer
- Sh. Eshan Ahad, Tech. Officer
- Dr. Muneer Ahmad Sheikh, Technical Officer
- Sh. Mehraj-ud-din Bhat, Sr. Technical Assistant (Driver)
- Sh. Farman Ali, Sr. Technical Assistant (Driver)
- Sh. Mohammad Ramzan Wani, Technical Assistant (T-1-3.)
- Sh. Puran Chandra, Sr. Technician (Field)
- Smt. Mubeena, Sr. Technican (Computer / Data Operator)
- Sh. Ajaz Ahmad Wani, Technician (Field)
- Sh Ishtiyaq Ahmad Sheikh, Sr.Technician (Field)

Skilled Supporting Staff

- Sh. Bashir Ahmad Dar,SSS
- Sh. Showkat Ahmad Dar, SSS
- Sh. Abdul Rashid Bhat,SSS (KVK, Baramulla)
- Sh. Bashir Ahmad Ganai, SSS
- Sh. Zubair Ahmad Swathi, SSS
- Sh. Madan Lal, SSS
- Sh. Khushi Ram, SSS
- Sh. Ghulam Nabi Bhat, SSS

- CITH-RS, Mukteshwar, Uttarakhand
- Scientific Staff
- Dr. Raj Narayan, Principal Scientist (Horticulture)
- Dr. Arun Kishor, Scientist (Fruit Science)
- Dr. Sovan Debnath, Scientist (Soil Science)

Administrative

- Sh. Akhil Thukral, Asstt. Admn. Officer
- Sh. Diwan Chandra, Assistant
- Sh. Pushpendra Kumar, LDC

Technical Staff:

- Sh. Vinod Chandra, Technical Officer

Skilled Supporting staff:

- Sh. Narayan Singh, SSS
- Sh. Govind Giri, SSS
- Sh. Shabir Ahmad Mir, SSS

Appointments/ Transfers/ Promotions/ Deputation

Retirements

- Prof. Nazeer Ahmed, Former Director, ICAR-CITH, Srinagar and present Vice Chancellor, SKUAST-K, Shalimar, Srinagar superannuated from council services on 31st May, 2018 (A/N)

Transfers

- Dr Shiv Lal, Scientist (Sr. Scale), Fruit Science transferred from ICAR-CITH, Srinagar to ICAR-NRC on Seed Spices, Ajmer on 2nd July, 2018 (A/N).