ANNUAL REPORT

2020

(January 2020 – December 2020)

ICAR-Central Institute of Temperate Horticulture,
Old Air Field Rangreth, Srinagar 191132 – (J &K), India

Published by:
Dr Om Chand Sharma
Director
Compiled & Edited by:
Dr D B Singh
Dr. O.C. Sharma
Dr. J.I. Mir
Dr W H Raja
Dr Arun Kishore
Dr Sajad Un Nabi
Dr. Geetika
Dr Madhu G S

Correct Citation:
CITH - Annual Report 2020
ICAR-Central Institute of Temperate Horticulture
Old Air Field, P.O.-Rangreth-191132, Srinagar (J&K)
Phone: 91-194-2305044, 2305045
E-mail: director.cith@icar.gov.in
Website: www.cith.icar.gov.in

Page setting and designing:
Shri Eshan Ahad & Ms Syed Mubeena

Printed by:

CONTENTS

Sr No	Particulars	Page No.
1	Executive Summary	*1-7*
2	Introduction	*8-10*
3	Research Achievements	*11-74*
	(i) Crop Improvement	*11-41*
	(ii) Crop Production	*42-50*
	(iii) Crop Protection	*51-54*
	(iv) Post Harvest Management	*55*
	(v) Externally Funded Projects	*56-74*
4	Meetings and Events	*75-82*
5	Extension and Other Programmes	*83-96*
6	Training and Capacity Building	*97*
7	Awards/Recognitions	*98*
8	Publications	*99-101*
9	Participation in Workshops/Conferences/Meetings etc	*102-103*
10	List of Ongoing Projects	*104*
11	Research Review and Management Committees	*105-107*
12	Personnel	*108-109*
13	Transfers/Promotions/Probation	*110*

Executive Summary

In temperate horticultural crops, considerable change in area and production has been noticed due to continuous support from research and development in the past. But still there is sufficient scope for its vertical and horizontal expansion which ultimately boosts the productivity of quality produce. ICAR- Central Institute of Temperate Horticulture, Srinagar (J&K) has focused on generation of technologies in different temperate horticultural crops by carrying out research on various aspects like improvement, production, protection & post harvest management since its inception. The generation of farmer's friendly technologies with low input cost and high returns is the need of the hour and Institute along with its Regional stations is continuously working on these lines. The number of technologies generated at ICAR-CITH is increasing year after year and their implementation at farmer's field is generating significant returns to growers of temperate region of the country. 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 and extension work carried out during 2020 are briefly summarized below:

Crop Improvement and Biotechnology

Crop improvement is one of the main components to boost the productivity because it is the variety which along with environmental factors and conditions decide the returns to the farmer. ICAR-CITH, Srinagar also acts as National Active Germplasm Site (NAGS) for temperate horticultural crops. The germplasm enrichment with trait specific traits is the need of every research organization so that it can be used to breed a desirable new cultivar in future. The collection, evaluation and characterization of germplasm of horticultural crops are the major objectives of the Institute. The Institute has added 60 new germplasm in its field gene bank and its number has reached to 2802 at main centre Srinagar, J&K while Regional Station Mukteshwar, Uttarakhand has added 218 germplasm lines of various fruit and vegetable crops.

In apple, four columnar apple varieties were evaluated and Sunlight showed maximum fruit weight (156g) and ascorbic acid (9.82%) in addition to its good antioxidant potential. The antioxidant potential of Moonlight is of considerable importance keeping in view its highest flavonols and flavonoids values. The least acidic and maximum TSS and firmness was observed in cultivar Redlane. In evaluation of commercially important apple varieties for physicochemical traits and antioxidative properties, 9 cultivars viz Gala Redlum, Super Chief, Red Velox, Golden Delicious Reindeers, Golden Delicious Clone B, Elstar, Jonaprince, Pinova, and Red Chief were evaluated. Highest fruit weight was recorded in Red Chief (205.5 g) followed by Super Chief (190.5 g). Based on fruit quality traits Gala Redlum, Red Chief, Super Chief and Red Velox are showing very good performance. Highest antioxidative potential was observed in Golden Delicious Reinders followed by Golden Delicious Clone B. To know the effect of number of fruits per cluster on fruit size in Gala Redlum on M9 rootstock, highest fruit weight, fruit length and fruit width was observed in cluster 1 and lowest physical parameters were recorded in cluster 4. In comparative evaluation of scab resistant and scab susceptible apple cultivars for fruit quality, anti-oxidative and free radical scavenging potential, higher phenol and flavonoid content in addition to higher antioxidative and

free radical scavenging potential was observed in scab resistant apple cultivars (Prima, Shireen and Liberty). Among commercial cultivars Golden Delicious showed maximum values of phenol, flavonoid, DDPH and FRAP. This study showed that one of modus operandi for resistance towards scab is higher values of phenolic compounds and their effects. The molecular diversity assessment in 29 *Malus baccata* accessions were also done using SSR markers revealed presence of significant level of genetic diversity along with population. Major allele frequency ranged from 0.27 for SSR marker Hi22f12 to 0.95 for Hi02d05 with a mean of 0.55 and 12 SSR loci expressed individual frequencies of more than 0.75. In pear, 19 European/Asian cultivars of pear were evaluated and maximum fruit weight (225.17 g), fruit length (89.54 mm), and fruit diameter (72.36 mm) were recorded in cultivar Max Red Bartlett while minimum fruit weight (43.03 g), fruit diameter (39.76 mm) in Punjab Beauty and fruit length (48.32 mm) in cultivar Doyenne Burrah. Maximum pedicle length (52.72 mm) was recorded in Kashmiri Nakh and minimum (17.23) in Gent Drouard. Fruit firmness in pear cultivars ranged from 48.93 RI in ZH Copeacae to 80.30 RI in Punjab Beauty**.** Significant differences were recorded for parameters such as total sugars, reducing sugars, ascorbic acid content and colour parameters. In quince, 31 quince genotypes were evaluated and fruit weight ranged from 45.19 in CITH-Q-18 to 225.33 in CITH-Q-04. Maximum fruit length (76.31 mm) was recorded in CITH-Q-04 while minimum (42.01mm) in CITH-Q-27. Maximum fruit diameter (77.65 mm) was recorded in CITH-Q-04, while minimum fruit length (42.82 mm) in CITH-Q-26. The maximum value of firmness (68.80 RI) was recorded in CITH-Q-33 and minimum (57.87RI) in CITH-Q- 11. In apricot, 64 genotypes were evaluated for fruit and yield traits in which highest yielding genotypes were CITH-Ap-2 (42.67 kg), CITH-Ap-1 (39.06 kg), Rival (32.20 kg) and Erani (29.64 kg). The TSS was highest (24.63 ^{o} B) in CITH-Ap-35. In peach, twenty three genotypes were evaluated and maximum fruits weight (138.99g), fruit length (64.36mm), fruit width (63.55mm) and fruit thickness (61.45mm) were recorded in cultivar Early Red June. Among four nectarine cultivars, maximum fruit weight (97.73g), fruit length (64.39 mm), fruit width (58.18mm) and fruit thickness (50.01 mm) were recorded in cultivar Fantasia. In plum, 23 cultivars (Japanese and European) were evaluated for various physicochemical and colour parameters. Maximum fruit weight (77.81g) & fruit diameter (50.89mm) were recorded in Frontier while maximum fruit length (56.62mm) was found in Grand Duke. Minimum fruit weight (10.73g), fruit length (23.97mm) and fruit diameter (26.13mm) were recorded in Kala Amritsari while minimum fruit thickness (24.61mm) was recorded in Methley. The minimum pedicle length (8.16mm) and maximum firmness (63.33RI) was recorded in Black Amber. Significant differences were recorded for parameters such as TSS, pH, total sugars, reducing sugars, ascorbic acid content and colour parameters. In strawberry, 72 genotypes were evaluated for fruit traits. The fruit weight varied from 4g (Dilpasand) to 17.3 g (Cammarosa), fruit length from 12 mm (Osograndy) to 27.1 mm (Cammarosa), fruit diameter from 17.5 mm (VL-13) to 48.6 (Winter Don). The cultivar/ genotypes EC 32602, Red Cross., Red Coat, Katrian Sweet, Jutogh Special, Dilpasand, Mechwary, Sea Scap, Gorilla, Cammarosa etc. produced maximum number of flowers and fruits. In evaluation of 18 cultivars of olive, maximum fruit weight (6.0g) and fruit width (20.5 mm) were recorded in cultivar Zaituna. Maximum average yield/ plant was recorded in cultivar Pendilino (22.21 kg).

In almond, 10 cultivars and 21 Selections were compared for nut and kernel traits. Maximum nut weight (3.04 g) was recorded in cultivar Makhdoom while kernel weight was maximum (1.56g) in cultivar Shalimar. The kernel percentage was highest (57.31%) in Merced. In almond Selections, maximum nut weight was recorded in CITH-A-18 (4.05 g) while kernel weight (1.44g) and kernel recovery (47.21%) were highest in CITH-A-19 Maximum yield per plant was reported in Makhdoom among cultivars while in selections, it was maximum in CITH-A-9. In walnut, 261 genotypes were evaluated for various nut and kernel traits. Among these, 28 genotype produced nuts having weight less than 10g, 155 genotypes produced nuts between 10 to 15 g, 68 genotypes between 15 to 20 g, 9 genotypes between 20 to 25 g and one genotypes more than 25g, respectively. Similarly, 40 genotypes produced nuts having kernel weight less than 5g, 177 genotypes between 5 to 8g, 35 genotypes between 8 to 10g and 9 genotypes have more than 10 g, respectively. The shell thickness of 2,27,99,92 and 41 genotypes was less than 1mm, 1 to 1.5mm, 1.5 to 2 mm, 2 to 2.5mm and more than 2.5mm, respectively. Similarly 23, 61,93,67 and 17 genotypes produced nuts which gave kernel recovery less than 40%, 40 to 45%, 45 to 50 %, 50 to 55 % and more than 55 per cent, respectively. Besides institute released varieties, CITH W 22, CITH W 88 and CITH W 118 were also seems to be promising based on nut and kernel traits. In pistachio, five selections were evaluated and based on nut and kernel traits CITH-Pistachio -Selection -1, CITH-Pistachio -Selection -3 and CITH-Pistachio -Selection -4 seems to be promising. The number of blank nuts was found more in CITH-Pistachio -Selection -5. CITH-Pistachio (Male) -1 flowered from 13th April to 29th April while CITH-Pistachio (Male) -2 initiated flowering on 16th April and ended on 2nd May. The female flowering initiated from 14th to 16th April in different Selections. In hazelnut, seven cultivars were evaluated and nut weight ranged from 2.01g (Tonda Gentile delle Langhe) to 2.98 g (Tonda di Giffoni) while nut length (23.66 mm), nut width (19.61 mm) and nut thickness (17.93 mm) were recorded more in cultivar Ennis. Highest kernel weight (1.39g) and minimum shell thickness (1.22 mm) was recorded in Tonda di Giffoni. Similarly kernel recovery ranged from 37.21 % (Tonda Romana) to 52.06 % in Fertil de Coutard. In pecan fruiting was observed in two seedlings and based on nut weight Selection 1 was found promising while for kernel recovery and shell thickness Selection 2 was found better.

Evaluation work was also carried out at Mukteshwar on various fruit crops such as peach, plum, apple and kiwi fruit. In peach, eight cultivars were evaluated and the highest fruit weight (115.5 g), carotene content (785.5 mg/100 g) and total anti-oxidant activity (27.0 mMT/L) were reported in Golden Monarch, Red June and Arkansas , respectively. In plum, five genotypes were evaluated and highest fruit weight (63.3 g), carotene content (387.0 mg/100 g) & total anti-oxidant activity (34.1 mMT/L) were reported in Satsuma, Ramgarh Monarch, and Kalegi (CITH Mukteshwar), respectively. In apricot, total six genotypes were evaluated and based on the physico-chemical characteristics of fruits, the highest fruit weight (93.7 g), carotene content (1175.9 mg/100 g) and total anti-oxidant activity (28.60 mMT/L) were reported in Local (Chapta), Erani, and Local (Gola) as compared to other apricot genotypes, respectively. In evaluation of four kiwifruit cultivars, most of the physico-chemical characteristics of fruits were found superior in Hayward and Allison as compared to other cultivars. In strawberry total eight cultivars were evaluated and based on the

physico-chemical characteristics of fruits, the highest fruit weight (16.0 g) and TSS (7.3 ^{0}B) were reported in Gorella as compared to other genotypes.

In apple, 23 apple cultivars belonging to Delicious group, spur type and colour strains were evaluated for various traits and the highest fruit weight (166.0 g), carotene content (308.6 mg/100 g) and total anti-oxidant activity (38.0 mMT/L) were reported in CITH Lodh Apple-1 and Bright-N-Early as compared to other apple cultivars, respectively. To study the effect of plant density on fruit and yield traits three cultivars were evaluated at three spacings i.e. 1.5×1.5 m, 1.5×2.5 m, 2.5×2.5 m and 6×6 m. The cultivar Starkrimson was found superior in term of yield and physiochemical characteristic of fruits and 2.5×2.5 m spacing was found best in terms of highest yield per hectare as compared to other spacing

In vegetable crops at Srinagar kale, root vegetables and exotic vegetables were maintained and evaluated under field conditions along with biochemical analysis of cabbage hybrid and exotic leafy vegetables. Based on performance, best genotypes in kale were CITH-KC-Sel-5 (20.50 (t/ha), CITH-KC-11 (20.35 (t/ha), CITH-KC-08 (17.85 (t/ha), CITH-KC-26 (16.28 (t/ha), Hanz Haaq (16.13 (t/ha) and Kawdari (15.63(t/ha); in radish Pusa Himani (385.00(t/ha) and in turnip Sel-2 (423.33(t/ha).In off-season cultivation of onion in Kashmir valley, 7 varieties planted in different dates from 1st July to30th August and Punjab White performed best with respect to production of whole bulbs yielding highest number of whole bulbs compared to other varieties at all dates of planting except 1st July. The best date for planting was observed to be 15th July where highest number of whole bulbs was observed in most of the varieties.

At Regional station, Mukteshwar, evaluation was carried out in 5 genotypes in capsicum, 5 in parthenocarpic cucumber and 9 genotypes in cherry tomato. Among these, CITH-M-SP-Sel-5 & CITH-M-SP-Sel-2 in capsicum, JLG in cucumber and CITH-M-CT-1, CITH-M-CT-2 (Yellow) and CITH-M-CT-6 in cherry tomato were found promising.

In development of superior cultivars/ hybrids in Ambri, two crosses (Ambri x Redlane & Ambri x *Malus floribunda*) were made to introgress traits like scab resistance and fruit colour to apple cultivar Ambri from columnar apple cultivar Redlane and wild apple species *Malus floribunda.* About 4000 seedlings obtained from these crosses were raised and grafted on M-9 apple clonal rootstock for further evaluation. In addition evaluation of apple hybrids obtained from previous crosses was done to identify the superior hybrids with respect to traits like scab resistance, fruit quality, pollinizer ability etc. Six Institute developed hybrids (Priame, Ammol, Amrit, Pride, Golden Snow and Pritor) were evaluated for antioxidative and free radical scavenging potential. Improvement of Ambri apple cultivar through mutation (gamma radiation) has been taken up and about 4000 buds were irradiated for generating the mutant population. In the ongoing pear improvement programme, crosses raised during the crossing programmes has been top worked during the year 2019 on BA-29-C rootstock and are in fruiting this year. The population obtained out of crossing done in 2019 has been raised in pots and is under evaluation for quality related traits (colour, bearing). In apple rootstock breeding, crosses preformed during 2019 between *Malus*

baccata L. with different Malling and Malling Merton series rootstocks as well as between Malling and Malling Merton series of apple rootstocks apple for pollen compatibility and population raised during the previous years will be subjected to evaluation for root rot and collar root and drought, dwarfness and multiplication in stool beds.

In characterization and diversity analysis of flowering related gene/ genes in almond, whole genome transcriptome analysis between early flowering (Shalimar, Waris and Nonpareil) and late flowering (Tardy Nonpareil, Ferragnese and Ferralise) almond cultivars has been done to identify the genes and pathways differentially expressed in either early flowering or late flowering genotypes. Phenological stage development and flowering time in different almond varieties has been studied with respect to effect of GDH/GDD accumulation on flowering time and phenological development. Top 50 most significant differentially expressed genes having annotation were used for plotting Heatmap. Pheatmap representing most significant genes expressed in the leaf and flower samples plotted using log10 of normalized read count values (CPM) for Leaf vs Flower, where shades of blue represents down regulated genes and shades of red represents highly expressed genes. In breeding for development of superior varieties/hybrids in Solanaceous crops, 100, 60 and 40 genotypes of chilli, capsicum and brinjal were used for seed production while elite germplasm evaluation for yield and related traits was done only in promising genotypes selected for further evaluation in IET at national level. In capsicum highest yield of 864.50q/ha was recorded in NS-284-1-111-1 followed by CITH-SP-31 (826.50q/ha) while in chilli and brinjal highest yield was recorded in CITH-HP-111-1 (372.75q/ha) and B-SB-2 (416.68q/ha), respectively. In development of CMS lines in onion (*Allium cepa* L), the bulbs of F1 generation of crossings between short day male sterile lines and long day onion genotypes Brown Spanish, Yellow Globe, CITH-O-1, CITH-O-2, CITH-O-33 and CITH-O-33-1 were planted in 2020 season for obtaining flowering in May-June, 2021 in order to score for male sterile plants, morphologically.

Crop Production

During the year institute has supplied about 35392 plants of different temperate fruit crops besides the supply of about 14000 scion wood. In vegetables, 292.38 kg of seed was produced in vegetable crops for supply and sale to different stakeholders and consumers like kitchen gardeners, vegetable growers, research organization and used for research purpose. At Regional Station Mukteshwar, Moreover 27735 plants of various horticultural crops as well as 1064.5 kg vegetable seeds were supplied to the farmers/government agencies/NGOs etc.

Apple

For enhancing the multiplication rate in clonal rootstocks of apple, different trials were conducted on different rootstocks in different media using cuttings and rootstocks. Air layering was also tried for vertical expansion.In multiplication of rootstocks through cutting, 30 cm cutting size along with the treatments Coco peat+Vermiculite @ 75:25 and Cocopeat 100% are the best for raising the cutting under greenhouse conditions, but the problem with treatment Coco peat+Vermiculite @ 75:25) is that requirement of water is more in comparison to Cocopeat. In propagation of clonal rootstocks of apple through cutting under greenhouse in soilless beds, more than 90% of rootstocks produced were

suitable for grafting having a well-developed root system and clipper size above (6.0 mm). Among the total cuttings, more than 50% of cuttings have got the calliper size of above (5 mm) during the month of August-September, so budding has also been done for about 25% of plants with a success percent of above 90 %. For enhancing the multiplication rate in clonal rootstocks of apple under protected condition by modified layering, a trial was conducted and maximum number of adventitious roots (16.1) per plant were recorded in treatment Perlite in Rootstock MM-106 whereas the minimum number of adventitious roots (3.2) was recorded in treatment C+P+V (50:25:25) in rootstock B-9. For vertical expansion of the nursery and to utilize the available space in the greenhouse, success was achieved in apple clonal rootstock MM-106. This technology will be very useful in promoting the vertical expansion of the nursery in greenhouse conditions and number. of plants per unit area can be increased 3-4 times without utilizing any extra inputs

Saffron

To develop almond based intercropping system involving saffron, erect, semi erect and spreading type of varieties and sole crop were tried. The highest saffron yield was recorded under erect (3.022kg/ha) followed by sole saffron crop ((2.488kg/ha) followed by erect almond varieties (2.123kg/ha), semi erect (1.876 kg/ha) and spreading (1.884 kg/ha) type of almond varieties. The highest almond was recorded in spreading type (18.06 q/h) followed by semi erect (9.62 q/h) and erect (8.21 q/h). The highest almond-saffron equivalent yield (3.686 kg/ha) was recorded in spreading type followed by erect type (2.944 kg/ha), semierect type (2.848 kg/ha). Decrease in saffron yield was noticed due to old plantation of saffron. Besides this effect of various planting systems i.e. raised bed planting, ridge & furrow and flat bed was also studied in saffron yield. Highest saffron yield (3.89 kg/ha) was recorded in raised bed system followed by ridge & furrow (3.36 kg/ha) and flat bed system (2.96kg/ha). Slight earliness was also observed in raised bed as compared to other methods.

Vegetables

For evaluation of integrated nutrient management of vegetables as intercrop in apple orchard, the technology were demonstrated among farmer under MGMG scheme at Sunkiya village during 2020 with the aim to promote crop diversification for sustainable production and to utilize better space as well as natural resources per unit area without eroding soil health for enhancing production per unit area.

Crop Protection

For elucidating the diversity, species spectrum and screening of apple germplasm against *Alternaria spp* infecting apple (*Malus domestica* Borkh), a survey of alternaria leaf blotch of apple disease in Kashmir valley was conducted and maximum ALB incidence and intensity of 87.12 and 62.5 percent, respectively was observed in Red Delicious cultivar fallowed by King Roat with 80.0 and 41.2 percent. While minimum disease incidence and intensity of 9.2 and 5.1 percent, respectively was observed in Red Fuji. Symptomatology and morphological studies of pathogen was also carried out and the fungus exhibited olive green to brown colony color with circular concentric mycelium with or without fluffy growth. The conidia morphology, which are large and dark brown, multi-celled, catenate or single, ovoid or obclavate, often beaked, brown, with transverse and longitudinal

septa. In diagnosis and prognosis of apple viral diseases – spatial and temporal variation in virus infection in apple germplasm (varieties and rootstocks) were screened for three viruses using DAS-ELISA. Among the 203 varieties screened, only two varieties were found positive for ApMV, and none of the rootstocks were found infected with ApMV. Most of the varieties were found infected with both ASPV and ASGV. In evaluation of rootstocks for sensitivity towards mosaic disease, 8 rootstocks were evaluated for their effect on mosaic disease of apple cv. Golden Delicious. The mosaic or mosaic/necrotic symptoms were observed on six root stocks, viz, MM106, MM111, M26, M27, M9 and Pajam-1. No symptoms were observed on two root stocks i.e., M9-T337 and M9-T339. The development of symptoms on different rootstocks also varied from 70-80 days after grafting (DAG). The symptoms on two rootstocks viz., MM106 and MM111were recorded 70 DAG. In other rootstocks the symptoms were observed after 80 DAG. The results showed that Malling Merton (MM) series shows symptoms earlier as compared to Malling series of rootstocks.

Post-Harvest Management

The generated technologies for value added products of quince candy, loquat, strawberry and fig were refined for up-scaling of product to demonstrations and exhibitions.

Events, Extension and other activities

During the year 2020, due to COVID 19 pandemic, restrictions and lockdown, few events and extension activities could be conducted. Among the events, 4th QRT Meeting, 16th IRC meeting, nursery accreditation, Farmers Day/ *Kisan Diwas,* National Unity Day/ Rashtriya Ekta Diwas, Vigilance Awareness Week, Hindi Week, Celebration of two year long commemoration of 150th Birth Anniversary of Mahatama Gandhi Ji and Swachchata Abhiyaan, Constitution Day, Swachh Bharat Mission Abhiyan and a meeting regarding exploring possibilities of Horticulture in Ladakh were organized during the year. For the speedy transfer of various technologies, ICAR-CITH, Srinagar and its Regional Stations are continuously using various extension means for popularization of technologies. The ICAR- CITH, Srinagar has organized one 10 days, one three days, and three one days training programme (off campus and on campus) for officers from Deptt. of Forest, Uttarakhand. During the year, 5 students visit/ training, one three days training was organized for the progressive orchardist of Ladakh. Nine one day trainings/ visits were organized for the farmers from different districts of Jammu & Kashmir. At ICAR-CITH, Regional Station Mukteshwar, 2 programme of one day duration were organized for officers, one student and one farmer's visits, besides organizing 23 training programmes/ awareness/ demonstration programmes / lectures etc were organized. The staff of the Institute has delivered 19 radio/ TV talks on different aspects for the benefit of farming community of the temperate region. The programmes were also carried out under TSP and MGMG programme.

Publication and Awards

The scientists of ICAR-CITH, Srinagar published 16 research papers, 2 review articles, 2 books, 2 book chapter, 1 popular articles and 4 extension bulletin/ folders for the benefit of students, researchers, extension functionaries and farmers. In addition to various appreciations, the scientists of ICAR- CITH, Srinagar received 5 awards during the year.

Introduction

The continuous efforts for promotion of horticulture in India through R&D during past had led to a significant increase in area, production and productivity in different horticultural crops. The horticultural crops and their problems vary from region to region depending upon the climatic conditions. The North western Himalayan states have different climatic conditions like cool to moderate climate, snowfall during winter in high hills, which fulfill the conditions for growing number of temperate horticultural crops which can't be grown in warmer areas**.** India has significant area under temperate region including states/UTs of Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Ladakh and North Eastern states. Maximum area and production of temperate horticultural crops is in Jammu and Kashmir followed by Himachal Pradesh and Uttarakhand but there is lot of scope for further promotion of temperate horticulture in other states as well. 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. 13,000 crores annually. In 1960-61 the area under temperate fruits in the country was just 0.82 lakh hectares which increased to 6.5 lakh hectares with production increased from 3.0 lakh tonnes to 40.0 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. which also have significance in regions economy. As per the first advance estimate of 2019-20 apple crop covered an area of 308 thousand ha with an estimated production of 2734 thousand MT. Walnut being second important crop estimated to cover an area of 107 thousand ha with 296 thousand MT productions at national level. Other important temperate crops include almond with 10,000 ha area and 9, 000 MT production, pear with 42, 000 ha area and 3,13, 000 MT production, peach with 19, 000 ha area and 1,27, 000 MT production, plum with 19, 000 ha area and 77, 000 MT production and strawberry with 1, 000 ha area and 8000 MT production etc. Although area and production of temperate crops has increased significantly but productivity of these crops is still behind the world average productivity. Temperate fruit crops are contributing significantly to the economic development of the country.

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) is 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 and to improve quality of produce, 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 and 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 and 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 (31st December, 2020)

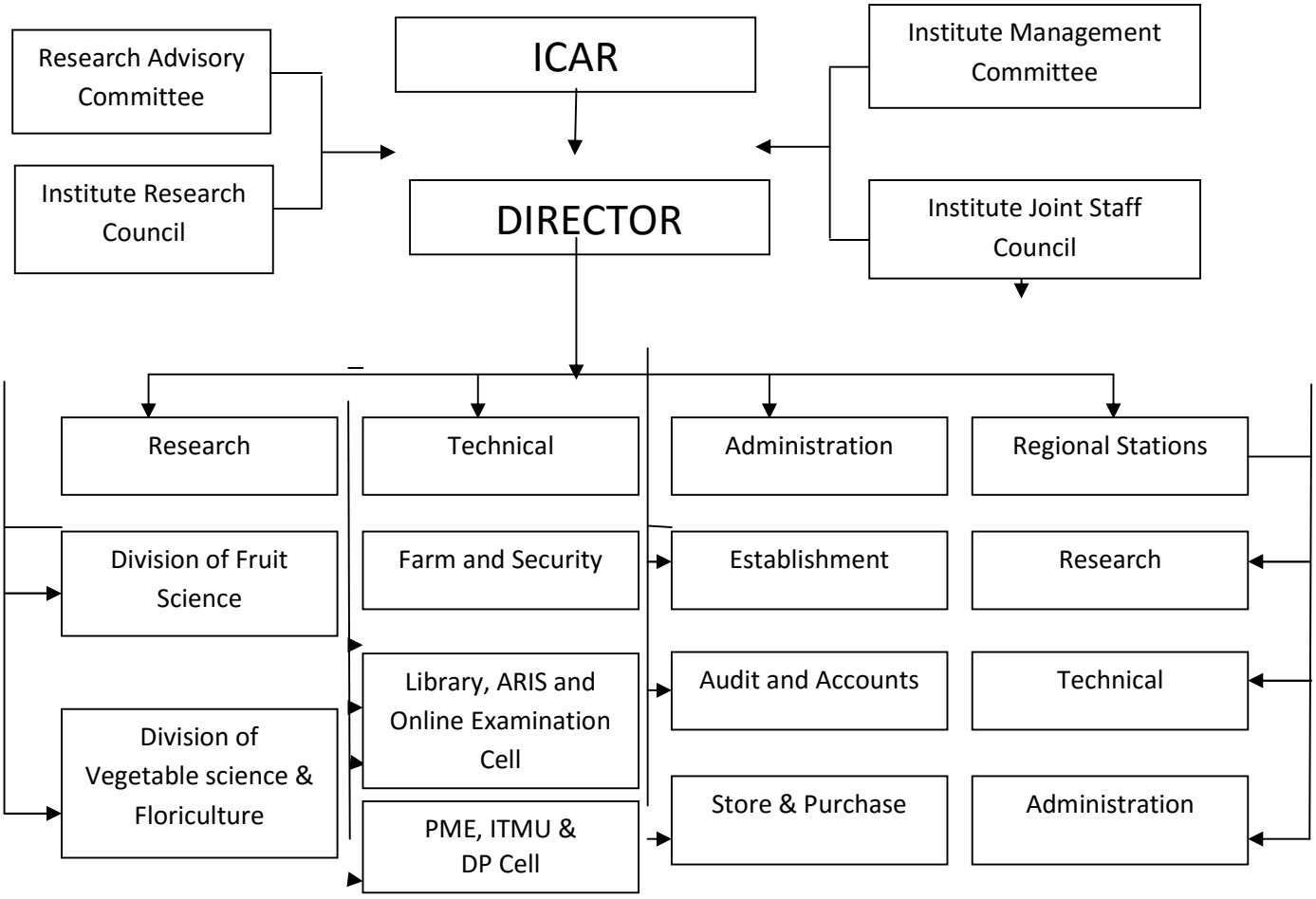
Category	Sanctioned	Filled (as on 31st December, 2020)	Vacant (as on 31st December, 2020)
Scientific	32+1RMP	8+1	24
Administrative	15	13	2
Technical	16	10	6
Supporting	11	11	0
Total	75	45	32

Financial Statement (April, 2020 to March, 2021)

S. No.	Sub-Head	Expenditure (Rs in Lakhs)
1	Capital	**6.78**

2	Establishment Charges	**465.80**
3	T.A.	**17.41**
4	Research & Operation Expenses	**299.44**
5	Administrative Expenses	**177.26**
6	Miscellaneous Expenses	**1.44**
7	Pension	**8.71**
8	Loans and Advances	**0.00**
Total		**976.84**
Revenue Generation		**62.71**

ORGANOGRAM OF CITH



Research Achievements

1. Crop Improvements

The productivity of crop is mainly dependent on the genetic potential of the genotypes being undertaken for commercial cultivation. The crop improvement plays an important role in any crop by production of elite genotypes by employing various breeding methods and tools. Breeding of genotypes in fruit crops with desirable traits is a complex and time-consuming process due to long juvenile period. More over the variability is also a prerequisite for the development of elite genotypes. North Eastern Himalayan states are suitable for cultivation of large number of temperate fruits, vegetables, ornamentals, medicinal and aromatic crops as well as many other horticulture-based enterprises. Some pockets of these hilly states are famous for offseason production of many crops especially vegetable & ornamental crops and their supply to plains at reasonably higher prices. Among fruit crops in the area having temperate conditions mainly apple, pear, plum, apricot, cherry, peaches, walnut, almond and to a limited extent quince, kiwifruit, hazelnut, persimmon, strawberry and other minor temperate fruit and nut crops are being grown. But as far as area, production and market share is concerned, apple and walnut are leading. The productivity of temperate fruit crops in India is low as compared to other advanced countries due to many reasons like availability of superior cultivar with high productivity potential. ICAR-Central Institute of Temperate Horticulture, Srinagar along with its regional stations situated at Mukteshwar (Uttarakhand) and Dirang (Arunachal Pradesh) are continuously engaged in identification/ production of superior cultivar/ genotypes and have played a great role in the past by recommending region specific cultivars for boosting farmers economy. The research work carried out during 2020 at main campus and its regional stations is presented below:

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

ICAR-CITH, Srinagar is National Active Germplasm Site for temperate fruit crops. The germplasm wealth is precious wealth to cater the present and future need of any country. To utilize the available diversity in temperate horticultural crops as well as its conservation for future use, ICAR- CITH, Srinagar along with its regional stations is continuously enriching germplasm wealth. Continuous efforts are going on for collection, evaluation, characterization and documentation of germplasm in temperate horticultural crops. During 2020, sixty germplasm collections of different crops like apple (12), stone fruits (18), nuts (5), other fruits (15), ornamentals (2) and vegetables (8) were collected and introduced at ICAR- CITH, Srinagar in the form of plant/ scion wood/ bulbs/ runners. Out of sixty, 25 were new introductions and 35 were repeated introductions which failed to survive earlier. The details of new germplasm added in various categories are presented in Table.1. To enrich the germplasm status of ICAR-CITH, Regional Station, Mukteshwar, 110 apple genotypes were supplied from ICAR-CITH, Srinagar for plantation at ICAR-CITH (RS), Mukteshwar for further evaluation and conservation.

Table 1. Germplasm status at ICAR-CITH, Srinagar (2020)

Sr No	Group	Germplasm Status (2018-19)	Added during 2020	Germplasm Status (2020)
1	**Fruits**	**1273**	**50**	**1323**
	Pome fruits	438	12	450
	Stone fruits	253	18	271
	Nuts	398	5	403
	Others	184	15	199
2	**Vegetables**	**1097**	**8**	**1105**
3	**Ornamentals**	**339**	**2**	**341**
4	**Medicinal and aromatic plants**	**33**	**-**	**33**
Total		**2742**	**60**	**2802**

APPLE

Evaluation of columnar apple cultivars for physicochemical characteristics

In order to elucidate the potential of columnar apple varieties for commercialization under temperate conditions of J & K, evaluation is going on for various traits. These cultivars possess the traits like scab resistance, low chill requirement, columnar growth habit etc. Their quality with respect to fruit size, TSS, acidity and other physicochemical traits is being ascertained by evaluating these cultivars under open field conditions over the years. During 2020, four columnar apple cultivars viz. Sunlight, Moonlight, Redlane and Goldlane were evaluated for fruit quality traits like TSS, acidity, pH, firmness, ascorbic acid, color parameters and for antioxidant potential through DPPH, FRAP, total phenols, flavonoids and flavonols assays. Sunlight showed maximum fruit weight (156g) and ascorbic acid (9.82%) in addition to its good antioxidant potential. The antioxidant potential of Moonlight is of considerable importance keeping in view its highest flavonols and flavonoids values. The least acidic and maximum TSS and firmness was observed in cultivar Redlane (Table 2 & Fig1.).

Table 2. Physico and biochemical parameters of different Columnar apple cultivars

Parameters		Sunlight	Moonlight	Redlane	Goldlane
Weight		156.0^{a}	118.31^{c}	47.49^{d}	122.5^{b}
TSS (%)		12.8^{c}	13.1^{a}	13.2^{ab}	12.5^{cd}
Firmness (RI)		60.5^{b}	58.3^{c}	63.3^{a}	57.4^{d}
pH		3.69^{b}	3.44^{c}	3.92^{a}	3.17^{d}
Acidity (%)		0.28^{b}	0.26^{c}	0.25^{cd}	0.33^{a}
Ascorbic Acid (%)		9.82^{a}	8.23^{c}	8.19^{d}	9.10^{b}
Color	L	64.21^{a}	59.53^{b}	45.26^{d}	53.71^{c}
	A	10.15^{c}	8.54^{d}	16.41^{a}	12.12^{b}
	B	37.70^{a}	31.41^{c}	32.11^{b}	25.36^{d}

	Tint	-47.43[a]	-50.57[b]	-87.21[d]	-61.22[c]
Phenols (mgGAE/100gFW)		185.6[a]	153.9[c]	158.9[b]	148.4[d]
Flavonoids (mgQE/100gFW		201.5[b]	211.8[a]	189.6[c]	156.8[d]
Flavanols (mgQE/100gFW		1.57[b]	1.73[a]	1.43[c]	1.21[d]
DPPH (µmol AAE/g FW)		33.31[a]	29.73[b]	21.11[c]	18.45[d]
FRAP (µmol $FeSO_4$ E/100g FW)		177.34[a]	149.32[c]	159.19[b]	117.66[d]

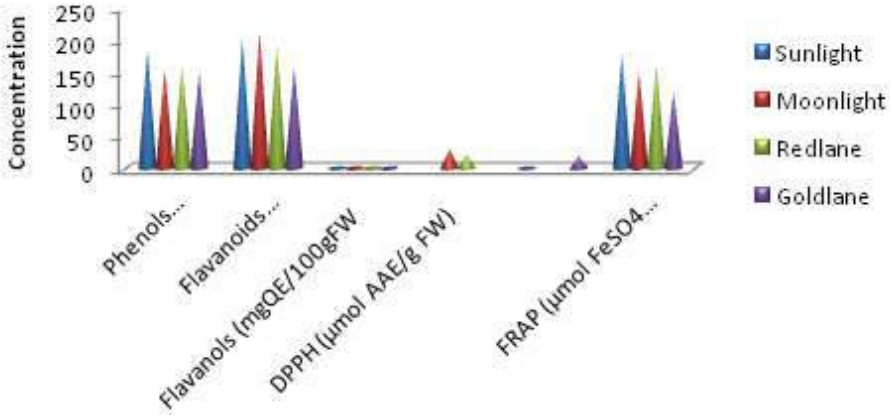


Fig 1. Physicochemical analysis of apple columnar varieties

Evaluation of commercially important apple varieties for physicochemical traits and antioxidative properties

Nine commercially important apple varieties including Gala Redlum, Super Chief, Red Velox, Golden Delicious Reindeers, Golden Delicious Clone B, Elstar, Jonaprince, Pinova, and Red Chief were evaluated for different fruit quality parameters, anti-oxidative and free radical scavenging potential. Free radical scavenging activity and antioxidant activity was evaluated using 1, 1-diphenyl-2-picryl- hydrazyl (DPPH) and FRAP assays. Highest fruit weight was recorded in Red Chief (205.5 g) followed by Super Chief (190.5 g). Based on fruit quality traits Gala Redlum, Red Chief, Super Chief and Red Velox are showing very good performance (Table 3). Apple varieties like Pinova, Elstar and Jonaprince have also the potential for commercialization owing to their desirable fruit quality traits.

Table.3. Physicochemical parameters of some commercially important apple cultivars

Variety	Weight (g)	Firmness (RI)	TSS (%)	Acidity (%)	pH	Ascorbic Acid (mg/100g)	Color			
							L	A	B	Tint
Gala Redlum	162.4[c]	59.5[f]	15.0[c]	0.30[ab]	3.5[c]	10.5[b]	42.31[g]	36.51[a]	28.51[d]	-115.2[i]
Elstar	100.0[i]	61.5[d]	14.4[ef]	0.28[c]	3.8[ab]	8.9[e]	65.79 [b]	7.12[g]	37.05[b]	-37.8[b]
Jonaprince	150.2[f]	63.1[c]	15.7[a]	0.31[a]	3.6[cd]	8.5[f]	43.17[f]	22.43[b]	31.62[b]	-110.8[g]
Pinova	133.2[g]	68.1[a]	15.0[c]	0.32[a]	3.7[cd]	9.0[d]	67.70[a]	14.48[e]	38.51[a]	-57.33[c]
Super Chief	190.5[b]	65.2[b]	14.2	0.25[d]	3.9[a]	8.9[e]	38.12[i]	12.56[f]	21.31[f]	-72.54[e]
Red Velox	159.8[e]	60.1[e]	13.0[g]	0.23[e]	4.0[a]	8.0[g]	40.15[h]	21.36[c]	17.14[g]	-93.85[f]

Golden Del Reinders	160.5^{d}	60.1^{e}	14.9^{d}	0.25^{d}	3.9^{a}	9.4^{c}	60.13^{c}	-8.91^{i}	31.2^{bc}	-69.41^{d}
Golden Del Clone B	120.5^{h}	57.4^{h}	15.2^{b}	0.27^{c}	3.8^{ab}	11.8^{a}	51.63^{d}	3.26^{h}	31.2^{bc}	-2.31^{a}
Red Chief	205.5^{a}	58.9^{g}	14.5^{e}	0.30^{ab}	3.7^{ab}	10.5^{b}	45.12^{e}	18.57^{d}	26.34^{e}	-112.2^{h}

Phenolic compounds and flavonoids are widely distributed in apple and in recent years they have gained much attention, due to their antioxidant activity and free radical-scavenging ability with potential beneficial implications in human health. Keeping in view the vast nutraceutical and pharmaceutical potential of apple fruit, nine apple cultivars were evaluated for their anti-oxidative and free radical scavenging potential. Highest phenol content was observed in Gala Redlum followed by Red Velox while as Golden Delicious Reinders deciphered highest flavonoid content (Table 4). The antioxidative capacity of apple fruit extracts were estimated using FRAP (Ferric-reducing/antioxidant power) assay and the values were expressed as µmol FeSO4 E/100g FW. The ferric reducing antioxidant power (FRAP) mechanism is based on electron transfer rather than hydrogen atom transfer. The FRAP assay is based on the ability of pH to reduce Fe^{3+} to Fe^{2+}. The FRAP reaction is conducted at acidic pH 3.6 to maintain iron solubility, so the reaction at low pH decreases the ionization potential that drives hydrogen atom transfer and increases the redox potential, which is the dominant reaction mechanism. When the reduction of Fe^{3+} to Fe^{2+} occurs in the presence of 2,4,6-trypyridyl-s-triazine, the reaction is accompanied by the formation of a colored complex with Fe^{2+} (absorption at 593 nm). The reducing power appears to be related to the degree of hydroxylation and extent of conjugation in pH. The highest antioxidative potential was observed in apple cultivar Golden Delicious Reinders. Free radical scavenging potential of apple fruit extracts was elucidated by DPPH (1, 1-diphenyl-2-picrylhydrazyl) assay. The hydrogen atom donating ability of the plant extracts was determined by the decolorization of methanol solution of 2, 2-diphenyl-1-picrylhydrazyl (DPPH). Highest antioxidative potential was observed in Golden Delicious Reinders followed by Golden Delicious Clone B.

Table 4. Antioxidative and free radical scavenging properties of some important apple cultivars

Cultivars	**Phenols (mg GAE/100g FW)**	**Flavonoids (mg QE/100gFW)**	**Flavanol (mg QE/100gFW)**	**DPPH (µmol AAE/g FW)**	**FRAP (µmol $FeSO_4$ E/100g FW)**
Gala Redlum	163.9^{a}	132.9^{e}	1.23^{c}	32.5^{e}	71.6^{i}
Elstar	117.3^{h}	109.6^{hi}	1.15^{d}	29.6^{f}	98.3^{e}
Pinova	149.6^{d}	172.3^{b}	1.38^{a}	25.3^{g}	105.2^{d}
Red Jonaprince	139.5^{e}	108.6^{h}	1.10^{de}	33.8^{d}	97.4^{f}
Super chief	132.5^{f}	171.5^{bc}	1.25^{c}	34.2^{c}	95.8^{g}
Red Velox	159.8^{b}	163.2^{d}	1.31^{b}	18.51^{i}	115.3^{c}
Golden Del Reinders	106.3^{i}	178.3^{a}	1.16^{d}	39.5^{a}	123.6^{a}
Golden Del Clone B	129.5^{g}	118.6^{f}	0.98^{f}	35.2^{b}	118.9^{b}
Red Chief	154.6^{c}	113.8^{g}	1.22^{c}	23.6^{h}	85.6^{h}

Physical analysis of Gala Redlum on M9 rootstock among different clusters

To know the number of fruits per cluster for quality produce, four clusters of Gala Redlum grafted on M9 rootstock were evaluated for three physical parameters (weight, length and width of fruits) during the year 2020. The various clusters include; Cluster 1- having one fruit per spur, Cluster 2 having two fruits per spur, Cluster 3 having 3 fruits per spur and Cluster 4 having 4 fruits per spur. Significant variation in fruit weight, length and width was observed in different clusters of Gala Redlum. Highest fruit weight, fruit length and fruit width were observed in cluster 1 and lowest physical parameters were recorded in cluster 4 (Table 5).

Table.5. physical parameters of different clusters of Gala Redlum

Gala Redlum Clusters	Fruit Weight (g)	Fruit Length (inch)	Fruit Width (Inch)
Cluster 1	160.8^{a}	2.48^{a}	2.78^{a}
Cluster 2	146.2^{ab}	2.37^{ab}	2.70^{ab}
Cluster 3	126.7^{bc}	2.31^{ab}	2.56^{bc}
Cluster 4	112.2^{c}	2.23^{b}	2.47^{c}




Cluster 1	Cluster 2	Cluster 3	Cluster 4

Fruits of Gala Redlum in different clusters

Evaluation of apple cultivars for crop density (number of fruits per plant)

The density of fruits per plant/ crop density is important parameter for quality produce and can vary from year to year depending upon the plant age. To evaluate this crop density, eight apple cultivars (Red Velox, Super Chief, Golden Delicious Reinders, Gala Redlum, Jonaprince, Pinova, Elstar and Golden Delicious Clone B) grafted on M9 rootstock under high density model were evaluated for number of fruits/ trees during year 2020. Significant variation in number of fruits / plants was observed among 8 cultivars of apple. Highest number of fruits per plant was observed in Golden Delicious Reinders and lowest was observed in Golden Delicious clone B (Table 6.)

Table.6. Number of fruits per plants of different cultivars of apple on M9 rootstock

Cultivars	No. of fruits / plant
Red Velox	27.31^{abc}
Super Chief	19.84^{bc}
Golden Delicious Reinders	50.80^{a}

Gala Redlum	34.60^{abc}
Jonaprince	43.33^{ab}
Pinova	30.93^{abc}
Elstar	38.75^{ab}
Golden Delicious clone B	12.48^{c}

Comparative evaluation of scab resistant and scab susceptible apple cultivars for fruit quality, anti-oxidative and free radical scavenging potential

Scab resistance in apple is mainly due to presence of resistant gene analogues activating different pathways related to plant deference mechanism. Several studies have suggested that certain types of phenolic compounds such as flavonoids may act as phytoanticipins or as phytoalexins to generate resistance to diseases. The role of flavonoids in plant defense is related to their antimicrobial activity against fungi and bacteria; they have the ability to inhibit the germination of dormant structures and prevent them from interfering with processes such as membrane transport, energy processing and the biosynthesis of nucleic acids. However, some studies have suggested that their role in plant defense could be associated with the antioxidant activity exhibited by these compounds, which could be used by the plants to regulate the levels of reactive oxygen species (ROS) that are generated during infection processes. Therefore, in present study comparative evaluation between scab resistant and scab susceptible cultivars was done with respect to phenolic content and biological activity. Higher phenol and flavonoid content in addition to higher antioxidative and free radical scavenging potential was observed in scab resistant apple cultivars (Prima, Shireen and Liberty). Among commercial cultivars Golden Delicious showed maximum values of phenol, flavonoid, DDPH and FRAP (Table 7). This study showed that one of modus operandi for resistance towards scab is higher values of phenolic compounds and their effects.

Table.7. Physico and biochemical parameters of scab Resistant apple varieties

Parameters	Prima	Shireen	Liberty	Red Delicious	Golden Delicious	Oregon Spur	Firdous
Weight	119.2^{c}	98.5^{d}	80.1^{d}	162.3^{a}	165.2^{a}	145.3^{b}	95.7^{d}
Phenols (mgGAE/100g FW)	183.7^{a}	179.5^{a}	162.33^{a}	142.3^{b}	145.18^{b}	135.10^{c}	121.09^{c}
Flavonoids (mg QE/100g FW)	189.3^{a}	183.2^{a}	188.9^{a}	117.1^{c}	168.23^{b}	139.28^{bc}	97.32^{d}
Flavanols (mg QE/100g FW)	2.81^{a}	2.80^{a}	2.66^{a}	1.24^{c}	2.01^{b}	1.54^{c}	1.31^{c}
DPPH (µM AAE/g FW)	48.8^{a}	39.61^{b}	34.8^{b}	28.6^{bc}	17.23^{d}	21.3^{c}	18.98^{d}
FRAP (µM $FeSO_4$/100g FW)	225.3^{a}	279.4^{a}	215.7^{a}	106.7^{d}	207.66^{b}	145.10^{c}	89.35^{d}

Molecular diversity assessment in Malus baccata using SSR markers

To assess the genetic diversity in 29 *Malus baccata* accessions, 79 SSR makers detected a total of 279 alleles. The number of alleles per locus ranged from 2.00 (Hi02d05, CN937679, CH04C07, C0051724, Hi12c02, CN930910, Hi02d02, CN949077, CN896269F, C0753776,

CN919347, CN948075, Hi03e03, Hi03d06) to 8 (CH02g01) with a mean of 3.7 alleles per locus. However, the effective number of alleles per locus was found to be lower for all SSR loci ranging from 1.21 for Hi02d05 and CN937679 to 4.78 for CH-Vf1 with a mean of 2.63. The higher number of alleles per locus (5) and almost identical mean effective number of alleles per locus were noted for the three SSR loci viz., Hi04c04 (4.1) Hi22f12 (4.4), and Hi04g11 (3.8). The level of observed heterozygosity ranged from 1 for Hi23g12, CN493139, Hi04a05, Hi04f09, Hi07d08 to 0.00 for CN921650 with a mean of 0.51. The gene diversity ranged from 0.10 for Hi02d05 to 0.79 for CH-Vf1. The polymorphism information content value ranged from 0.76 (CH-Vf1) to 0.10 (Hi02d05) with an average of 0.50. A total of 43 SSR loci expressed PIC value of more than 0.5 thus, representing the high discriminating power of the selected SSRs. Major allele frequency ranged from 0.27 for SSR marker Hi22f12 to 0.95 for Hi02d05 with a mean of 0.55. In the present study, 12 SSR loci expressed individual frequencies of more than 0.75 (Fig 2&3). The study highlights the presence of a substantial magnitude of genetic variability among the *Malus baccata* accessions collected across the Himalayas and helped to group these accessions into two sub-populations with a moderate level of differentiation. The information obtained signifies an impression about a range of diversity and indicates a scope for their subsequent utilization in apple improvement programmes for developing novel apple cultivars, discriminating power of the selected SSRs. Major allele frequency ranged from 0.27 for SSR marker Hi22f12 to 0.95 for Hi02d05 with a mean of 0.55. In the present study, 12 SSR loci expressed individual frequencies of more than 0.75.

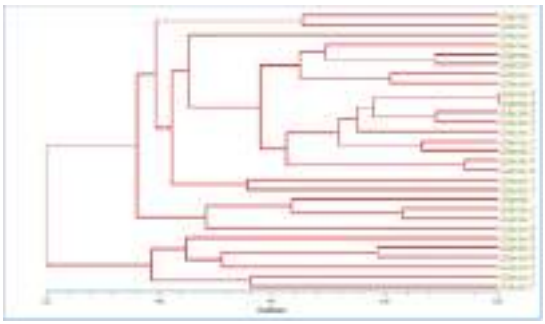


Fig 2. NTSYS analysis of of 29 MB accessions based on 79 SSR markers

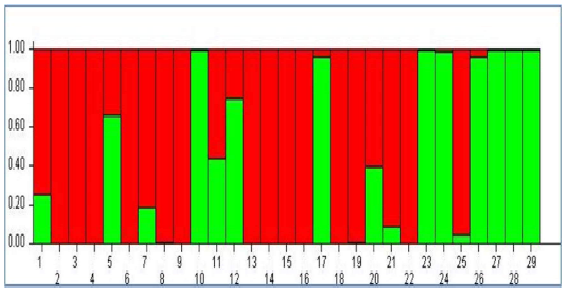


Fig 3.Genetic structure of 29 MB accessions as inferred by STRUCTURE based on 79 SSR data

 CITH-B-01	 CITH-B-02	 CITH-B-03	 CITH-B-04	 CITH-B-0 5	 CITH-B-06
 CITH-B-07	 CITH-B-08	 CITH-B-0 9	 CITH-B- 10	 CITH-B- 11	 CITH-B- 13
 CITH-B -14	 CITH-B -15	 CITH-B- 16	 CITH-B- 17	 CITH-B- 18	 CITH-B- 19
 CITH-B- 20	 CITH-B-21	 CITH-B-22	 CITH-B-23	 CITH-B-24	 CITH-B-24

					
CITH-B-25	**CITH-B-26**	**CITH-B-27**	**CITH-B-28**	**CITH-B- 29**	**CITH-B-30**

PEAR

In pear, 19 European/Asian cultivars of pear were evaluated and maximum fruit weight (225.17 g), fruit length (89.54 mm) and fruit diameter (72.36 mm) were recorded in cultivar Max Red Bartlett while minimum fruit weight (43.03 g) & fruit diameter (39.76 mm) in Punjab Beauty and fruit length (48.32 mm) in cultivar Doyenne Burrah. Maximum pedicle length (52.72 mm) was recorded in Kashmiri Nakh and minimum (17.23) in Gent Drouard. Fruit firmness in pear cultivars ranged from 48.93 RI in ZH Copeacae to 80.30 RI in Punjab Beauty. Maximum TSS was recorded in Starkrimson (17.13) and minimum in ZH Copeace (11.83). Maximum values for pH were recorded in Smart (4.50) and minimum in Punjab Nectar (3.10). Significant differences were recorded for parameters such as total sugars, reducing sugars, and ascorbic acid content (Table 8). Among color characteristics (L*, a*, b* and tint), L* values ranged from (41.10) in Starkrimson to (64.27) in Punjab Nectar while a* value ranged from (-8.20) in Smart to (19.06) in Starkrimson. Values for b* scale ranged from 13.30 in Starkrimson to 41.33 in Punjab Soft and no accession showed a negative b* value indicated that there is no blue-coloured variety. Values for Tint ranged from -88.40 in ZH Copeacae to -0.85 in Badshah Nakh. The values for chroma ranged from 23.44 in Starkrimson to 52.28 in ZC, while values for Hue angle ranged from -85.56 in Kashmiri Nakh to 83.68 in Doyenne de Comice and values for colour index ranged from -5.31 in Smart to 37.25 in Pear cultivar Starkrimson

Table 8. TSS, pH, reducing sugars, total sugar, and ascorbic acid content in different pear cultivars

Cultivars	TSS(B^0)	pH	Reducing Sugar (%)	Total sugar (%)	Ascorbic Acid (mg/100g)
ZH Copacea	11.83 ^{h}	3.50 ^{f}	5.05 ^{h}	7.88 ^{g}	3.63 ^{i}
Max Red Bartlett	16.50 ^{ab}	3.93 ^{cd}	5.22 ^{fg}	8.61 ^{de}	3.25 ^{J}
Gent Drouard	14.20 ^{f}	3.80 ^{e}	5.30 ^{e}	8.64 ^{e}	5.15 ^{c}
Mayan	15.30 ^{cd}	3.90 ^{cd}	5.64 ^{cd}	9.19 ^{c}	5.00 ^{d}
William Bartlett	13.83 ^{f}	4.00 ^{cd}	5.20 ^{fg}	7.38 ^{h}	5.71 ^{a}
Smart	13.63 ^{fg}	4.50 ^{a}	5.26 ^{f}	8.31 ^{f}	3.73 ^{ı}
Flemish Beauty	12.07 ^{h}	4.20 ^{b}	5.70 ^{c}	9.69 ^{b}	4.75 ^{e}
Punjab Gold	13.57 ^{fg}	4.10 ^{bc}	4.24 ^{j}	6.58 ^{i}	5.25 ^{c}
Doynne de Comice	13.40 ^{fg}	3.90 ^{cd}	6.77 ^{a}	10.30 ^{a}	4.75^{e}
Badshah Nakh	14.80 ^{d}	3.70 ^{e}	3.78 ^{l}	5.76 ^{k}	5.50 ^{b}
Punjab Beauty	12.90 ^{fg}	3.20 ^{g}	4.69 ^{ı}	6.26 ^{J}	5.75 ^{a}
Monarch	12.87 ^{g}	3.60 ^{ef}	5.73 ^{c}	7.23 ^{h}	3.25 ^{J}
Pyasua behapa	12.90 ^{g}	4.00 ^{cd}	5.12 ^{gh}	8.37 ^{ef}	5.00 ^{d}
Severenta	14.73 ^{de}	3.60 ^{ef}	4.72 ^{ı}	8.80 ^{d}	4.50 ^{f}
Punjab Nectar	14.03 ^{ef}	3.10 ^{g}	5.40 ^{e}	8.47 ^{ef}	5.50 ^{b}
Doyenne Burrah	14.67 ^{de}	3.90 ^{cd}	4.22 ^{j}	5.66 ^{k}	4.25 ^{g}
Punjab soft	15.20 ^{cd}	3.20 ^{g}	3.71 ^{l}	5.60 ^{k}	5.50 ^{b}
Kashmiri Nakh	15.90 ^{bc}	3.70 ^{e}	4.05 ^{k}	6.72 ^{i}	5.75 ^{a}
Starkrimson	17.13 ^{a}	3.50 ^{f}	6.12 ^{b}	8.50 ^{ef}	5.25 ^{c}

QUINCE

In quince, 31 quince genotypes were evaluated and fruit weight ranged from 45.19g in CITH-Q-18 to 225.33 in CITH-Q-04. Maximum fruit length (76.31 mm) was recorded in CITH-Q-04 while minimum (42.01mm) in CITH-Q-27. Maximum fruit diameter 77.65 mm was recorded in CITH-Q-04, while minimum fruit length 42.82 mm in CITH-Q-26. Among colour characteristics, L* value ranged from 62.00 in CITH-Q- 02 to 80.27 in CITH-Q- 04 while values of a* scale ranged from -7.45 in CITH-Q- 13 to 24.10 in CITH-Q-12. In case of b* scale the value ranged from 37.38 in CITH-Q-27 to 84.20 in CITH-Q-04. The values for tint ranged between -46.59 in CITH-Q- 17 to 15.62 in CITH-Q- 05. The values for chroma ranged from 37.41 in CITH-Q-27 to 84.35 in CITH-Q-04. The values for Hue angle ranged from -88.39 in CITH-Q-25 to 88.65 in CITH-Q-32 and the values for color index ranged from -3.00 in CITH-Q- 13 to 6.30 in CITH-Q-12. The maximum value of firmness (68.80 RI) was recorded in CITH-Q-33 and minimum 57.87RI in CITH-Q- 11 (Table 9).

Table 9. Data on fruit and colour parameters in different quince genotypes

Genotypes	Fruit weight (g)	Fruit length (mm)	Fruit dia Meter (mm)	L	a	b	Tint	Chroma	Hue angle	Color Index	Firmness
CITH-Q-01	63.17 ^{ijkl}	45.78 ^{klm}	51.46 ^{fgh}	79.87 ^{ab}	5.18 ^{bcd}	79.07 ^{b}	-38.09 ^{def}	79.24 ^{a}	86.25 ^{a}	0.82 ^{bcde}	60.67 ^{fgh}
CITH-Q-02	74.41 ^{hij}	50.37 ^{hijk}	53.18 ^{fg}	62.00 ^{k}	-5.55 ^{de}	40.82 ^{lm}	-20.44 ^{bcd}	41.19 ^{hij}	-82.26 ^{d}	-2.19 ^{fg}	62.40 ^{defg}
CITH-Q-04	225.33 ^{a}	76.31 ^{a}	77.65 ^{a}	80.27 ^{a}	5.08 ^{bcd}	84.20 ^{a}	-36.31 ^{cdef}	84.35 ^{a}	86.55 ^{a}	0.75 ^{bcde}	62.67 ^{cdefg}
CITH-Q-05	110.20 ^{g}	61.13 ^{ef}	60.00 ^{e}	69.74 ^{fghi}	5.88 ^{bcd}	46.66 ^{ghijk}	15.62 ^{a}	47.03 ^{efgh}	82.82 ^{a}	1.81 ^{bcd}	67.80 ^{ab}
CITH-Q-06	179.13 ^{bc}	69.29 ^{b}	68.44 ^{bc}	73.67 ^{cdef}	5.05 ^{bcd}	55.35 ^{c}	-35.19 ^{cdef}	55.58 ^{bc}	84.79 ^{a}	1.24 ^{bcde}	66.23 ^{abc}
CITH-Q-07	190.37 ^{b}	75.56 ^{a}	72.27 ^{b}	74.33 ^{cdef}	5.13 ^{bcd}	49.06 ^{defgh}	-32.85 ^{bcdef}	49.33 ^{cdefg}	84.03 ^{a}	1.41 ^{bcd}	68.1380 ^{a}
CITH-Q-08	163.40 ^{cd}	67.77 ^{bcd}	70.30 ^{b}	70.86 ^{efghi}	1.50 ^{bcde}	39.17 ^{m}	-43.11 ^{ef}	39.20 ^{ij}	87.81 ^{a}	0.54 ^{bcdef}	63.03 ^{cdefg}
CITH-Q-09	183.47 ^{b}	69.33 ^{b}	72.47 ^{b}	77.94 ^{abc}	1.18 ^{bcde}	47.46 ^{fghijk}	-21.42 ^{bcd}	47.47 ^{defgh}	88.58 ^{a}	0.32 ^{bcdef}	59.47 ^{gh}
CITH-Q-10	49.15 ^{kl}	44.05 ^{lm}	44.23 ^{jk}	74.99 ^{bcdef}	-1.21 ^{bcde}	50.04 ^{defg}	-30.08 ^{bcdef}	50.06 ^{cdefg}	-88.62 ^{c}	-0.32 ^{cdef}	62.70 ^{cdefg}
CITH-Q-11	108.68 ^{g}	63.61 ^{cde}	59.35 ^{e}	75.98 ^{abcde}	7.06 ^{bc}	38.55	-43.49 ^{ef}	39.20 ^{ij}	79.62	2.41 ^{bc}	57.87 ^{h}
CITH-Q-12	144.38 ^{e}	69.75 ^{b}	65.08 ^{cd}	74.39 ^{cdef}	24.10 ^{a}	51.40 ^{cdef}	-38.18 ^{def}	56.77 ^{b}	64.88 ^{ab}	6.30 ^{a}	61.57 ^{efgh}
CITH-Q-13	141.36 ^{ef}	69.07 ^{bc}	62.38 ^{de}	63.58 ^{jk}	-7.45 ^{e}	39.12 ^{m}	-25.62 ^{bcdef}	39.82 ^{ij}	-79.22 ^{d}	-3.00 ^{g}	64.53 ^{bcde}
CITH-Q-14	67.32 ^{hijk}	52.95 ^{ghi}	48.88 ^{ghij}	63.13 ^{jk}	-3.63 ^{cde}	37.80 ^{m}	-17.88 ^{bcd}	37.98 ^{j}	-84.52 ^{d}	-1.52 ^{efg}	65.60 ^{abcd}
CITH-Q-16	51.55 ^{kl}	50.55 ^{hijk}	44.39 ^{jk}	67.37 ^{ghijk}	-2.06 ^{bcde}	44.15 ^{jkl}	-16.27 ^{bc}	44.20 ^{ghij}	-87.33 ^{d}	-0.69 ^{defg}	59.57 ^{gh}
CITH-Q-17	60.04 ^{jkl}	48.08 ^{ijkl}	48.85 ^{ghij}	63.60 ^{jk}	8.41 ^{b}	49.03 ^{defgh}	-46.59 ^{f}	49.74 ^{cdefg}	80.26 ^{a}	2.70 ^{a}	62.83 ^{cdefg}
CITH-Q-18	45.19 ^{l}	42.96 ^{lm}	44.35 ^{jk}	67.74 ^{ghij}	4.44 ^{bcd}	51.61 ^{cdef}	-32.22 ^{bcdef}	51.80 ^{cdef}	85.08 ^{a}	1.27 ^{bcde}	67.9380 ^{ab}
CITH-Q-19	83.50 ^{h}	66.20 ^{bcde}	54.54 ^{f}	72.41 ^{defg}	4.54 ^{bcd}	53.42 ^{cd}	-37.41 ^{cdef}	53.61 ^{cde}	85.15 ^{a}	1.17 ^{bcde}	60.17 ^{gh}
CITH-Q-20	141.62 ^{ef}	65.51 ^{bcde}	61.90 ^{de}	70.68 ^{efghi}	-2.18 ^{bcde}	43.42 ^{kl}	-16.89 ^{bcd}	43.48 ^{ghij}	-87.13 ^{d}	-0.71 ^{defg}	61.87 ^{efg}
CITH-Q-21	152.36 ^{de}	63.09 ^{de}	65.29 ^{cd}	71.39 ^{efgh}	4.39 ^{bcd}	48.47 ^{efghij}	-35.68 ^{cdef}	48.67 ^{cdefg}	84.82 ^{a}	1.27 ^{bcde}	60.43 ^{gh}
CITH-Q-22	62.00 ^{ijkl}	52.58 ^{ghij}	48.79 ^{ghij}	77.65 ^{abcd}	5.41 ^{bcd}	49.52 ^{defg}	-36.24 ^{cdef}	49.81 ^{cdefg}	83.76 ^{a}	1.41 ^{bcd}	68.4380 ^{a}
CITH-Q-23	84.37 ^{h}	56.32 ^{fg}	53.88 ^{f}	72.86 ^{cdefg}	3.68 ^{bcde}	49.99 ^{defg}	-31.40 ^{bcdef}	50.12 ^{cdefg}	85.79 ^{a}	1.01 ^{bcde}	68.2080 ^{a}
CITH-Q-24	183.69 ^{b}	65.40 ^{bcde}	72.20 ^{b}	72.12 ^{efgh}	3.45 ^{bcde}	49.34 ^{defgh}	-29.79 ^{bcdef}	49.46 ^{cdefg}	86.00 ^{a}	0.97 ^{bcde}	61.43 ^{efgh}
CITH-Q-25	124.51 ^{fg}	67.37 ^{bcd}	60.68 ^{de}	71.63 ^{efgh}	-1.36 ^{bcde}	48.63 ^{efghi}	-19.24 ^{bcd}	48.65 ^{cdefg}	-88.39 ^{d}	-0.39 ^{cdefg}	59.53 ^{gh}
CITH-Q-26	47.44 ^{kl}	43.81 ^{lm}	42.82 ^{k}	65.74 ^{ijk}	8.19 ^{b}	44.91 ^{hijkl}	-44.28 ^{ef}	45.65 ^{fghi}	79.67 ^{a}	2.77 ^{b}	60.50 ^{gh}
CITH-Q-27	58.58 ^{jkl}	42.01 ^{m}	50.03 ^{fghi}	67.41 ^{ghijk}	1.33 ^{bcde}	37.38 ^{m}	-24.20 ^{bcde}	37.41 ^{j}	87.96 ^{b}	0.53 ^{bcdef}	64.23 ^{cdef}
CITH-Q-28	47.18 ^{kl}	49.95 ^{hijk}	43.50 ^{k}	64.14 ^{jk}	-1.86 ^{bcde}	44.36 ^{ijkl}	-12.92 ^{b}	44.40 ^{ghij}	-87.60 ^{d}	-0.65 ^{defg}	68.7780 ^{a}
CITH-Q-29	52.18 ^{kl}	43.64 ^{lm}	47.17 ^{hijk}	63.97 ^{jk}	4.29 ^{bcd}	47.91 ^{efghij}	-17.80 ^{bcd}	48.10 ^{defgh}	84.89 ^{a}	1.40 ^{bcd}	64.23 ^{cdef}
CITH-Q-30	81.67 ^{hi}	57.73 ^{fg}	54.42 ^{f}	71.64 ^{efgh}	2.89 ^{bcde}	51.80 ^{cdef}	-31.88 ^{bcdef}	51.88 ^{cdef}	86.81 ^{a}	0.78 ^{bcde}	61.37 ^{efgh}
CITH-Q-31	78.19 ^{hij}	54.43 ^{gh}	52.35 ^{fg}	66.85 ^{hijk}	3.01 ^{bcde}	54.64 ^{c}	-31.26 ^{bcdef}	54.72 ^{bcd}	86.85 ^{a}	0.82 ^{bcde}	60.43 ^{gh}
CITH-Q-32	81.53 ^{hi}	50.61 ^{hijk}	53.33 ^{fg}	70.69 ^{efghi}	1.14 ^{bcde}	48.20 ^{efghij}	-28.22 ^{bcdef}	48.21 ^{defgh}	88.65 ^{a}	0.33 ^{bcdef}	59.63 ^{gh}
CITH-Q-33	66.51 ^{hijk}	47.34 ^{jklm}	45.62 ^{ijk}	64.26 ^{jk}	3.70 ^{bcde}	52.28 ^{cde}	-31.52 ^{bcdef}	52.41 ^{cdef}	85.95 ^{a}	1.10 ^{bcde}	68.80 ^{a}

Fruits of some quince genotypes collections at CITH, Srinagar

APRICOT

In apricot, 64 genotypes were evaluated for fruit and yield traits. The fruit weight varied from 15.28 g (CITH-Ap-18) to 69.91 g (CITH-Ap-1) while fruit length ranged between 29.41 mm (CITH-Ap-35) to 47.84 mm (Heartly). Similarly, TSS varied from 11.84 ^{o}B (Yarwani) to 24.63 ^{o}B (CITH-Ap-35). The genotypes which produced fruits having TSS more than 20 ^{o} B were CITH-Ap-11, CITH-Ap- 12, CITH-Ap-18, CITH-Ap-19A, CITH-Ap-20, CITH-Ap-28, CITH-Ap-32, CITH-Ap-33, CITH-Ap-35, Afghani, Communis Holy and Tokopopa. Different colour parameters L, a, b and tint varied among the evaluated genotypes. The stone weight, stone length, stone width and stone thickness were found minimum in Afghani, CITH-Ap-17, Afghani and CITH-Ap-27, respectively. Highest yielding genotypes were CITH-Ap-2 (42.67 kg), CITH-Ap-1 (39.06 kg), Rival (32.20 kg) and Erani (29.64 kg) during 2020.

PEACH

Twenty-three genotypes of peach and four cultivars of nectarine were evaluated for fruit traits. The heaviest fruits (138.99g), fruit length (64.36mm), fruit width (63.55mm) and fruit thickness (61.45mm) were recorded in cultivar Early Red June. The TSS was found highest in cultivar Red Globe. Among four nectarine cultivars, maximum fruit weight (97.73g), fruit length (64.39 mm), fruit width (58.18mm) and fruit thickness (50.01 mm) recorded in cultivar Fantasia. The stone characteristics and fruit colour traits also varied from genotype to genotype.

PLUM

In plum, 23 cultivars (Japanese and European) were evaluated for various physicochemical and colour parameters and maximum fruit weight (77.81g) and fruit diameter (50.89mm) were recorded in Frontier while maximum fruit length(56.62mm) was found in Grand Duke.

Minimum fruit weight (10.73g), fruit length (23.97mm) and fruit diameter (26.13mm) were recorded in Kala Amritsari while minimum fruit thickness (24.61mm) was recorded in Methley. The minimum pedicle length (8.16mm) and maximum firmness (63.33RI) was recorded in Black Amber. Among the stone parameters, the highest stone weight was recorded for Kubio Plum (3.19g) and minimum in Red Plum (0.46g). Among colour characteristics, L* value ranged from 21.93 in Kala Amritsari to 64.22 in Kanto-5 while values of a* scale ranged from -2.95 in Green Gauge to 32.98 in Beauty. In case of b* scale, the value ranged from 1.54 in Stanley to 46.76 in Kanto-5. The values for tint ranged between -161.88 in Red Plum to -15.33 in Green Gauge. The values for chroma ranged from 6.68 in Kala Amritsari to 46.79 in Kanto-5. The values for Hue angle ranged from -88.40 in Kanto-5 to 83.67 in Monarch and the values for color index ranged from -1.20 in Green Gauge to 170.99 in Kala Amritsari. Significant differences were recorded for parameters such as TSS, pH, total sugars, reducing sugars, and ascorbic acid content (Fig 4& 5).

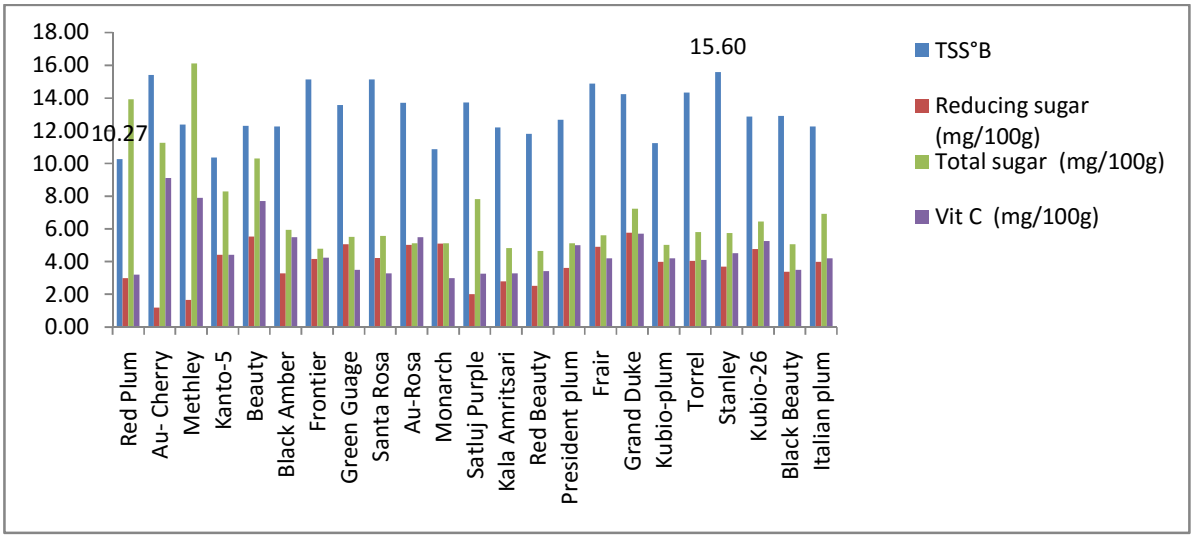


Fig 4. TSS, total sugars, reducing sugars and ascorbic acid content in different plum cultivars

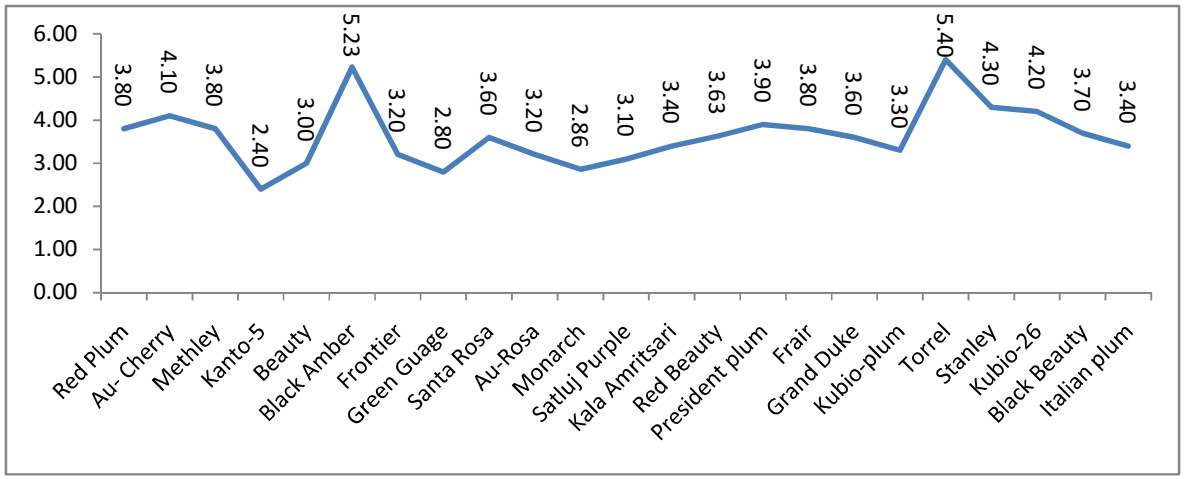


Fig 5. pH in different plum cultivars

Some cultivars of plum in fruiting at CITH, Srinagar

STRAWBERRY

In strawberry, 72 genotypes were evaluated for fruit traits. The fruit weight varied from 4g (Dilpasand) to 17.3 g (Cammarosa), fruit length from 12 mm (Osograndy) to 27.1 mm (Cammarosa), fruit diameter varied 17.5 mm (VL-13) to 48.6 (Winter Don). The cultivar/ genotypes EC 32602, Red Cross., Red Coat, Katrian Sweet, Jutogh Special, Dilpasand, Mechwary, Sea Scap, Gorilla, Cammarosa etc. produced maximum number of flowers and fruits.

OLIVE

In olive, 18 cultivars were evaluated for various fruit traits and 17 cultivars were evaluated for yield traits. Among fruit traits, maximum fruit weight (6.0g) and fruit width (20.5 mm) were recorded in cultivar Zaituna while maximum fruit length (25.97mm), stone length (19.90 mm) and stone length/width ratio (2.42) was recorded in cultivar Cornicobra. The minimum stone weight (0.49g) was recorded in cultivar Pendolino and Itrana. Maximum average yield/ plant was recorded in cultivar Pendolino (22.21 kg) followed by Ceregnola (15.4 kg,) Messenese, Zaituna, Leccino (13.9 kg each), Tonda Ibea (12.55 kg), Picholine (10.6 kg), Ottobratica (10kg), Coratina (9.65 kg) and Frontoio (8kg). Based on production, these cultivars were found promising and can be used for commercial production in temperate region.

ALMOND

In almond, 10 cultivars and 21 selections were compared for nut and kernel traits. Maximum nut weight (3.04 g) was recorded in cultivar Makhdoom and minimum (1.71 g) in Merced. The kernel weight was maximum (1.56g) in cultivar Shalimar and minimum in cultivar Merced. The kernel percentage was highest (57.31%) in Merced and minimum (44.85%) in California Paper Shell. In almond selections, maximum nut weight was recorded in CITH-A-18 (4.05 g) while minimum (1.94 g) in CITH-A-4. Similarly kernel weight was highest (1.44g) in CITH-A-19 while it was minimum (0.71g) in CITH-A-9. The kernel recovery

ranged from 26.12% in CITH-A-16) to 47.21 in CITH-A-19. Maximum yield per plant was reported in Makhdoom among cultivars while in selections, it was maximum in CITH-A-9.

WALNUT

In walnut, 261 walnut genotypes were evaluated for various nut and kernel traits. Among these, 28 genotypes produced nuts having weight less than 10g, 155 genotypes produced nuts having nut weight between 10 to 15 g, 68 genotypes having nut weight between 15 to 20 g, nine genotypes having nut weight between 20 to 25 g and one genotype have nut weight more than 25g. Similarly, 40 genotypes produced nuts having kernel weight less than 5g, 177 genotypes having kernel weight between 5 to 8g, 35 genotypes having kernel weight between 8 to 10g and 9 genotypes having kernel weight more than 10 g. The shell thickness of 2, 27, 99, 92 and 41 genotypes were less than 1mm, 1 to 1.5mm, 1.5 to 2 mm, 2 to 2.5mm and more than 2.5mm, respectively. Similarly, 23, 61,93,67 and 17 genotypes produced nuts which gave kernel recovery less than 40%, 40 to 45%, 45 to 50 %, 50 to 55 % and more than 55 per cent, respectively. Besides institute released varieties, CITH W 22, CITH W 88 and CITH W 118 were also seems to be promising based on nut and kernel traits.

PISTACHIO

In pistachio, five selections were evaluated for nut and kernel traits and heaviest nuts (2.54g) were produced by CITH-Pistachio -Selection -4 followed by CITH-Pistachio -Selection -1 (2.34g), CITH-Pistachio -Selection -2 (2.08g), CITH-Pistachio -Selection -6 (1.16g) and CITH-Pistachio -Selection -5 (1.13g). Similarly heaviest kernels were found in the nuts produced by CITH-Pistachio -Selection -4 (0.730g) and minimum in CITH-Pistachio -Selection -6 (0.56g). The kernel percentage was found maximum in CITH-Pistachio -Selection -3 (57.08%) closely followed by CITH-Pistachio -Selection -4 (56.98%). Hence based on nut and kernel traits CITH-Pistachio -Selection -1, CITH-Pistachio -Selection -3 and CITH-Pistachio -Selection -4 seem to be promising. The number of blank nuts was found more in CITH-Pistachio -Selection -5. CITH-Pistachio (Male) -1 flowered from 13th April to 29th April while CITH-Pistachio (Male) -2 initiated flowering on 16th April and ended on 2nd May. The female flowering initiated from 14th to 16th April in different Selections.

HAZELNUT

In hazelnut, seven cultivars were evaluated and significant differences were recorded for most of the physical nut parameters. Nut weight ranged from 2.01g (Tonda Gentile delle Langhe) to 2.98 g (Tonda di Giffoni). Maximum nut length (23.66 mm), nut width (19.61 mm) and nut thickness (17.93 mm) were recorded in cultivar Ennis. Highest kernel weight (1.39g) and minimum shell thickness (1.22 mm) was recorded in Tonda di Giffoni. Similarly kernel recovery ranged from 37.21 % (Tonda Romana) to 52.06 % in Fertil de Coutard.

PECAN

Two pecan seedling selections came into fruiting first time at ICAR-CITH, Srinagar and evaluated for nut traits. The nut weight, nut length, nut width, nut thickness, shell thickness, kernel weight and kernel recovery in Selection 1 were 4.18g, 27.51mm, 20.09mm, 20.7mm, 0.65mm, 1.66g and 39.71 per cent, respectively. These parameters were at the tune of 2.09g, 25.52mm, 14.31mm, 15.64mm, 0.35mm, 0.93g and 44.50 per cent. Based on nut weight

Selection 1 was found promising while for kernel recovery and shell thickness Selection 2 was found better.



Fruiting in Pecan Selection 1 Fruiting in Pecan Selection 2



CITH- Pistachio-1 CITH- Pistachio-4 CITH- Pistachio-5

Fruiting in some Pistachio Selections

ICAR-CITH, Regional Station, Mukteshwar

The collection of germplasm was carried out in the form of plants/ scion wood/ runners in various crops like apple, pear, peach, plum, apricot, walnut, strawberry and chestnut. More than 218 genotypes were collected and planted/ propagated there. Besides this, 314 different genotypes under various horticultural crops were maintained at ICAR-CITH, RS Mukteshwar.

Evaluation of temperate fruit germplasms at Mukhteshwar, Uttarakhand

Evaluation work was done under various fruit crops such as peach, plum, apple and kiwi fruit for various physicochemical traits including antioxidant potential and carotene contents under mid hill conditions of Uttarakhand.

In peach, total eight cultivars/ genotype namely Red June, FLA-16-33, Flordasun, Flordaking, Red Nectarine, Golden Monarch & Arkansas were evaluated and the highest fruit weight (115.5 g), carotene content (785.5 mg/100 g) and total anti-oxidant activity (27.0 mMT/L) were reported in Golden Monarch, Red June and Arkansas as compared to other peach cultivars, respectively. In plum, total five cultivars/ genotypes namely Santa Rosa, Green Gage, Kalegi (CITH Mukhteshwar), Satsuma & Ramgarh Monarch were evaluated and highest fruit weight (63.3g g), carotene content (387.0 mg/100 g) and total anti-oxidant activity (34.1 mMT/L) were reported in Satsuma, Ramgarh Monard, and Kalegi (CITH Mukteshwar) as compared to other plum cultivars, respectively. In apricot, total six cultivars/genotypes were evaluated and the highest fruit weight (93.7 g), carotene content

(1176.9 mg/100 g) and total anti-oxidant activity (28.60 mMT/L) were reported in Local (Chapta), Erani, and Local (Gola) as compared to other apricot genotypes, respectively.
In evaluation of four kiwifruit cultivars, most of the physico-chemical characteristics of fruits were found superior in Hayward and Allison as compared to other cultivars. In strawberry total eight cultivars were evaluated and the highest fruit weight (16.0g) and TSS (7.3^{o}B) were reported in Gorella as compared to other genotypes. In apple, 23 apple cultivars belonging to Delicious group, spur type and colour strains were evaluated and the highest fruit weight (166.0 g), carotene content (308.6 mg/100 g) and total anti-oxidant activity (38.0 mMT/L) were reported in CITH Lodh Apple-1 and Bright-N-Early as compared to other apple cultivars, respectively.

Effect of plant density on fruit and yield traits

In high density apple the effect of different planting densities *i.e.,* 1.5×1.5 m, 1.5×2.5 m, 2.5×2.5 m and 6×6m on yield and physico-chemical characteristics of three apple cultivars Starkrimson, Golden Delicious and Mollies Delicious were evaluated. Effect of spacing was found significant. The highest mean number of fruits per tree (226.89), yield per tree (37.68 kg), fruit weight (173.82 g), fruit volume (184.56 cc), fruit length (6.81 cm), fruit diameter (7.57), TSS (13.11°B) minimum acidity (0.40 %), maximum total sugar (7.06 %), reducing sugar (5.29 %), carotene content (191.60 µg/100g) were recorded at 6×6 m spacing. While highest mean yield per hectare (37.16 MT), fruit firmness (7.80 lb/inch^2) and total anti-oxidant activity (38.03 mMTE/L) were recorded at 2.5×2.5 m spacing and lowest mean yield per hectare was recorded at 6×6 m spacing. Effect of cultivar was also found significant. Whereas highest fruits per tree (172.42), yield per tree (26.95 kg), yield per hectare (38.60 MT), fruit firmness (7.98 lb/inch^2), TSS (11.79° B) and ascorbic acid content (14.67 mg/100g) were recorded in Starkrimson as compared to other cultivars. Conclusively, Starkrimson cultivar was found superior in term of yield and physiochemical characteristic of fruits and 2.5×2.5 m spacing was found best in terms of highest yield per hectare as compared to other spacing.

Strawberry germplasm evaluation at Regional Station Mukteshwar

VEGETABLE CROPS

ICAR-CITH, Srinagar

During the year kale, root vegetables and exotic vegetables were maintained and evaluated under field conditions along with biochemical analysis of cabbage hybrid and exotic leafy vegetables. A brief description of germplasm along with elite genotypes is given in Table 10 & 11.

Table 10. Evaluation of kale and root vegetables for various traits

Crop	Genotypes evaluated	Checks	Yield range (t/ha)	Root/ head weight range (g)	Best genotypes
Kale	14+4 (C)	Khanyari, GM Dari, Kawdari, Hanz Haaq	10.05 – 20.50	-	CITH-KC-Sel-5 (20.50), CITH-KC-11 (20.35), CITH-KC-08 (17.85), CITH-KC-26 (16.28), Hanz Haaq (16.13) and Kawdari (15.63)
Radish	3+2 (C)	Japanese White Long, Pusa Himani	-	192.67 – 385.00	Pusa Himani (385.00)
Turnip	17+1 (C)	Nigeen-1	-	170.00 – 423.33	Sel-2 (423.33)

Table 11. Evaluation of exotic and leafy vegetables for various traits

Crop	Genotype	Head weight (Kg)	Head height (cm)	Head width (cm)	TSS (%)	Plant height (cm)	Plant spread (cm)	DPPH radical scavenging activity (µM AAE/g FW)	FRAP (µM FeSO4 E/g FW)
Broccoli	CITH-Broccoli-1	0.301	15.21	12.69	11.97	70.93	71.30	-	-
Chinese cabbage	CITH-CC-1	2.200	24.96	16.76	5.12	-	71.53	0.565	1.027
Cabbage	Golden Acre	1.23	15.52	15.82	7.97	31.10	52.90	0.571	1.213
Cabbage Hybrid	Golden Acre x CITH-RC-1	1.19	14.52	16.52	7.84	33.70	51.57	0.597	1.213
Swiss Chard	CITH-SC-Red	-	-	-	-	-	-	4.852	2.843
Swiss Chard	CITH-SC-Green	-	-	-	-	-	-	2.493	1.972

Off-season cultivation of onion in Kashmir valley

In Kashmir, onion is almost always cultivated in *Rabi* season (October to June). This leads to glut in onion supply during the months of June, July and August followed by scarcity leading to price hike starting from September/October. The valley is also forced to buy onion from other states of the country. To alleviate this problem, a preliminary study was conducted at the institute by involving different day length responsive varieties collected from other states in combination with different dates of bulb-set planting so as to identify a combination for producing commercial bulbs during off-season (i.e., October to December) in the field. Since the major challenge in onion offseason cultivation are bolting and higher frequency of bulb splitting/ doubling, observations on these undesirable characteristics were given primary consideration at preliminary stage (Table 12). Punjab White performed best with respect to production of whole bulbs yielding highest number of whole bulbs compared to other varieties at all dates of planting except 1st July, 2020.The best date for planting was observed to be 15th July, 2020 where highest number of whole bulbs were observed in most of the varieties. This date was also among the dates that produced no bolters. All the dates before and after 15th July,2020 produced up to 90 to 100 per cent split bulbs in one or the other variety (Table 10). In conclusion, during the next season variety Punjab White and planting date of 15th July, 2020 will be given more consideration

Table 12. Data on per cent whole bulbs and low bolting at different dates of bulb-set planting of different varieties on onion.

Varieties	% whole bulbs	% split bulbs	% bolting	Varieties	% whole bulbs	% split bulbs	% bolting
01.07.2020				**15.07.2020**			
Punjab White	20	80	0	Punjab White	0	0	0
Punjab Naroya	30	70	0	Punjab Naroya	0	0	0
Arka Kalyan	0	100	70	Arka Kalyan	0	0	0
PRO-7	40	60	0	PRO-7	0	0	0
PRO-6	10	90	0	PRO-6	0	0	0
Bhima Shakti	0	100	70	Bhima Shakti	0	60	0
P-305	10	90	20	P-305	0	0	0
30.07.2020				**14.08.2020**			
Punjab White	50	50	0	Punjab White	0	0	0
Punjab Naroya	0	100	0	Punjab Naroya	0	0	0
Arka Kalyan	0	100	0	Arka Kalyan	0	0	0
PRO-7	40	60	0	PRO-7	0	0	0
PRO-6	0	100	0	PRO-6	0	0	0
Bhima Shakti	10	90	0	Bhima Shakti	0	0	0
P-305	0	100	0	P-305	0	0	0
30.08.2020							
Punjab White	80	20	0	PRO-6	0	0	0
Punjab Naroya	20	80	0	Bhima Shakti	0	0	0
Arka Kalyan	10	90	0	P-305	0	0	0
PRO-7	60	40	0				

Regional Station Mukteshwar

Evaluation of vegetable germplasm

In capsicum, five genotypes were evaluated for their growth and yield parameters. Highest plant height 68.9 cm and average fruit weight 332.0 g were recorded in genotype CITH-M-SP-Sel-5 and CITH-M-SP-Sel-2, respectively. Whereas, number of branches/plant 3.5 and fruit length 77.6 mm were recorded in CITH-M-SP-Sel-5. In parthenocarpic cucumber, 5 genotypes were evaluated for their growth and yield parameters. Highest plant height 295.0 cm and average weight of five fruits 4.7 kg was recorded in genotype JLG. Whereas, number of fruits/plant (60.0) and fruit length (32.8 cm) recorded in Multi Star and JLG, respectively. In cherry tomato Nine genotypes were evaluated for their growth and yield parameters. Highest plant height 3.2 m and average weight of five fruits 90.0 g was recorded in genotype CITH-M-CT-1 and CITH-M-CT-7, respectively. Whereas, number of fruits/plant 446.0 and TSS (8.1 ^{0}B) recorded in CITH-M-CT-6 and CITH-M-CT-2 (Yellow), respectively.

Different genotypes of cucumber, cherry tomato and capsicum

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

Two crosses (Ambri x Redlane & Ambri x *Malus floribunda*) were made to introgress traits like scab resistance and fruit colour to apple cultivar Ambri from columnar apple cultivar Redlane and wild apple species *Malus floribunda*. About 4000 seedlings obtained from these crosses were raised and grafted on M-9 apple clonal rootstock for further evaluation. In addition, evaluation of apple hybrids obtained from previous crosses was done to identify the superior hybrids with respect to traits like scab resistance, fruit quality, pollinizer ability etc. Six apple hybrids were evaluated for fruit quality traits *viz* antioxidative and free radical scavenging potential. Studies revealed that superior quality parameters with respect to TSS, acidity, ascorbic acid content, fruit weight and bioassays were obtained in hybrids with respect to their parents. Highest fruit weight was observed in Golden Delicious x Snow Drift (225.1g) followed by Prima x Ambri (184.2g) which is significantly higher than their respective parents Hybrid Priame (Prima x Ambri) is showing higher crop density, TSS, fruit weight and anti-oxidative potential over their parents in addition to scab resistance owing to presence of resistant gene analogue "*Vf*". Similarly scab resistant hybrid Pride (Prima x Red Delicious) posses higher fruit quality parameters viz a viz free radical scavenging potential. Ammol (Ambri x Mollies Delicious) and Amrit (Ambri x Top Red) do not have scab resistance but have better quality traits over their respective parents. Pritor (Prima x Top Red) is having scab resistant gene with better quality fruits having higher fruit size, TSS, firmness and phenol content with respect parents (Table 13). Six hybrids identified and evaluated for different quality parameters showed their potential for further promotion through commercialization. Their registration through NBPGR for obtaining INGR numbers and protection through PPV&FRA has been undertaken in addition to their release through IVRC for their popularization. Improvement of Ambri apple cultivar through mutation (gamma radiation) has been taken up with the objective for improvement of colour. About 4000 buds were irradiated for generating the mutant population. Radiation is proven as an effective method to increase the genetic variation within the species. Gamma radiation is the most preferred physical mutagen by plant breeders.

Table 13. Physio-chemical and Biological Analysis of Hybrids developed at ICAR-CITH, Srinagar

Parameters	Prima x Ambri (Priame)	Ambri x Mollies Delicious (Ammol)	Ambri x Top Red (Amrit)	Prima x Red Delicious (Pride)	Golden Delicious x Snow Drift (Golden Snow)	Prima x Top Red (Pritor)	Prima	Ambri	Mollies Delicious	Top Red	Red Delicious	Golden Delicious	Snow Drift
Weight (g)	184.2[b]	148.2[c]	129.5[e]	128.5[f]	225.1[a]	168.1[c]	119.2[e]	141.6[c]	134.2[c]	95.6[g]	145.3[c]	125.2[d]	178.5[a]
TSS (%)	19.0[a]	14.8[f]	16.8[d]	17.4[bc]	16.8[d]	17.5[b]	12.3[d]	14.1[b]	14.1[b]	15.2[a]	14.3[b]	15.0[a]	13.5[c]
Firmness (RI)	67.9[c]	55.3[f]	65.3[e]	64.8[d]	72.3[a]	70.2[ab]	60.1[c]	65.3[a]	55.6[e]	53.4[f]	64.2[b]	65.1[a]	59.7[d]
Acidity (%)	0.27[b]	0.23[d]	0.25[bc]	0.32[a]	0.22[d]	0.25[bc]	0.25[c]	0.29[b]	0.25[c]	0.23[d]	0.22[de]	0.33[a]	0.28[b]
Ascorbic Acid (%)	12.66[a]	10.91[d]	10.54[e]	11.38[b]	11.32[bc]	9.10[f]	9.23[d]	11.0[b]	11.81[a]	8.9	11.82[a]	10.20[c]	11.80[a]
Phenols (mgGAE/100g FW)	169.53 [d]	148.32[e]	202.31 [a]	160.43[d]	254.31[a]	210.23	163.7[d]	191.2[c]	132.18[f]	112.6[g]	142.3[e]	195.18[b]	225.16[a]
Flavonoids (mg QE/100g FW)	158.2[d]	116.23[f]	185.23[c]	129.33[e]	211.39[a]	198.12[b]	109.3[g]	135.2[e]	145.70[d]	197.2[a]	117.1[f]	178.23[c]	189.21[b]
Flavonols (mg QE/100g FW)	1.22[f]	1.65[cd]	2.08[a]	1.79[b]	1.69[c]	1.32[e]	1.87[c]	1.53[e]	1.01[g]	1.62[d]	1.24[f]	2.01[b]	2.54[a]
DPPH (µM AAE/g FW)	23.15[d]	28.1[b]	18.52[e]	23.51[c]	32.01[a]	18.33[e]	20.60[d]	19.61[f]	27.23[c]	20.34[e]	28.60[a]	17.23	28.15[b]
FRAP (µM $FeSO_4$/100g FW)	189.6[b]	220.15[a]	175.32[c]	158.13[d]	138.71[e]	134.91[f]	183.1[b]	179.4[c]	102.1[f]	129.8[e]	106.7	207.66[a]	174.10[d]

New apple Hybrids developed and Identified by ICAR-CITH, Srinagar

Six apple hybrids have been developed by ICAR-CITH, Srinagar with respect to traits like scab resistance, fruit quality and yield. These hybrids are being evaluated under different temperate regions of the country and will be released for the benefit of the farmers.

(Breeders involved in development and evaluation of these hybrids: J. I. Mir, O. C. Sharma, D. B. Singh, K. K. Srivastava, N Ahmed, W H Raja, S. U. Nabi, G Malik, S. Yasmeen, S N Kirmani and M A Sheikh).

1. <u>PRIAME</u> (Prima X Ambri)

Priame is hybrid between Prima and Ambri. It matures one week later than Prima but two months prior to Ambri *i.e.*, in 2nd week of August. It is scab resistance due to presence and expression of Vf (Rvi6) gene. It produces larger fruits (184 g) than parents Prima (120 g) and Ambri (140 g) with moderate acidity (0.27%). Fruits have higher TSS (19°B) than Prima (12.5 °B) and Ambri (14 °B). Firmness of fruits is also higher (68 RI) than Prima (60 RI) and Ambri (65 RI) which contributes to higher shelf life. Fruits have higher phytoanticipins having 170 mgGAE/100g FW phenols, 160 mg QE/100g FW flavonoids and 1.22 mg QE/100g FW flavanols. The anti-oxidative and free radical scavenging potential is significantly higher than parents. The DDPH activity of hybrid is 23.15 µM AAE/g FW against Prima (20 µM AAE/g FW) and Ambri (19.61 µM AAE/g FW) and FRAP activity is 190 µM FeSO4/100g FW in comparison to Prima (183 µM FeSO4/100g FW) and Ambri (179.4 µM FeSO4/100g FW). Thus, in addition to Resistant Gene Analog (Vf gene) this hybrid posses' additional resistance due to presence of higher phytoanticipins

Hybrid		Prima	Ambri
	 		

2. PRIDE (Prima X Red Delicious)

Pride is hybrid between Prima and Red Delicious. It matures ten days later than Prima but forty days prior to Red Delicious (i.e., in 3rd week of August). Scab resistance is due to presence and expression of Vf (Rvi6) gene. Fruit size is moderate (130 g) with respect to parents Prima (120 g) and Red Delicious (145 g) with moderate acidity (0.30%). Fruits have higher TSS (18°B) than Prima (12.5 °B) and Red Delicious (14.3 °B). Firmness of fruits is also higher (65 RI) than Prima (60 RI) and Ambri (64.2 RI) which contributes to its higher shelf life. Fruits have higher phytoanticipins having 160 mgGAE/100g FW phenols, 130 mg QE/100g FW flavonoids and 1.79 mg QE/100g FW flavonols. Anti-oxidative and free radical scavenging potential is moderate. DDPH activity of hybrid is 23.51 µM AAE/g FW against Prima (20 µM AAE/g FW) and Red Delicious (28.0 µM AAE/g FW) while FRAP activity is 158 µM FeSO4/100g FW in comparison to Prima (183 µM FeSO4/100g FW) and Red Delicious (106.4 µM FeSO4/100g FW).

Hybrid		Prima	Red Delicious
			

3. AMMOL (Ambri x Mollies Delicious)

Ammol is hybrid between Ambri and Mollies Delicious. It matures three weeks later than Mollies Delicious and forty days prior to Ambri *i.e.* in 4th week of August. Fruit size is higher (150 g) than parents Ambri (140 g) and Red Delicious (145 g) with moderate acidity (0.23%). Fruits have same TSS (15°B) than Ambri (14 °B) and Red Delicious (14.3 °B). Firmness of fruits is moderate (55.5 RI) with respect to Ambri (65 RI) and Mollies Delicious (55 RI). Fruits have moderate phytoanticipin content, having 148 mg GAE/100g FW phenols, 116 mg QE/100g FW flavonoids and 1.65 mg QE/100g FW flavanols. Anti-oxidative and free radical scavenging potential is significantly higher. DDPH activity of hybrid is 28. 1 µM AAE/g FW against Ambri (19.6 µM AAE/g FW) and Mollies Delicious (27.0 µM AAE/g FW) and FRAP activity is 220 µM FeSO4/100g FW in comparison to Ambri (179.4 µM FeSO4/100g FW) and Mollies Delicious (102.1 µM FeSO4/100g FW).

Hybrid		Ambri	Mollies Delicious
			

4. <u>AMRIT</u> (Ambri x Top Red)

Amrit is hybrid between Ambri and Top Red. It matures one week after Top Red and two weeks before Ambri *i.e.,* in last week of September. Fruit size is moderate (130 g) than parents Ambri (140 g) and Top Red (95 g) with moderate acidity (0.25%). Fruits have higher TSS (17^{o}B) than Ambri (14 ^{o}B) and Top Red (15.2 ^{o}B). Firmness of fruits is high (65.3 RI) as Ambri (65 RI) than Top Red (53.4 RI). Fruits have higher phytoanticipin content, having 202 mg GAE/100g FW phenols, 185 mg QE/100g FW flavonoids and 2.08 mg QE/100g FW flavanols. Anti-oxidative and free radical scavenging potential is moderate. DDPH activity of hybrid is 18. 52 µM AAE/g FW against Ambri (19.6 µM AAE/g FW) and Top Red (20.4 µM AAE/g FW) while FRAP activity is 175.32 µM FeSO4/100g FW in comparison to Ambri (179.4 µM FeSO4/100g FW) and Top Red (129.8 µM FeSO4/100g FW).

Hybrid		Ambri	Top Red
			

5. <u>GOLDEN</u> SNOW (Golden Delicious X Snow Drift)

Golden Snow is hybrid between Golden Delicious and Snow Drift. It possesses pollinizer ability/ quality of Golden Delicious and russeting tolerance from Snow Drift. It is late in maturity (three weeks after Snow Drift and 50 days before Golden Delicious i.e., in first week of October. Fruits are larger in size (225g) than parents Golden Delicious (130 g) and Snow Drift (178 g) with moderate acidity (0.22%). Fruits have higher TSS (16.8^{o}B) than Golden Delicious (15 ^{o}B) and Snow Drift (13.5 ^{o}B). Firmness of fruits is high (72 RI) than Golden Delicious (65 RI) and Snow Drift (59.5 RI). Fruits have higher phytoanticipin content, having 254 mg GAE/100g FW phenols, 211 mg QE/100g FW flavonoids and 1.70 mg QE/100g FW flavanols. Anti-oxidative and free radical scavenging potential is very high. DDPH activity of hybrid is 32 µM AAE/g FW against Golden Delicious (17.6 µM AAE/g FW) and Snow Drift (28.1 µM AAE/g FW) while FRAP activity is 138.50 µM FeSO4/100g FW in comparison to Golden Delicious (207 µM AAE/g FW) and Snow Drift (174 µM AAE/g FW).

Hybrid		Golden Delicious	Snow Drift
			

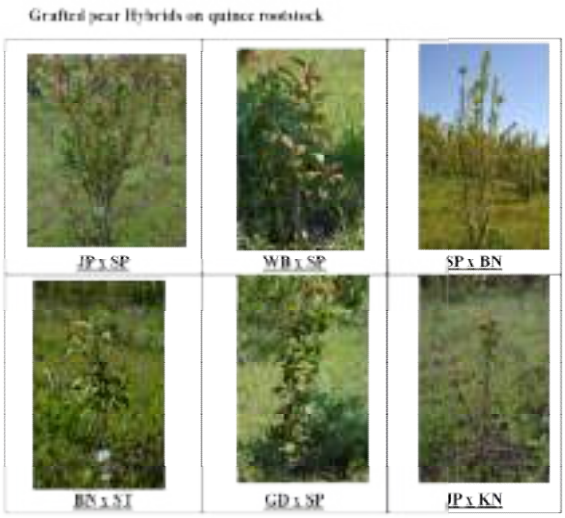
6. PRITOR (Prima x Top Red)

Pritor is hybrid between Prima and Top Red. The scab resistance is due to presence and expression of Vf (Rvi6) gene. Maturity time is similar to Top Red but seven-eight weeks after Prima i.e., in 3rd week of September. Fruit size is higher (170g) than parents Prima (120 g) and Top Red (95 g) with moderate acidity (0.25%). Fruits have higher TSS (17.5°B) than Prima (12.5 °B) and Top Red (15.2 °B). Firmness of fruits is high (70.2 RI) than Prima (60 RI) and Top Red (53.4 RI). Fruits have higher phytoanticipin content, having 210 mgGAE/100g FW phenols, 198 mg QE/100g FW flavonoids and 1.32 mg QE/100g FW flavanols. Anti-oxidative and free radical scavenging potential is moderate. DDPH activity of hybrid is 18. 6 µM AAE/g FW against Prima (20 µM AAE/g FW) and Top Red (20. 4 µM AAE/g FW) and FRAP activity is 135 µM FeSO4/100g FW in comparison to Prima (183 µM AAE/g FW) and Top Red (129.8 µM AAE/g FW).

Hybrid		Prima	Top Red
			

PEAR

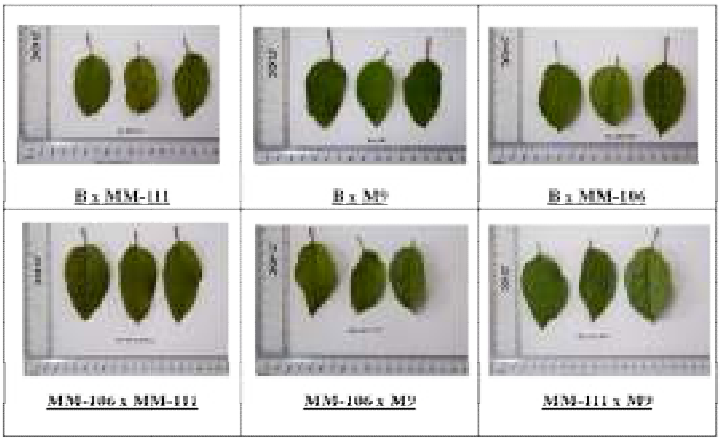
In the ongoing pear improvement programme, crosses raised during the crossing programmes has been top worked during the year 2019 on BA-29-C Rootstock and are in fruiting this year. The population obtained out of crossing done in 2019 has been raised in pots and is under evaluated for quality related traits (colour, bearing).



Rootstock breeding in apple

During the year 2019, crossing was preformed between *Malus baccata* L. with different Malling and Malling Merton series rootstocks as well as between t Malling and Malling Merton series of apple rootstocks apple for pollen compatibility studies and rootstock improvement. The population raised during the previous years will be subjected to evaluation for root rot and collar root and drought, dwarfness and multiplication in stool beds.

Crossed population of apple rootstocks under evaluation for drought



Variation in leaf traits of apple rootstocks population raised.

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

Characterization and expression of flower development genes

Whole genome transcriptome analysis between early flowering (Shalimar, Waris and Nonpareil) and late flowering (Tardy Nonpareil, Ferragnese and Ferralise) almond cultivars has been done to identify the genes and pathways differentially expressed in either early flowering or late flowering genotypes. Phenological stage development and flowering time in different almond varieties has been studied with respect to effect of GDH/GDD accumulation on flowering time and phenological development. Breeding for introgression of late flowering trait in commercial varieties of almond will be initiated during 2021 after completing comparative transcriptome studies. Transcriptome studies provided insights about the genes/markers associated with late flowering and nut quality. These identified markers will be very useful in selection of hybrids possessing traits like late flowering and better nut quality in early stages to speed up the breeding programme in almond. In this study comparative transcriptome analysis. In this study comparative transcriptome analysis was performed between early flowering almond cultivars and late flowering almond cultivars to identify regulators and pathways that are involved in the flowering time and nut quality of these cultivars. Bioinformatics analysis of high-quality reads was processed through denovo master assembly, unigene identification, pathway analysis, CDR, SSR identification and identification of DEGs (Fig 6). Differentially expressed genes (DEGs) were identified between the cultivars in flower as well as in leaf samples. Large number of these DEGs was related to flower development, flowering time, plant hormone pathways, sugar metabolism, cell wall biosynthesis, cell cycle regulation etc. Comparisons made for annotated proteins of DEGs using NR, UNIPORT, KOG and PFAM are shown in Ven diagram (Fig 7).

Heatmap for significantly expressed differential genes in leaf and flower samples of early and late flowering almond cultivars

Top 50 most significant differentially expressed genes having annotation were used for plotting Heatmap. Pheatmap package from R software was used for producing Heatmap. Pheatmap representing most significant genes expressed in the leaf and flower samples plotted using log10 of normalized read count values (CPM) for Leaf vs Flower, where shades of blue represent down regulated genes and shades of red represents highly expressed genes (Fig 8).

Fig 6. Bioinformatics analysis workflow

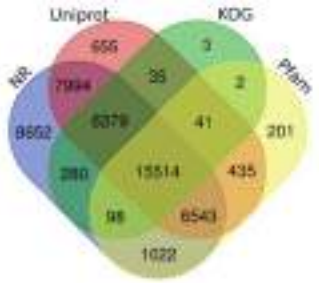


Fig.7. Venn diagram for annotated proteins in different database

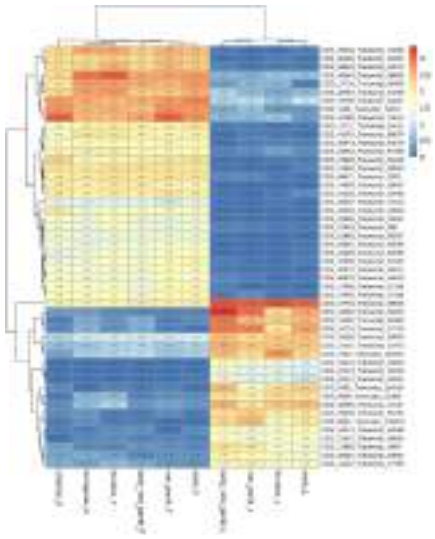


Fig.8. Heatmap representing most significant genes expressed in the samples was plotted using log10 of normalized read count values (CPM) for Leaf vs Flower, where shades of blue represent down regulated genes and shades of red represents highly expressed genes.

Breeding for development of superior varieties/hybrids in Solanaceous crops

In chilli, capsicum and brinjal 100, 60 and 40 genotypes were grown for seed production, respectively, however, evaluation for yield and related traits was done only in promising genotypes selected for further evaluation in IET at national level under AICRP-VC. The data obtained is presented in the Table 14.

Table.14. Performance of some elite genotypes of Solanaceous vegetables

S.No.	Crop	Genotypes	Yield (q/ha)	Fruit length (cm)	Fruit width (cm)
1	Capsicum	Gold-sel-01	354.90	7.18	6.35
		Cith-sp-31	826.50	5.88	7.20
		N-4-1-1	597.80	6.67	6.27
		Cith-sp-4	183.10	2.97	4.98
		CW-4-1/15	780.80	7.18	7.00
		NS-284-1-1-15	864.50	6.42	7.07
		Nishat-1 sel-05	597.30	7.43	7.97
2	Chilli	CITH-HP-111-1	372.75	8.55	3.08
3	Brinjal	B-SB-2	416.68	22.00	2.98

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

The bulbs of F1 generation of crossings between short day male sterile lines and long day onion genotypes Brown Spanish, Yellow Globe, CITH-O-1, CITH-O-2, CITH-O-33 and CITH-O-33-1 were planted in 2020 season for obtaining flowering in May-June, 2021 in order to score for male sterile plants, morphologically

ICAR-CITH, RS Dirang (Arunachal Pradesh)

The establishment of experimental field for research is going on at ICAR-CITH Regional Station Dirang (Arunachal Pradesh). New varieties of apple, peach, apricot, almond and walnut were planted in mother orchards at ICAR-CITH, Regional Station, Dirang. Official formalities for transfer of land to ICAR-CITH, Regional Station, Dirang (30 ha) was further initiated. The plants of different crops are in vegetative phase so evaluation data can be presented in coming years.

Crop Production

The temperate horticulture industry of India has witnessed many production problems arisen from time to time and were solved through scientific interventions to reach the present-day scenario. But it is not sufficient because the productivity level is still low compared to advanced countries. There are many factors responsible for the low productivity including lack of quality planting material coupled with production technologies like training, pruning, nutrient and water management, pollination, post-harvest handling, diseases, and pest management which ultimately decides the benefit to the farmer. 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 departments, and research organizations. The demand for institute planting material along with production technology is increasing year after year. During the year 2020, the institute has supplied about 35392 plants of different temperate fruit crops besides the supply of about 14000 scion wood. In vegetables, 292.38 kg of seed was produced in vegetable crops and supplied/ sold to different stakeholders and consumers like kitchen gardeners, vegetable growers, research organizations, etc. Besides this, more than 25000 seedlings of elite varieties of different seasonal vegetable was also produced and supplied to the farmers During the year 2020 emphasis was given to the multiplication and commercialization of walnut varieties released by ICAR-CITH, Srinagar. About 11000 grafted plants of walnut were provided to Uttarakhand Forest Resource Management Project for the establishment of mother orchards under project promotion of walnut in Uttarakhand funded under Japan International Cooperation Agency (JICA). Revenue of 62.71 lakh was generated at ICAR-CITH, Srinagar by the sale of quality planting material and farm produce. At Regional Station Mukteshwar, Moreover 27735 Nos. planting materials of various horticultural crops as well as 1064.5 kg vegetable seeds were supplied to the farmers/government agencies/NGOs and generated the farm revenue of Rs. 430549. The outcomes of various experiments on the production aspect for generating farmer-friendly technologies presented below:

Development of almond based intercropping system involving saffron

Saffron is one of the important crops called golden spice, mainly grown in Kashmir and up to a limited extent in other areas of the country. Due to numerous production problems, the productivity of the crop is low, leading to fewer returns to the farmers. So to avoid losses to farmers an attempt has been done to develop an almond-based intercropping system involving saffron. In almond, many types of varieties having diverse growth habits viz. erect, semi-erect, and spreading types were tried along with sole saffron crop and effect of various almond varieties was studied on the growth and saffron yield. The highest saffron yield was recorded in the Sole saffron crop (2.488kg/ha) followed by Saffron-erect almond varieties (2.123kg/ha), Saffron-semi-erect (1.876 kg/ha), and Saffron-spreading (1.884 kg/ha) type of almond varieties. The highest almond yield (q/ha) was recorded in the Saffron-spreading type (18.06 q/h) followed by Saffron-semi-erect (9.62 q/h) and saffron- erect (8.21 q/h) type of almond variety, respectively. The highest almond-saffron equivalent yield (3.686 kg/ha) was recorded in

spreading type followed by erect type (2.944 kg/ha) and semi-erect type (2.848 kg/ha). The saffron planting was done 8 to 9 years back which has resulted in the development of corm rot diseases leading to a reduction in saffron yield. So, keeping saffron for many years is not desirable and replacement/ planting after few years is always advisable To avoid disease incidence and severity proper disease management practices must be undertaken for better saffron yield. The non-significant effect has been observed for most of the other plant and flower-related traits. Thus saffron-almond is the best system and there is less effect of almond varieties having different growing habits on growth traits of saffronand can give an additional return benefit farmers especially to compensate the losses during adverse biotic and abiotic stresses. The varieties especially the spreading type can give higher returns to the growers due to higher almond yield which is due to a varietal potential as more number of spurs due to large canopy sphere. Besides this effect of various planting systems i.e. raised bed planting, ridge and furrow, and flatbed was also analyzed on yield of saffron. The highest saffron yield (3.89 kg/ha) was recorded in raised bed system followed by ridge & furrow (3.36 kg/ha) and minimum in the flatbed system (2.96kg/ha). Slight earliness was also observed in a raised bed as compared to other methods of plantings.

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

For evaluation of integrated nutrient management of vegetables as intercrop in the apple orchard, the technology was demonstrated to the farmer under MGMG adopted villages at Sunkiya during the year 2020. The main objective of programme was to promote crop diversification for sustainable production and to utilize better space as well as natural resources per unit area without eroding soil health for enhancing production per unit area.

Enhancing multiplication rate of clonal rootstocks of temperate fruit crops under protected conditions

Rootstock is the most essential component of commercial fruit production and its potential has been well exploited in temperate fruit crops in different countries. With the continuous breeding efforts, number of rootstocks have been developed to mitigate biotic and abiotic stresses beside the effect on plant vigour. Owing to high returns from high density plantation, the demand for rootstock is increasing day by day. So there is urgent need to enhance the multiplication rate, so that demand can be fulfilled and production and productivity can be increased. To enhance different multiplication rate in rootstocks following experiments were carried out:

Effect of length of cuttings and growing medium on routings of cuttings under protected conditions

Clonal propagation of rootstock through cuttings is of special importance as it is a supplementary means to increase the production of rootstock to utilize the aerial portion of stool layers above the grafting point. The Tip portion of shoots is usually discarded because they are usually low in stored carbohydrates and often contain unwanted flower buds. The remaining portion of

rootstock can be used for cuttings and converted into rooted plantlets to increase the multiplication rate of three important clonal rootstocks of apple. Keeping in view these facts, an experiment was framed to select the most appropriate cutting size (15 cm, 20cm, 25cm, and 30 cm) for three clonal rootstocks of apple MM-106, MM-111, M-9. The four best three rooting mediums comprising of. Sand, Coco peat 100%, Coco peat 50% +Vermiculite 50%, Coco peat 75%+ Vermiculite 25%, from the previous experiment were employed for propagation. The hardwood cuttings of (15 cm, 20cm, 25cm, 30 cm) length having 7-9 buds were prepared from dormant twigs of rootstock. Before planting in the pots, the cuttings were placed in fungicidal treatment (Carbendazim 0.03%) for 10-15 minutes. Later basal portion of the cuttings was dipped in IBA. 3000 ppm, for 1-2 minutes and planted in plastic pots (25cm× 20 cm) filled with rooting medium in the first week of March. After planting, regular cultural practices for nursery raising were followed. The pots were given water at regular intervals to avoid dying. After planting the growth will start and all active buds from base to top on cuttings will sprout. When the shoots on cuttings will attain 3-5cm growth, only vigorously growing uppermost shoot was kept rest were removed. Various parameters related to rooting of cuttings, the average number of roots, length of root, root girth, root weight, plant height, plant girth, root fresh weight, root dry weight were recorded.

In case of clonal rootstock MM106, 100% rooting was recorded in with the cutting size (30cm) by employing rooting medium (Coco peat+Vermiculite @75:25), followed by the same rootstock (98.2%) in cutting size 25cm planted in rooting medium consisting of Cocopeat+Vermiculite (75:25). The minimum rooting percentage of 2.01% was recorded in rootstock M-9-pajam with cutting of size 20cm planted in rooting medium (Coco peat+Vermiculite @ 50:50). Maximum root length was recorded in rootstock M-9 Pajam (28.33mm) in 20cm cuttings with the rooting medium (Coco peat+Vermiculite @75:25) and minimum (5.3mm) also M-9 Pajam in 15 cuttings with the rooting medium (Coco peat+Vermiculite @50:50). The highest root diameter (16.2.15mm) was recorded in the rootstock MM-111, in cuttings size 30cm with the rooting medium cocopeat (100%), followed by M-9 Pajam (5.36mm) with the same rooting medium, but in 25cm cutting size. The minimum root diameter was recorded in the rootstock M-9 Pajam (0.56 mm) when rooting medium consisting of Coco peat+Vermiculite @50:50) was employed. The maximum number of adventitious rooting (12.2) was recorded in rootstock MM-106 with the rooting medium cocopeat 100% when the cutting size was 30cm. The minimum no of adventitious roots was recorded in M9-Pajam (3.04) in 15cm cutting in rooting medium sand. The maximum fresh weight (19.4g) and roots dry matter were recorded in rootstock MM-111 with rooting medium cocopeat (100%) with cutting length 30cm and minimum root fresh weight. (0.6g) and dry weight. (0.1g) were recorded in the rootstock MM-106 with the treatment consisting of Coco peat+Vermiculite (50:50) in 15cm cutting size (Fig.10)

Hence, it can be concluded that 30 cm cutting size along with the treatments Coco peat+Vermiculite @ 75:25 and Cocopeat 100% are the best for raising the cutting under greenhouse conditions, but the problem with treatment Coco peat+Vermiculite @ 75:25) is that requirement of water is more in comparison to Cocopeat. So, this technology has the scope will

revolutionize the rootstock production in the country and can be instrumental in increasing the multiplication rate of rootstocks thereby increasing the availabilities of rootstocks that will ultimately reduce the cost of planting material.

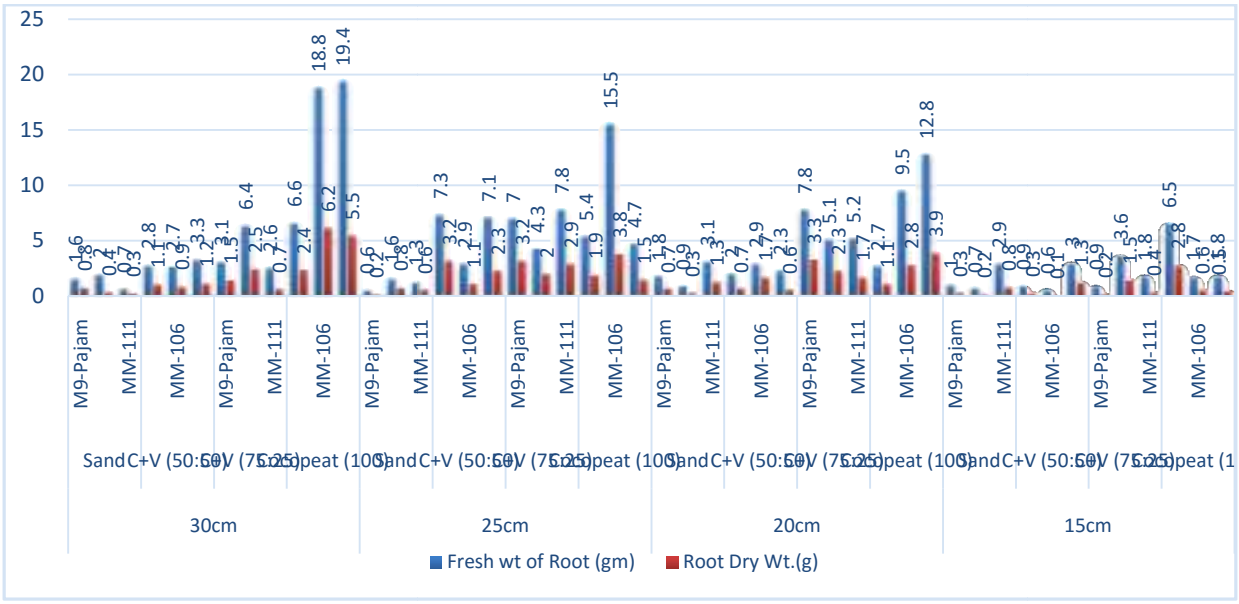


Fig. 10. Effect of cutting size and media on fresh and dry root weight in different rootstocks of apple

Different stages of rooting of cutting in soilless rooting medium under protected conditions.

Propagation of clonal rootstocks of apple through cutting under greenhouse

To reduce the cost of production, ease in operations and to make technology more feasible & friendly for nurserymen an experiment was done by planting the cutting in soilless beds. The cuttings of one-year-old and greenhouse are essential for successful propagation because maintaining high humidity around the cutting is critical particularly in early stage**.** Sunken beds of dimensions of 2.5 0 ft (76cm wide) and 1.0 ft (30cm) depth were prepared by digging out the upper 1.0 ft soil. After preparing the sunken beds the beds were filled with sand and cocopeat. The lower 6 inches (15cm) of the bed were filled with sand and the upper 6 inches (15cm) with cocopeat. The purpose of digging out soil from the filled it with sand and cocopeat to make soilless beds for conducive conditions for cuttings and to avoid weed problem and reduce the water requirement considerably. Lower 6 inches of the bed were filled with well coarse sand to facilitate proper drainage and the upper portion of the bed 6 inches with cocopeat for planting the cuttings in it. The width of the beds was kept less to facilitate important operations like pinching, weeding, watering and spray of plant protection chemicals, however the length of bed can vary depending upon the space available.. The cuttings of 30 cm size and pencil thickness (5-6 mm) with 8-9 buds were selected and lower portion of the cuttings was given a horizontal cut and light cut on either side of the cut stem at the base to expose more of the cambium for callusing. The cuttings were planted in the first week of March after fungicidal treatment and rooting hormone Indole Butyric Acid IBA (2500 ppm) for 2-3 minutes. The cuttings were planted in the soilless beds at a spacing of 3 inches (7.62 cm) both in rows and cutting to cutting accommodated 52 cuttings per sq. meter area. The cuttings will start sprouting within two weeks. When these shoots on cuttings will attain 3-5cm length, only vigorously growing uppermost shoot was kept rest were removed. The beds are regularly irrigated twice or once a week based on the temperature inside the greenhouse. Water was given by hose pipe at low intensity to avoid disruption of cuttings and growing medium. Initially up to June watering twice a week was sufficient afterward daily irrigation was given to avoid extreme temperatures in the greenhouse. Shade nets also have been installed to avoid drying of the cuttings and succulent leaflets inside the greenhouse. Although very little weeds growth was observed, weeds emerged if any were removed along with roots without disturbing the cuttings. The insects (aphids and Larval Fungal Gnats) and diseases (powdery mildew) were managed by plant protection chemicals. Important parameters like percentage of rooted cuttings, plant height, root length, root diameter, number of adventitious roots, root fresh weight and root dry weight was recorded at the end of the growth after leaf fall. From the data, it can be revealed that 84.3% of rooting was recorded in cuttings. Among the cuttings average plant height (115.93 cm), plant diameter (8.41mm), and average root length (32.13cm), average number of adventitious roots (12.31), root fresh weight (17.40 g) and dry weight. (8.80 g) were recorded (Fig11). More than 90% of rootstocks produced were suitable for grafting having a well-developed root system and clipper size above (6.0 mm). Among the total cuttings, more than 50% of cuttings have got the calliper size of above (5 mm) during the month of August-September, so budding has also been done for about 25% of plants with a success percent of above 90 %. The purpose of this was to reduce the cost of scion wood and prepare the plants for the coming season. The operation of budding inside the greenhouse

can be extended up to two to three weeks due to extended growing conditions available under protected conditions. By this technology, 40-45 plants with well-developed root system were harvested from per square meter area of the nursery. This technology will revolutionize the production of that the rootstocks are produced from the thrown-away part of the plant. By adopting this technology, the cost of rootstock/planting material will reduce and dependence on import for quality planting material will reduce drastically.

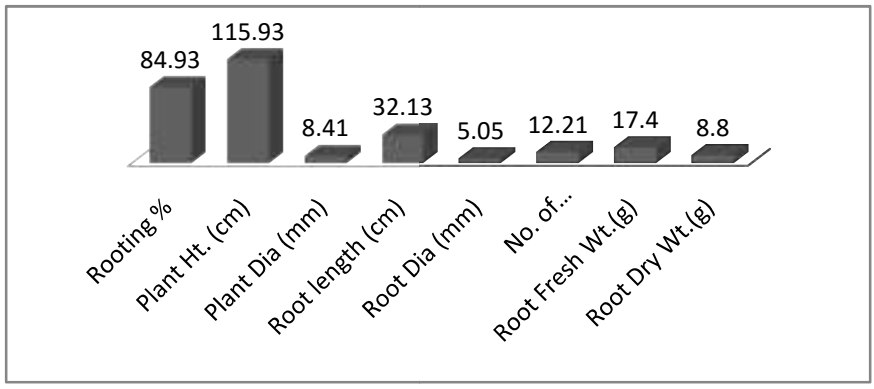


Fig. 11.Propagation of clonal rootstocks of apple through cutting in soilless beds

Different stage of nursery development using by cuttings in soilless beds under protected conditions

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

For enhancing the multiplication rate in clonal rootstocks of apple, under protected condition by modified layering, a trial was conducted during 2020 to find the effect of different rooting mediums on different root traits. Three rooting mediums including Cocopeat 100%, Perlite 100%, and Cocopeat 50+ Perlite 25 + Vermiculite 25 were employed. The rootstocks were planted during the year 2018 in a greenhouse. Clonal rootstocks (MM- 106, MM-111, 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 root related traits. The maximum plant height (126.20cm) was recorded in treatment C+P+V (50:25:25) in rootstock M9-T339 and minimum in substrate Perlite (68.60cm) in rootstock B-9. Maximum plant diameter (10.06mm) in P-22 with C+P+V (50:25:25) and minimum (6.08mm) in rootstock B-9 with treatment Perlite. Maximum root length (30.60cm) was recorded in Treatment Cocopeat in rootstock M9-Pajam and minimum (13.80cm) in rootstock M9-Pajam with treatment Perlite. Maximum root diameter (3.86mm) was recorded in Treatment C+P+V (50:25:25) in rootstock P-22 and minimum (1.97mm) in rootstock B-9 with treatment Perlite. The maximum number of adventitious roots (16.1) per plant were recorded in treatment Perlite in Rootstock MM-106 whereas the minimum number of adventitious roots (3.2) was recorded in treatment C+P+V (50:25:25) in rootstock B-9. The Maximum root fresh weight (10.20g) in treatment Perlite in rootstock MM-106, and minimum (1.20g) in rootstock B-9 with treatment Perlite. Maximum root dry weight (3.70g) was recorded in treatment Perlite in rootstock MM-106 and minimum (0.70g) in rootstock B-9 with treatment Perlite (Fig 12). One more thing which has done this year, that budding has been done in greenhouse conditions a plant is attained a sufficient girth, above (5 mm) upto to month of July and all the plants were found suitable for budding operation. The budding has been done to about 60% of clone with an almost 95% success rate.

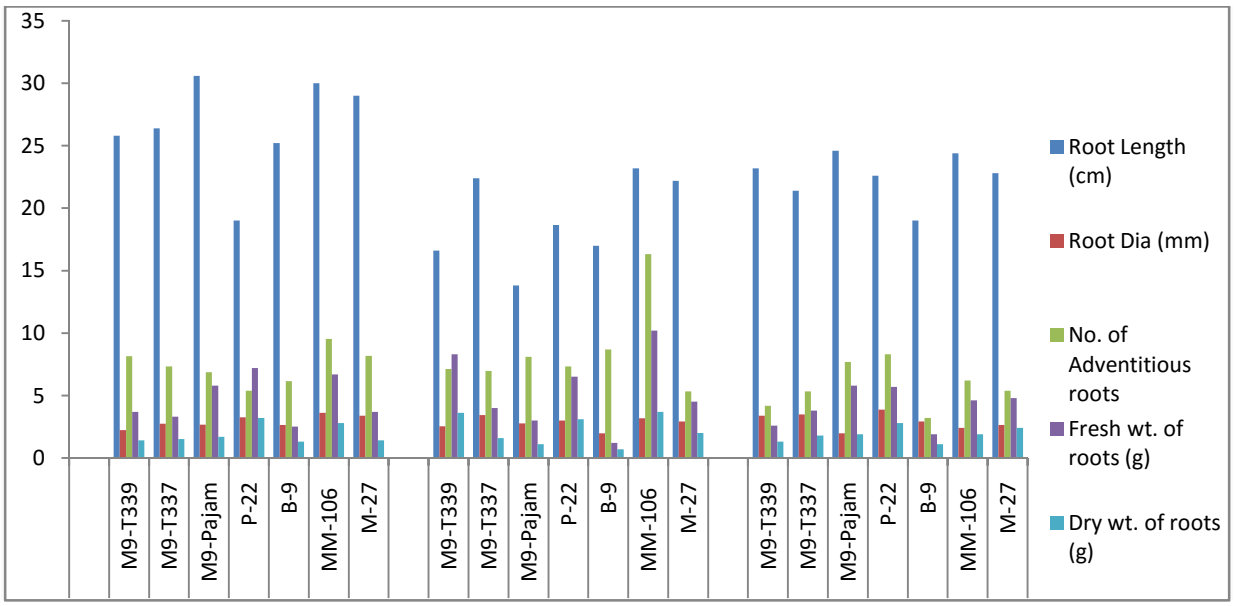


Fig. 12. Effect of different rooting medium on root traits in clonal rootstocks of apple under greenhouse conditions

Rooting in budded clonal apple rootstocks by employing different rooting medium under protected conditions

Technology for the vertical expansion of Nursery Under protected conditions using soilless rooting medium.

The experiment on the vertical expansion of the nursery was started during the year 2019, to utilize the available space in the greenhouse and to exploit the vertical growth of plants and success was achieved in apple clonal rootstock MM-106. During the year 2020, trial on air layering has been attempted in other clonal rootstocks including (M9, Pajam, T337, T339, MB-9, P-22, M-27). The plants having a diameter of (5 mm and above) at 30 cm (1.0 ft) above ground level were selected and wounding/incision has been given by sharp knife/blade and rooting hormones IBA (2500 ppm) was applied to the wounded portion. The wounding is done to the targeted region to expose the inner stem for applying the rooting compound. The treatment was started from the second week of June till the last week of August. Small polybags filled with rooting medium have been fastened at the points where rooting needs to be initiated. A lightweight substrate (Cocopeat) having high water holding capacity was used. Staking was done with the help of bamboo sticks to hold the bags in a proper position. Watering at regular intervals was done to keep the rooting media moist. Sufficient rooting has been recorded in all the rootstocks. From the data, it can be revealed that the maximum plant height (134.3cm) was recorded in rootstock MM-106 and minimum (89.17cm) in rootstock M9-Pajam while maximum plant diameter (8.77mm) was recorded in rootstock MM-106 and minimum (6.49mm) in rootstock P- 22. The highest number of plants per rootstock (3.9) was recorded in MM-106 whereas the minimum number of plants per rootstock (2.1) was recorded in rootstock M-27. Maximum root length (15.83cm) was recorded in rootstock M9-Pajam and minimum (9.67cm) in rootstock M9-T339. Maximum root diameter (2.39mm) was recorded in rootstock MM-106 and minimum (1.10mm) in rootstock B-9. The highest no. of adventitious roots (5.9) per plant was recorded in rootstock MM-106 whereas the lowest number of adventitious roots (2.1) was recorded in rootstock P-22. The highest root fresh weight (4.0g) was recorded rootstock M-106 and the lowest (2.1g) in rootstock M-27. Maximum root dry weight (3.70g) was recorded in in rootstock MM-106 and minimum (1.80g) in rootstock B-9 (Fig.13). This technology will be very useful in promoting the vertical expansion of the nursery in greenhouse conditions and number. of plants per unit area can be increased 3-4 times without utilizing any extra inputs. One more additional benefit of this technology is that under greenhouse conditions a plants attained a

sufficient girth, above (5mm) and all the daughter plants are suitable for budding operation. The budding has been done to about 45% of daughter plants with an almost 95% success rate. This technology not only produced the additional 2-4 plants but also the budded plants which added the further advantage to this technology that budded plants with well-developed root system are produced in one year of the nursery cycle.

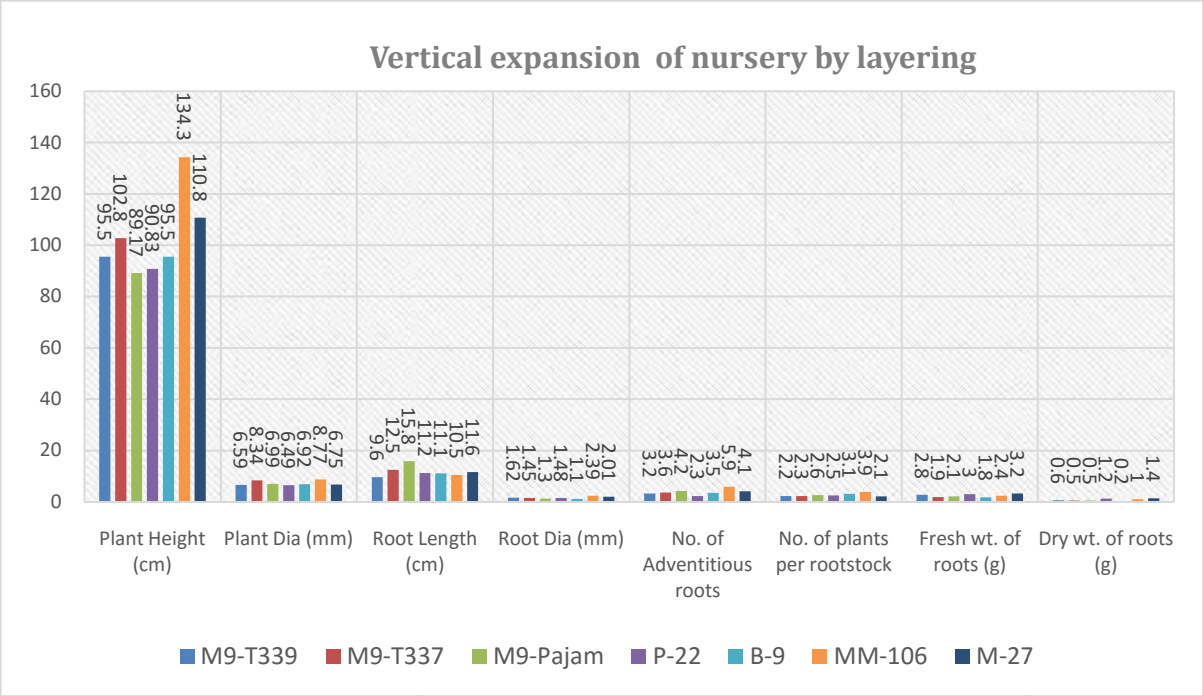


Fig. 13. Data on various parameters of different rootstocks under vertical expansion of nursery under protected conditions using soilless rooting medium.

Different stages of air layering technique in apple clonal rootstocks for vertical expansion of Nursery

Crop Protection

Elucidating the diversity, species spectrum and screening of germplasm against Alternaria spp. infecting temperate fruits

Survey of Alternaria leaf blotch of apple disease in Kashmir valley

Survey was conducted in various apple growing districts (Kupwara, Baramulla, Budgam, Bandipora, Pulwama, Shopian and Kulgam) of Kashmir to record the status of Alternaria leaf blotch (ALB) of apple. During the course of survey, Alternaria Leaf Blotch was observed on apple trees with varied degrees of incidence and intensity. Among the five districts surveyed, maximum Alternaria Leaf Blotch incidence and intensity of 80.15 and 48.85 percent, respectively was observed in Baramulla district followed by Pulwama district with incidence and intensity of 51.21 and 27.40 percent, respectively. While minimum disease incidence and intensity of 31.04 and 15.14 percent was observed in district Kupwara. Among the varieties observed, maximum Alternaria Leaf Blotch incidence and intensity of 87.12 and 62.5 percent, respectively was observed in Red Delicious cultivars fallowed by King Roat with 80.0 and 41.2 percent while minimum disease incidence and intensity of 9.2 and 5.1 percent, respectively was observed in Red Fuji. It was also observed that delicious varieties are more susceptible to Alternaria Leaf Blotch (Fig. 14 & 15).

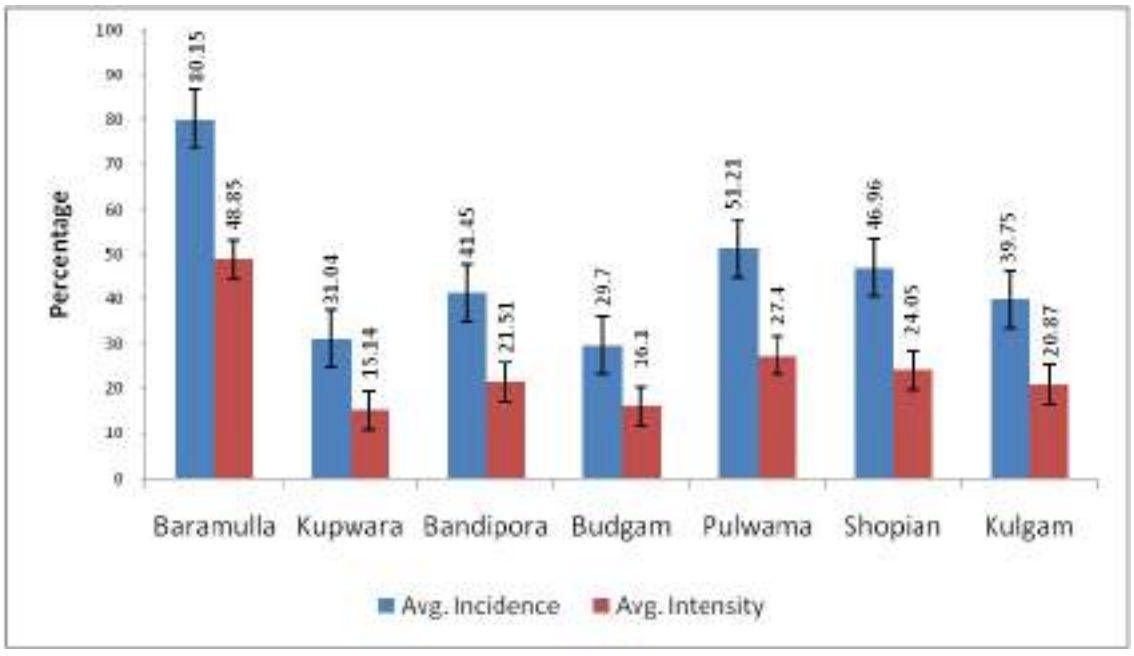


Fig 14. Average disease incidence and intensity of Alternaria leaf blotch in various districts of Kashmir valley

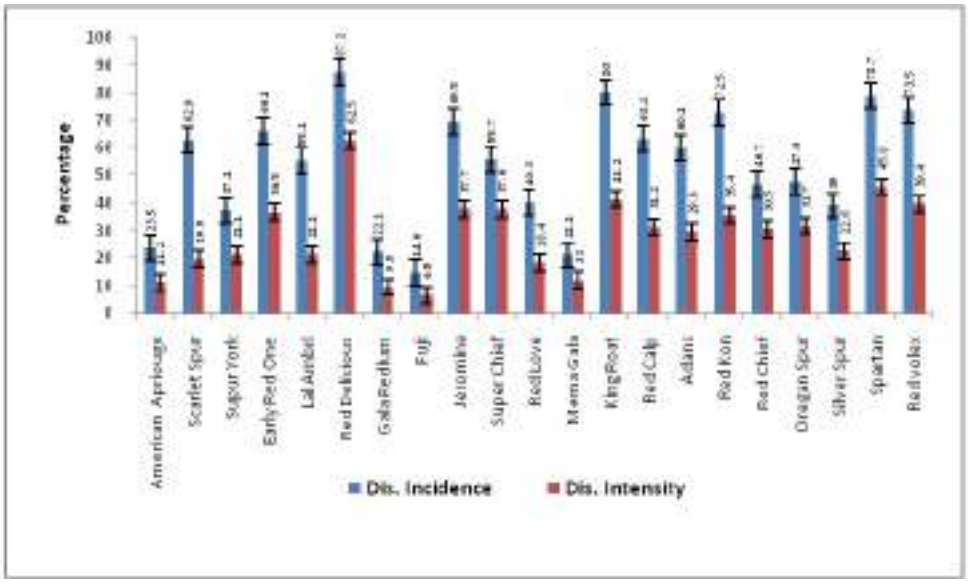


Fig 15. Average disease incidence and intensity of ALB in different apple varieties

Symptomatology

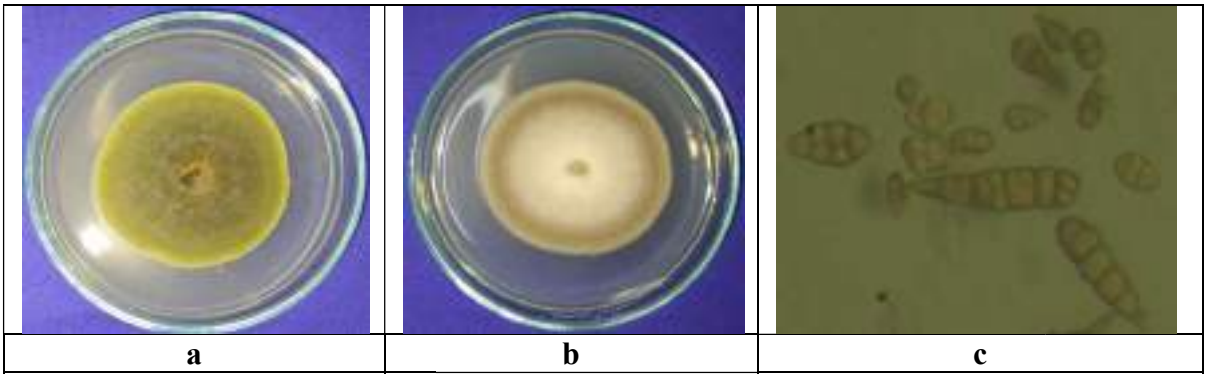
During the survey a small, round, purplish or blackish spots were observed on leaves with purplish border (a). In some orchards frog eye like symptoms or crescent-shaped rings were observed on leaves where infection rate is very high (b). The petiole infections were also observed which resulted in the yellowed leaves and premature defoliation (c). Severe defoliation was present in old and senile orchards of Delicious varieties which also resulted in premature fruit drop (d).

Alternaria leaf blotch		
	a	**b**
Alternaria leaf blotch		
	c	**d**

Symptoms of Alternaria leaf blotch of apple

Morphological Studies of Pathogen

The morphological characters of the fungus *Alternaria spp*. causing leaf blotch of apple were studied both *in-vitro* and *in-vivo*. On potato dextrose agar medium, the fungus exhibited olive green to brown colony color with circular concentric mycelium with or without fluffy growth (a, b). The conidia morphology, which are large and dark brown, multi-celled, catenate or single, ovoid or obclavate, often beaked, brown, with transverse and longitudinal septa. (c)



a	b	c

Plate: **a,b**-seven days old culture of *Alternaria spp.*, **c**- Conidia under microscope at 40X magnification

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

Screening of apple germplasm (varieties and rootstocks) for three viruses using DAS-ELISA

Screening was carried out in different varieties and rootstocks of apple for detection of three viruses (apple mosaic virus-ApMV, apple stem pitting virus-ASPV and apple stem grooving virus-ASGV) during the month of August 2020 using DAS-ELISA. Among 203 varieties screened, it was observed that only two varieties were found positive for ApMV, and none of the rootstocks were found infected with ApMV. Most of the varieties were found infected with both ASPV and ASGV.

Evaluation of rootstocks for sensitivity towards Mosaic disease

Among the 8 rootstocks evaluated for their effect on mosaic disease of apple cv. Golden Delicious. The mosaic or mosaic/necrotic symptoms were observed on six root stocks, viz, MM106, MM111, M26, M27, M9 and Pajam.The presence of both (mosaic and necrosis) or only mosaic observed on different rootstocks as shown in Table.15. No symptoms were observed on two root stocks i.e., M 9-T337 and M 9-T339. The development of symptoms on different rootstocks also varied from 70 to 80 days after grafting. The symptoms on two rootstocks viz., MM106 and MM111 were recorded 70 days after grafting. In other rootstocks the symptoms were observed after 80 days after grafting. The results showed that Malling Merton (MM) series shows symptoms earlier as compared to Malling series of rootstocks.

Transmission rate

The transmission rate of Apple Mosaic Diseases was observed differently on different rootstocks via grafting of scion from mosaic infected plants (Golden Delicious).The disease transmission rate using grafting varied from 0 to 100%. The highest was on rootstocks MM106 and MM111 with 100% and lowest on M 9-T339 and M 9- T337 with 0 per cent. The rate of transmission on rootstocks is shown in Table 15.

Table 15. Presence or absence of mosaic/ necrosis on various Root stocks and transmission rate of mosaic disease

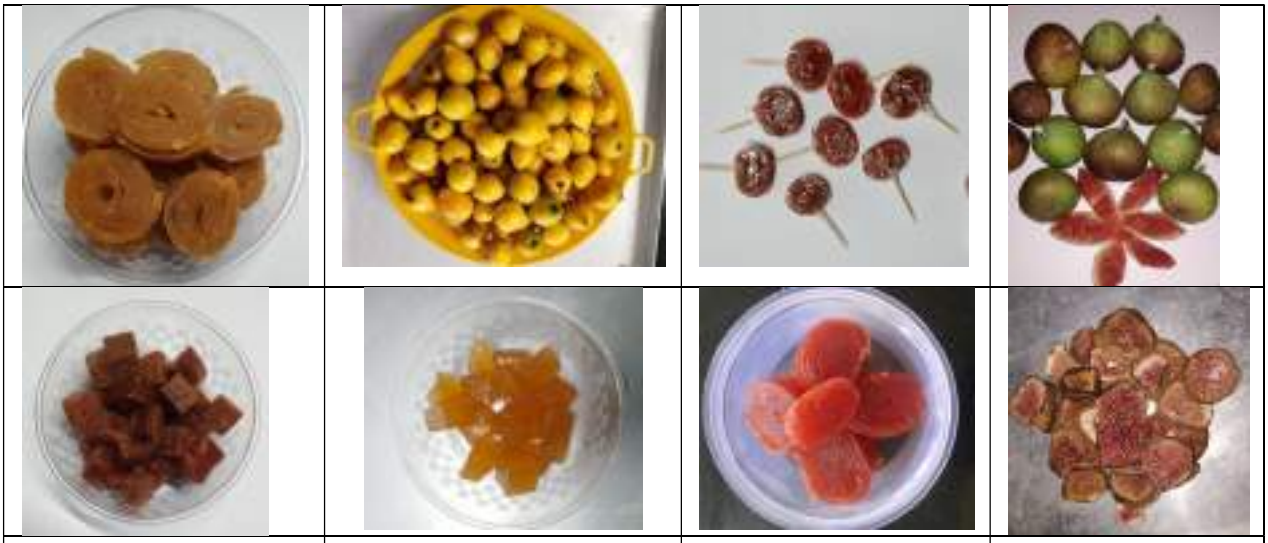
S.No	Root stock	Avg. No. of days for symptom development	Mosaic	Necrosis	Transmission rate (%)
1	**MM-106**	75	+	+	100
2	**MM-111**	75	+	-	100
3	**M-9**	80	+	+	66.6
4	**M-26**	80	+	-	66.6
5	**M-27**	80	+	+	66.6
6	**Pajam**	80	+	-	33.3
7	**M 9-T337**	-	-	-	0
8	**M 9-T339**	-	-	-	0

(+)- Presence (-)-Absence

Post-Harvest Technology

Refinement of process technology and up-scaling of product for demonstrations and exhibitions

Fruits and vegetables are characterized as the protective foods as they provide essential vitamins, minerals, dietary fibres, antioxidants and bioflavanoids. Accordingly, increased consumption of a variety of fruits and vegetables on daily basis is recommended for health benefits like reduced risk of certain form of cancers, coronary heart diseases, stroke and other chronic ailments. Although, country is a major producer of these crops, many Indians are still unable to get their daily requirements of fruits and vegetables as per the recommended daily allowance of 280-350g fruits and vegetables per capita per day. ICAR-CITH, Srinagar has developed value added products having better quality appearance, texture, flavor and nutritive value etc. During 2020, the process technologies were further refined for up-scaling the quality products. Licensing of the process technologies for different products will be taken up.



Quince candy	Loquat candy	Strawberry candy	Dehydrated fig

Process technology developed and refined for production of value added products developed during 2020

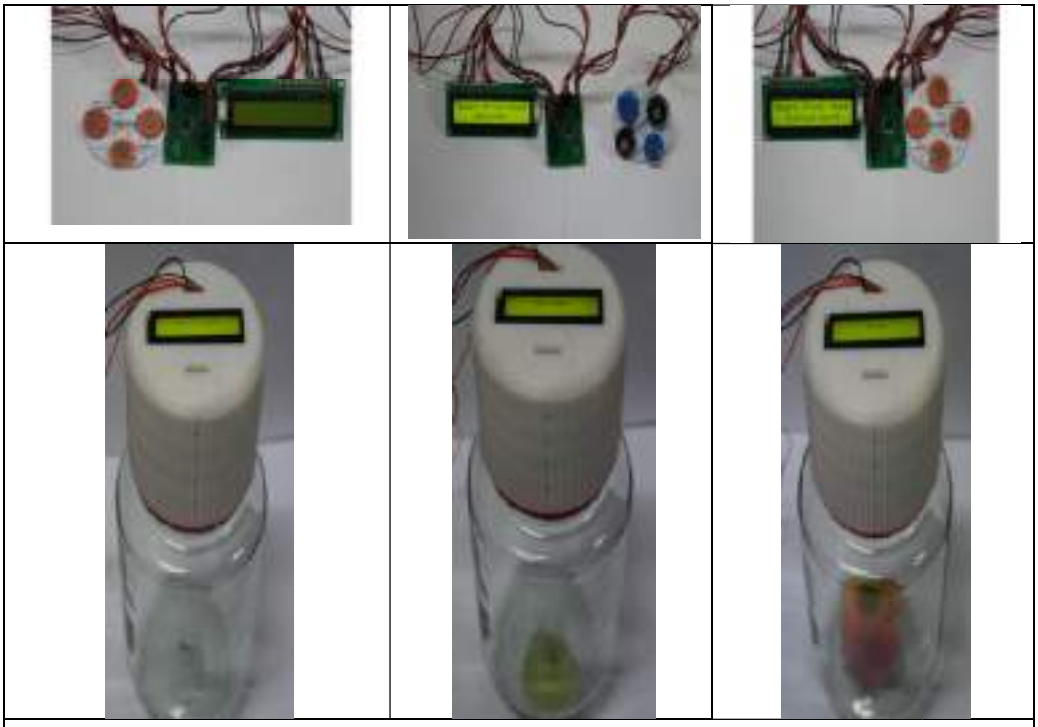
Externally Funded /Network projects

The work carried out in different externally funded /network projects along with outcome is briefly presented project wise below:

Development of an electronic nose sensor to determine the optimum harvesting time for apple and papaya

Activities done during 2020 by ICAR-CITH, Srinagar

The main objective of the project was establishment of ripening and quality associated metabolites for apple that serve as potential biomarkers for sensing using e-nose sensor. During 2020, samples of three varieties of apple (Shireen, Red Delicious and Golden Delicious) have been evaluated for various fruit quality traits like TSS, acidity, pH, firmness, ascorbic acid, color parameters, antioxidant activity, total phenols, flavonoids and flavanol content (Table 16). The samples of these three apple cultivars were collected at different pre and post-harvest stages and sent to IIT, Roorkee for further analysis. Electronic nose sensor was developed by IIT Roorkee with enhanced sensitivity of transducer using various combinations of a semiconducting thin film material to selectively sense ripening associated metabolites, also a mobile app was developed for easy application of sensor. Its validation in the field was done in ICAR-CITH, Srinagar and the data recorded was further re-validated by electronic nose under laboratory conditions (Table17).



E-Nose for apple – Prototype developed by IIT, Roorkee and evaluated for apple maturity indices and quality analysis

Table 16. Physicochemical parameters of apple cultivars at harvest stage

Parameters		Shireen	Red Delicious	Golden Delicious
Weight (g)		98.5^{c}	102.3^{b}	125.2^{a}
TSS (%)		16.3^{a}	14.1^{c}	15.0^{b}
Firmness (RI)		60.6^{c}	64.2^{b}	65.1^{a}
pH		3.25^{bc}	3.30^{b}	3.80^{a}
Acidity (%)		0.31^{a}	0.22^{b}	0.33^{a}
Ascorbic Acid (%)		9.21^{c}	11.80^{a}	10.20^{b}
Color	L	53.17^{b}	57.20^{a}	42.45^{c}
	A	15.63^{c}	20.41^{a}	19.56^{b}
	B	48.81^{a}	31.52^{b}	25.31^{c}
	Tint	-138.29^{c}	-121.4^{b}	-90.76^{a}
Phenols (mgGAE/100g FW)		159.5^{b}	142.3^{c}	195.18^{a}
Flavonoids(mgQE/100g FW)		163.2^{b}	117.1^{c}	178.23^{a}
Flavonols (mg QE/100g FW)		1.81^{b}	1.24^{c}	2.010^{a}
DPPH (µM AAE/g FW)		19.61^{b}	28.60^{a}	17.23^{c}
FRAP (µM $FeSO_4$/100g FW)		179.4^{b}	106.7^{c}	207.66^{a}

Demonstration of e-Nose to scientific staff in field

Demonstration of e-Nose to students staff in field

Working of e-Nose

Table 17 Comparison of Electronic Nose Sensor Values with refractometer reading

		Parameter	Refractometer Reading	E-Nose Sensor Reading
Red Delicious	BH	**TSS (%)**	9.2	9.0
	H		13.4	13.0
	AH		16.8	17.0
Golden Delicious	BH		10.2	10.0
	H		12.8	12.0
	AH		15.5	15.0

BH: Before Harvest; H: Harvest; AH: After Harvest, TSS: Total Soluble Solids

DUS centre for temperate fruits and nuts

Characterization of apple, walnut and almond reference varieties was performed as per the DUS descriptor developed by ICAR-CITH, Srinagar. The characterized data was converted into different notes which will serve as a data base for comparing candidate varieties with reference varieties at any time. Maintenance of reference varieties is being done and all traits/characters are being tested at nodal centre ICAR-CITH, Srinagar for their uniformity and stability. The new reference variety block of apple representing 250 apple cultivars has been developed for further evaluation and characterization. During the year PPV&FRA has awarded protection to farmer's varieties in apple, apricot and peach which were inspected and recommended by DUS Centre on temperate fruits and nuts, Srinagar. Walnut and almond genotypes were characterized with respect to DUS descriptor and other fruit quality traits. In walnut, 27 genotypes were evaluated for nut and yield traits. Maximum nut diameter (42.57 mm) was observed in CITH-W-7 while maximum nut length (47.83 mm) was recorded in CITH-W-20. Nut weight (21.26 g) was recorded in CITH-W-3 while highest kernel weight (9.59g) was observed in CITH-W-1. Among 27 Genotypes 10 walnut genotypes have kernel percentage more than 40 per cent. The highest kernel percentage was observed in CITH-W-1 (51.22 %) followed by CITH-W-9 (50.89 %), Turtle (50.57%), CITH-W-11 (49.61 %) and CITH-W-15 (49.21 %). In fatty acid profile of 27 genotypes of walnut, maximum fat percent was observed in CITH-W-9 (69.68 %) and was found significantly superior to all the genotypes except CITH-W-1 (68.74 %). The colour of walnut kernel was measured using colorimeter. L* is the lightness component which range from 0 to 100, and parameter a*(from green to red), and b (from blue to yellow). Hue value ranges from 75.85 to 53.12 while value of chroma ranges from 31.97 to 8.90. In terms of whiteness index, CITH-W-10 was found significantly superior as compared to all other varieties but was found significantly at par with CITH-W-8 and CITH-W-15 (Table. 18, 19 &20).

Table 18. Nut and kernel quality traits in different walnut genotypes

Variety/ / Genotypes	Nut dia. (mm)	Nut length (mm)	Nut weight (g)	Shell thickness (mm)	Kernel weight (g)	Kernel percentage
CITH-W-1	42.38^{a}	45.07^{bac}	18.72^{dc}	o.89^{i}	9.59^{a}	51.22^{a}
CITH-W-2	33.17^{gfhe}	35.84^{ed}	14.69^{e}	1.40^{g}	5.51^{ed}	37.50^{efdc}
CITH-W-3	34.75^{gdfe}	35.08^{ed}	21.26^{a}	1.77^{ecd}	5.08^{e}	23.90^{j}
CITH-W-4	35.90^{gdfce}	32.83^{e}	18.13^{d}	1.77^{ecd}	5.50^{ed}	30.40^{hjfig}
CITH-W-5	32.49^{gifh}	44.23^{bac}	14.24^{fe}	1.76^{ecd}	4.56^{e}	32.01^{hefig}
CITH-W-6	41.44 ^{ab}	44.14^{bac}	20.51^{bac}	1.48^{fg}	5.14^{e}	25.03^{ji}
CITH-W-7	42.57 ^{a}	45.32^{ba}	20.21^{bac}	1.59^{efg}	5.32^{e}	26.30^{hji}
CITH-W-8	32.49^{gifh}	28.14^{f}	11.43^{g}	1.87^{bc}	5.15^{e}	45.37^{bac}
CITH-W-9	32.39^{gih}	41.26^{c}	14.24^{fe}	1.71^{ecd}	7.26^{cb}	50.89^{a}
CITH-W-10	36.66 ^{dce}	36.66^{ed}	17.22^{d}	1.65^{efd}	6.66^{cbd}	39.77^{edc}
CITH-W-11	35.60^{gdfce}	46.27^{ba}	13.98^{fe}	1.86^{bc}	6.93^{cb}	49.61^{a}
CITH-W-12	34.17^{gfhe}	46.17^{ba}	19.24^{bdc}	1.81^{cd}	5.50^{ed}	28.58^{hjig}
CITH-W-13	34.36^{gdfhe}	45.69^{ba}	18.57^{dc}	1.59^{efg}	6.69^{cbd}	36.03^{efdg}
CITH-W-14	29.19^{ij}	34.53^{ed}	12.54^{fg}	2.11^{a}	4.53^{e}	36.02^{efdg}
CITH-W-15	35.46^{gdfce}	47.14^{ba}	14.50^{fe}	1.59^{efg}	7.15^{cb}	49.21^{a}
CITH-W-16	33.86^{gfhe}	43.19^{bc}	17.65^{d}	2.03^{ba}	6.86^{cb}	38.97^{edc}
CITH-W-17	35.46^{gdfce}	45.13^{ba}	18.86^{bdc}	o.96^{i}	6.80^{cbd}	36.15^{efdg}

CITH-W-18	39.01^{bc}	47.17^{ba}	20.76^{ba}	o.93^{ı}	7.18^{cb}	34.55^{efdg}
CITH-W-19	31.08^{ihj}	43.75^{bc}	14.09^{fe}	1.24^{h}	5.08^{e}	36.02^{efdg}
CITH-W-20	33.56^{gfhe}	47.83^{a}	17.26^{d}	2.04^{ba}	7.83^{b}	45.31^{bac}
Hamdan	37.87^{dc}	43.33^{bc}	18.62^{dc}	o.90^{ı}	7.67^{cb}	41.24^{bdc}
Turtle	36.01^{gdfce}	36.94^{d}	14.40^{fe}	o.91^{ı}	7.27^{cb}	50.57^{a}
Opex Caulchry	28.63^{j}	34.96^{ed}	13.97^{fe}	o.94^{ı}	4.63^{e}	33.22^{hefdg}
Cheinovo	36.10^{dfce}	37.70^{d}	14.03^{fe}	1.85^{bcd}	6.70^{cbd}	47.86^{ba}
Nugget	24.21^{k}	34.54^{ed}	13.35^{fe}	2.10^{a}	4.54^{e}	34.07^{hefdg}
Sulaiman	33.18^{gfhe}	36.84^{d}	18.79^{bdc}	1.87^{bc}	6.51^{cbd}	34.79^{efdg}
Franquette	36.62^{dce}	33.92^{ed}	14.35^{fe}	1.40^{g}	6.92^{cb}	48.21^{ba}

Table19 Fat percentage of different walnut genotypes

Name of variety	Fat %	S.No.	Name of variety	Fat %
CITH-W-1	68.74^{a}	15	CITH-W-15	63.76^{efdc}
CITH-W-2	64.57^{bdc}	16	CITH-W-16	62.31^{hefdg}
CITH-W-3	59.17^{hkjgı}	17	CITH-W-17	60.93^{hefdg}
CITH-W-4	68.16^{ba}	18	CITH-W-18	60.52^{hefjgı}
CITH-W-5	67.18^{bac}	19	CITH-W-19	56.38^{kl}
CITH-W-6	62.58^{efdg}	20	CITH-W-20	59.02^{hkjgi}
CITH-W-7	56.84^{kjli}	21	Hamdan	57.64^{kjli}
CITH-W-8	64.24^{edc}	22	Tutle	54.73^{l}
CITH-W-9	69.67^{a}	23	OpexCaulchery	57.41^{kjli}
CITH-W-10	58.51^{hkjli}	24	Cheinovo	67.18^{bac}
CITH-W-11	58.40^{hkjli}	25	Nugget	54.54^{l}
CITH-W-12	57.01^{kjli}	26	Suleiman	63.96^{efdc}
CITH-W-13	60.13^{hkfjgi}	27	Franquette	59.07^{hkjgi}
CITH-W-14	59.08^{hkjgi}			

Table 20. Colour parameters of walnut kernels in different genotypes

Variety	L Value	A value	B value	Tint	Hue	Chroma	Whiteness index
CITH-W-1	35.28^{ml}	12.70^{b}	21.49^{hg}	-70.45^{g}	59.44^{jk}	24.96^{hg}	30.63^{lm}
CITH-W-2	41.43^{g}	5.99^{n}	15.67^{n}	-32.64^{bac}	69.17^{ed}	16.79^{o}	39.12^{d}
CITH-W-3	49.11^{dc}	7.34^{m}	24.91^{dce}	-41.47^{ebdac}	73.58^{b}	25.97^{fe}	42.86^{b}
CITH-W-4	48.36^{d}	11.01^{gfed}	26.63^{b}	-54.23^{edgc}	67.57^{ed}	28.81^{cb}	40.86^{c}
CITH-W-5	38.96^{h}	10.97^{gfed}	17.75^{lk}	-52.95^{edgcf}	58.31^{jk}	20.86^{l}	35.42^{f}
CITH-W-6	41.70^{g}	12.17^{c}	25.39^{dc}	-66.41^{eg}	64.44^{gfh}	28.16^{c}	35.25^{f}
CITH-W-7	43.28^{fe}	11.64^{ced}	24.66^{de}	-59.7^{edg}	64.76^{gf}	27.26^{d}	37.06^{e}
CITH-W-8	55.77^{a}	19.19^{a}	25.57^{c}	-42.33^{ebdacf}	53.12^{l}	31.97^{a}	45.41^{a}
CITH-W-9	36.23^{lk}	11.50^{ced}	18.05$_{k}$	-60.45^{edgf}	57.53^{k}	21.40^{lk}	32.73^{ji}
CITH-W-10	49.87^{c}	4.6^{o}	18.24^{k}	-25.76^{ba}	75.85^{a}	18.82^{m}	46.42^{a}
CITH-W-11	38.99^{h}	12.39^{cb}	28.89^{a}	-63.55^{edgf}	66.80^{ef}	31.46^{a}	31.35^{lk}
CITH-W-12	37.26^{ijk}	10.52^{gfh}	20.64^{ı}	-59.5^{edg}	63.01^{gh}	23.17^{j}	33.11^{jih}
CITH-W-13	34.87^{m}	8.53^{l}	13.99^{p}	-45.52^{ebdgcf}	58.63jk	16.38^{o}	32.83^{ji}
CITH-W-14	37.53^{ij}	8.59^{lk}	17.08^{lm}	-46.87^{ebdgcf}	63.34^{gh}	19.12^{m}	34.68^{gf}
CITH-W-15	52.07^{b}	8.02l^{m}	24.13^{e}	-39.49^{bdac}	71.61^{cb}	25.44^{fg}	45.68^{a}
CITH-W-16	37.07^{jk}	8.48^{lk}	16.80^{m}	-46.4^{ebdgcf}	63.26^{gh}	18.82^{m}	34.29^{gfh}
CITH-W-17	37.69^{ij}	11.86^{cbd}	20.89^{hı}	-68.01^{g}	60.43^{ji}	24.03^{li}	33.21^{ih}
CITH-W-18	32.93^{n}	9.51^{ji}	14.85^{o}	-53.66^{edgcf}	57.40^{k}	17.63^{n}	30.64^{lm}
CITH-W-19	42.37^{fg}	10.69^{gfe}	20.15^{ı}	-53.24^{edgcf}	62.09^{ih}	22.81^{j}	37.96^{ed}

CITH-W-20	49.75^{c}	9.2^{jk}	24.6d^{e}	-41.72^{ebdac}	69.52^{cd}	26.26^{e}	43.29^{b}
Hamdan	24.46^{o}	5.34^{on}	7.11^{q}	-32.53b^{ac}	53.12^{l}	8.90^{p}	23.93^{n}
Tutle	44.03^{e}	11.44^{cfed}	26.61^{b}	-19.67^{a}	66.76^{ef}	28.96^{b}	36.97^{e}
Opex Caulchry	44.21^{e}	11.46^{cfed}	24.60^{de}	-59.3^{edc}	65.04^{ef}	27.14^{d}	37.95^{ed}
Cheinovo	43.67^{e}	9.14^{jk}	23.16^{f}	-50.15^{bdgc}	68.48^{ed}	24.90^{hg}	38.41^{d}
Nugget	32.39^{n}	9.67^{jhi}	15.64^{n}	-57.36^{edgc}	58.3^{jk}	18.39^{m}	29.93^{m}
Suleiman	38.40^{h}	10.69^{gfe}	21.99^{g}	-60.64^{edg}	64.10^{gh}	24.46^{hi}	33.72^{gih}
Franquette	35.55^{ml}	10.26^{ghi}	19.17^{j}	-58.71^{edc}	61.87^{ih}	21.74^{k}	31.97^{jk}

In Almond thirteen genotypes were evaluated for various traits related to nut and kernel characteristics. Maximum nut weight (3.50g) was observed in Ferragnes followed by Drake (3.43g), California Paper Shell (3.31g), Makhdoom (3.29g) and Nonpareil (3.22g). Highest kernel weight (1.64g) was recorded in California Paper Shell while lowest values were recorded in Waris (0.87g). Highest value of L (53.86) was recorded in Makhdoom followed by Pranyaj (46.44).Highest values of Hue (63.51), chroma (37.25) and whiteness index (50.62) was observed in Makhdoom while lowest values were recorded in Ferralise (Table 21 &22) .

Table 21 Nut and kernel traits in different almond cultivars

Cultivars	Nut weight (g)	Kernel Weight (g)	Kernel percentage (%)
Merced	2.87^{dc}	1.26^{b}	43.82^{bdac}
IXL	2.99^{bdc}	1.43^{ba}	47.85^{ba}
Shalimar	1.96^{e}	0.98dc	50.02^{a}
Nonpareil	3.22^{bac}	1.19^{bc}	37.14^{de}
California Paper Shell	3.31^{ba}	1.64^{a}	49.85^{a}
Makhdoom	3.29^{ba}	1.25^{b}	38.32^{d}
Waris	1.90^{e}	0.85^{d}	44.61^{bdac}
Tardy Nonpareil	1.94^{e}	0.91^{d}	46.77^{bac}
Primorskij	2.68d	1.2^{bc}	45.01^{bdac}
Pranyaj	3.18^{bac}	1.40^{b}	44.23^{bdac}
Ferralise	2.94^{bdc}	0.88^{d}	30.16^{e}
Ferragnes	3.50^{a}	1.37^{b}	39.19^{dc}
Drake	3.43^{a}	1.42^{ba}	41.61^{bdc}

Table 22. Colour parameters of almond kernels in different cultivars

Cultivars	L	a*	b*	Tint	Hue	Chroma	Whiteness index
Shalimar	37.20^{g}	17.53^{ba}	25.26^{f}	-89.81^{l}	55.27^{f}	30.75d	34.61^{h}
Drake	42.64^{d}	16.15^{de}	27.28^{e}	-81.25^{i}	59.3^{cd}	31.71c	40.17^{d}
Merced	42.55^{d}	16.15^{de}	28.03^{de}	-81.09^{h}	60.0^{cb}	32.34c	40.08^{d}
Nonpareil	41.49^{e}	16.15^{de}	25.23^{f}	-79.45^{g}	57.41^{e}	29.96d	39.09^{e}
Pranyaj	46.44^{b}	15.5^{e}	28.37^{dc}	-72.87^{f}	61.39^{1b}	32.33c	43.99^{b}
Primorskij	40.02^{f}	17.67^{a}	29^{c}	-91.21^{m}	58.65^{ed}	33.96b	37.23^{f}
IXL	41.44^{e}	13.63^{f}	23.73^{g}	-69.64^{b}	60.16^{cb}	27.37e	39.67^{ed}
Waris	44.80^{c}	16.94^{bc}	30.30^{b}	-82.97^{j}	60.82^{b}	34.71b	42.00^{c}
Makhdoom	53.86^{a}	16.63^{dc}	33.33^{a}	-71.8^{e}	63.51^{a}	37.25^{a}	50.62^{a}
CPS	35.41^{h}	15.74^{e}	23.34^{g}	-84.54^{k}	56.02^{f}	28.15e	33.34^{i}
Tardy Nonpareil	37.77^{g}	12.76^{g}	18.64^{h}	-64.52^{a}	55.62^{f}	22.59f	36.32^{g}
Ferralise	32.36^{j}	12.33^{g}	15.70^{i}	-70.72^{c}	51.89^{g}	19.97g	31.12^{k}
Ferragnes	33.27^{i}	11.22^{h}	16.26^{i}	-71.02^{d}	55.42^{f}	19.76g	32.22^{j}

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

During 2020, two important technologies viz; Predictor and planner for almond (PPA)-A software application and Land use and Contingency Planner (LCP)-software application has been commercialized through Aggroinovate India Limited.

Registration of germplasm through NBPGR for hybrid apple varieties has been initiated and data for different accessions of walnut are being compiled for online registration. The already maintained Germplasm inventory is being updated regularly. ICAR-CITH has entered into Memorandum of Understanding (MOU) with Department of Botany, Government Degree College Baramulla for promotion of quality research and training.

Validation and Development of DUS guidelines in olive

During 2020 data was recorded on various tree, leaf, fruit and stone 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. To know the stability of traits data was also recorded on some varieties available at Ramban.

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

Canopy management and plant architectural engineering in temperate fruit crops aimed 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 seven centers with different temperate fruit crops of their regional importance. The summary of results from different centers during is presented in Table 23.

Table 23. Summary of results at different centers on canopy management and plant architectural engineering in temperate fruit crops

Centre	*Crops*	*Findings*
ICAR-CITH, Srinagar	Apple & Pear	In apple, Oregon Spur on MM 111 and MM 106 gave highest productivity on Vertical Axis training system. Light interception was found more in Cordon System. In Pear, Red Bartlett on Q C and Starkrimson on BA-29C rootstock on Vertical Axis system excelled other in productivity.
ICAR-CITH, Regional Station, Mukteshwar	Apple & Peach	In apple, the highest plant height was recorded in Modified Leader System, highest plant diameter was recorded in cordon System. Maximum number of branches/ plant were recorded in CITH Lodh Apple 1 on Modified Central leader system on M 9 rootstock In peach trial, the highest plant diameter & plant height was recorded in open centre System.
Dr YSP UH&F, Solan (H P)	Peach	In Snow Queen Nectarine, maximum yield was recorded in Espalier system. In peach, Red haven gave better yield in Espalier system closely followed by Tatura Trellis system
Dr YSP UH&F, Solan , RHRS, Bajaura, Kullu (HP)	Apple	Maximum productivity was recorded in cv Jeromine on M-9 rootsock followed by Red Velox on M-9, Scarlett Spur II on M-7 and Super Chief on M-7 in Vertical Axis system. Gale Gala on M-9 rootstock gave production of 36.37 t/ha Vertical Axis and Head and Spread systems were found better for fruit weight
Panjab Agriculture University, Ludhiana	Pear &Plum	In Pear, vegetative growth of pear plants on Kainth rootstock is substantially higher than grafted on the Quince C rootstock. Maximum number of fruit were recorded on Kainth rootstock in Tatura Trellis System . All pear varieties grafted on Quince C rootstock exhibited overgrowth on the union as evidenced by greater union diameter values as compared to either stock or stem diameter. Due to incompatibility the mortality rate was approximately 80 % in Punjab Beauty/Quince C combination while it was approximately 15 % in both Nijisseiki/Quince C and Punjab Soft/Quince C combinations. In Plum, fruit number per plant was maximum in Tatura Trellis system of planting.
ICAR Research Complex for NEH Region, Shillong, Meghalaya and Arunachal Pradesh Center, Basar& Sikkim Centre), Tadong, Gangtok, Sikkim	Peach and Kiwifruit	Highest fruit weight, yield and TSS was obtained in Y shaped trellis at both the centers In Kiwifruit at Sikkim, Maximum yield of 9.41 kg/plant was recorded in cv Hayward in Duble Circle System followed by Allison on Paragola system (9.3kg) and Hayward on Tatura Trellis System (9.12 kg).

Espalier system in peach in Shillong

Y Shape trellis system in peach in Shillong

Extended T Bar System in Sikkim

Pergola System in Sikkim	
	
Espalier System of Training at Bajaura	***Gale Gala under Espalier System at Bajaura***
	
Jeromine under Espalier system at Bajaura	***Fruiting under Spindle Bush system at Bajuara***
	
Fruiting under Head & Spread system of Training at Bajuara	***Red Velox cv. of apple under Vertical Axis of Training at Bajuara***

Walnut propagation for production of quality planting material

This project was initiated with an aim to promote walnut cultivation in Uttarakhand for improving the livelihood and socioeconomic status of farmers. But to ahead further the availability of quality planting material was main problem. Due to low propagation success in walnut as compared to other pome and stone fruits, the increase in acreage under this crop is going at a slow pace. The propagation success depends upon many factors. The walnut propagation is done in polyhouse conditions due to low temperature outside unsuitable for better success at ICAR-CITH, Srinagar. So ICAR-CITH, Srinagar along with its Regional station, Mukteshwar started producing vegetative propagated walnut plants as well as human resource development of staff and farmers of Uttarakhand along with standardization of propagation method and time. To study the best method and time of propagation in walnut, a small trial was carried out under polyhouse conditions during 2020. Five propagation methods *i.e.* chip budding, tongue grafting, wedge (manual), wedge (machine) and cleft grafting were performed in 6th, 15th, 24th February, 4th and 13th March in CITH-W-1. During the comparison, maximum success rate (90%) was recorded in cleft grafting performed on 15th and 24th February, 2020. As compared to previous year, other methods gave very less success in this year which may be due to newly planted rootstock. In another trial, twenty four walnut genotypes were compared for cleft grafting success under different conditions. Maximum grafting success (62.25%) was recorded in CITH-W-9 followed by CITH-W-7 (57.85%), CITH-W-3 (54.37%) and WBPH (53.27%) while minimum was recorded in KHS-9(9.41%). The varied success rate in different genotypes may be growing conditions, genetic response and condition of rootstock (especially planting time of rootstock, establishment time) and difference in grafting dates along with temperature and humidity. The overall results indicates that the grafting success is a complex phenomenon and depends upon many factors like climatic conditions i.e temperature & humidity condition and planting of rootstock, condition of scion wood, time and grafting skill. The well established rootstock gave better success as compared to newly planted rootstock.

During December, 2020, eleven thousand grafted/budded plants of elite varieties /genotypes were provided to UFRMP-Dehradum and planted in Garhwal and Kumaon region covering approximately 70 hectare area. ICAR-Regional Station, Mukteshwar also started production of walnut plants. During 2020, one 10 days, one 3 days and 4 one day training programmes were organized for officers, staff from forest, horticulture and progressive farmers (Table 24). Excellent impact of human resource development was noticed as more than 1000 plants were produced by the Forest Department nurseries in Uttarakhand.

Table 24. Training/ demonstration programmes organized at various locations

Date	Duration	Venue	Training/ demonstration	No. of participants	Category of trainees
18th to 27th Feb, 2020	10 days	ICAR-CITH, Srinagar	Walnut Propagation	9	Gardeners from Deptt of Forest, Uttarakhand
5th Feb,2020	1 day	Magra	Walnut Propagation	44	Officers from Deptt of Forest, line Deptt and farmers from Uttarakhand

7th Feb, 2020	1 day	Sony	Walnut Propagation	32	Officers from Deptt of Forest and farmers from Uttarakhand
9th Feb, 2020	1day	Silalekh	Walnut Propagation	68	Officers from Deptt of Forest and farmers from Uttarakhand
10th Feb, 2020	1 day	Mukteshwar	Walnut propagation for quality planting material production	41	Officers from Deptt of Forest, Deptt of Horticulture and farmers from Uttarakhand
3rd to 5th Dec,2020	3 days	ICAR-CITH, Srinagar	Handling , packaging and transportation of grafted plants	4	Officers/ staff from Deptt of Forest, Deptt



Glimpses of one day training programmes/ demonstrations organized at Magra, sony & Silalekh


Glimpses of one day training programmes/ demonstrations organized at ICAR-RS Mukteshwar


Glimpses of ten days training programmes organized at ICAR-CITH, Srinagar

Packing and supply of walnut plants to Uttarakhand

Growth of mother block plants, grafted, plants and supply of walnut plants at Regional Station, Mukteshwar

All India network research project on onion and garlic

This project was implemented at ICAR-CITH, Srinagar and ICAR-CITH Regional station Mukteshwar. The outcomes of this project are briefly presented under different heads.

ICAR-CITH, Srinagar (J&K)

The outcome of various project is briefly presented under different sub-projects as below:

Germplasm collection, conservation and evaluation

Onion

No new collections were made during 2020. One hundred eleven previous collections and selections were evaluated against check Brown Spanish. The marketable bulb yield (q/ha) ranged from 92.27 to 484.00 q/ha with an average of 249.32 q/ha. The genotypes CITH-O-37 (484.00 q/ha) was the highest yielder but at par with check Brown Spanish (412.08 q/ha).

Garlic

No new collections were made during 2020. Eighty-one previous collections were evaluated against 4 checks. There were statistically significant differences among genotypes for marketable

yield that ranged from 152.81 to 399.77 q/ha. The mean marketable yield of germplasm was found to be 270.55 q/ha. The genotype, CITH-G-60 (399.76), CITH-G-5 (387.01), CITH-G-21 (377.90), CITH-G-7 (369.59), CITH-G-32 (366.88), CITH-G-73 (365.96) and CITH-G-1 (361.57) exhibited the highest yields, which were at par with each other.

Evaluation of long day onion varieties for cultivation under long day conditions

Significant differences exist among tested hybrids and varieties having long day adaptation (Table 25). Highest marketable yield was observed in CITH-O-2 (47.37),Brown Spanish (46.80), Super Ex (45.77), Red Coral**(**20-20**)** (37.86) and Red Coral (37.48) which were at par with each other and significantly superior to all other entries. Total soluble solids varied significantly among different genotypes. Highest TSS was found in Brown Spanish (13.20) followed by CITH-O-2 (11.80).

Table 25. Yield and other parameters in long day onion varieties under Kashmir conditions

S. No.	Varieties	MY (t/ha)	PD (cm)	ED (cm)	TSS (%)
1	**CITH-O-2**	47.375	5.450	6.770	11.800
2	**Red Coral (20-20)**	37.865	5.450	7.690	6.700
3	**Golden Globe**	28.955	5.265	8.430	7.300
4	**Rosa Bella**	24.365	4.740	7.380	8.467
5	**Super Ex**	45.775	5.560	8.250	6.633
6	**F_1 Wagay Seed**	21.220	5.685	7.230	10.367
7	**Brown Spanish (C)**	46.805	5.510	6.690	13.200
8	**Red Coral**	37.487	5.370	7.280	7.567
CD at 5%		**16.034**	**0.461**	**0.779**	**0.732**

Determination of optimum fertilizer regime for cultivation of long day onion under Kashmir conditions

Different treatments *viz* T1: FYM: 15, N: 110, P: 40, K: 60 (RDF for short day conditions as control),T2: FYM: 15, N: 132, P: 48, K: 72,T3: FYM: 15, N: 154, P: 56, K: 84,T4: FYM: 15, N: 176, P: 64, K: 96,T5: FYM: 15, N: 198, P: 72, K: 108 and T6: FYM: 15, N: 220, P: 80, K: 120 were compared and data is presented in Table. 26. There were no significant differences for marketable yield and related parameters with varying fertilizer dosage in Brown Spanish and Yellow Globe. Significant differences were observed for storage traits. In Brown Spanish the cumulative % loss by number, the lowest loss was found in T6 (5.94) and T4 (6.55) and in Yellow Globe, it was observed in T4 (9.83) and T3 (12.46). : In Brown Spanish, lowest % loss was observed in treatment T1 (22.69) and in Yellow Globe, it was observed in T6 (27.72).

Table 26. Yield and storage attributes in Brown Spanish and Yellow Globe in response to fertilizer dosage

Genotype	Treatment	MY (t/ha)	% A grade bulbs (no.)	% A grade bulbs by weight	% B grade Bulbs (no.)	% B grade bulbs by weight	% C grade Bulbs (no.)	% C grade bulbs by weight	% D grade bulbs (no.)	% D grade bulbs by weight	Cumulative % loss after 4 months by (no.)	Cumulative % loss after 4 months by weight	B:C ratio
Brown Spanish	**T1**	46.009	24.341	26.764	29.563	40.234	17.982	19.675	26.214	12.707	15.490	22.697	2.631
	T2	41.000	21.715	23.967	34.264	36.623	26.746	29.369	15.045	9.850	7.874	26.867	2.214
	T3	46.380	26.479	26.927	23.620	22.624	24.519	25.011	25.161	25.077	42.254	45.743	2.955
	T4	49.165	25.331	25.687	25.789	31.004	23.927	24.261	24.123	18.459	6.559	31.707	2.640
	T5	43.780	25.908	29.194	23.530	29.825	22.814	25.507	24.210	15.174	22.475	38.363	2.603
	T6	49.827	22.621	23.585	27.859	35.634	26.961	28.158	21.574	12.452	5.994	35.364	3.273
Yellow Globe	**T1**	44.480	24.744	24.349	22.395	22.485	25.246	24.762	27.897	28.127	13.117	34.223	2.107
	T2	44.152	26.821	30.899	30.051	33.411	26.348	28.964	12.662	6.479	14.827	30.887	1.985
	T3	43.973	21.295	23.878	19.822	22.205	38.718	43.313	17.364	10.614	12.461	30.340	2.199
	T4	41.953	23.747	25.342	20.097	21.264	20.519	21.692	33.840	31.303	9.836	33.726	2.070
	T5	44.232	24.081	29.547	25.262	31.087	21.795	26.678	23.203	12.411	28.241	39.552	2.032
	T6	45.151	25.522	24.931	22.661	22.157	25.835	25.524	26.482	26.611	26.786	27.728	3.156
Genotype	**CD**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**1.64**	**2.23**	-
	SE(d)	**0.30**	**2.44**	**2.91**	**3.46**	**2.00**	**1.71**	**2.77**	**2.16**	**1.55**	**0.72**	**0.99**	-
	SE(m)	**0.21**	**1.72**	**2.05**	**2.44**	**1.41**	**1.21**	**1.96**	**1.53**	**1.10**	**0.51**	**0.70**	-
Treatment	**CD**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**7.82**	**5.93**	**7.32**	**8.69**	**4.65**	**2.84**	**1.23**	-
	SE(d)	**0.58**	**4.02**	**4.38**	**3.24**	**3.75**	**2.84**	**3.50**	**4.16**	**2.23**	**1.26**	**0.54**	-
	SE(m)	**0.41**	**2.84**	**3.10**	**2.29**	**2.65**	**2.01**	**2.48**	**2.94**	**1.57**	**0.89**	**0.38**	-
GXT	**CD**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**8.21**	**1.24**	**1.89**	-
	SE(d)	**0.82**	**5.68**	**6.20**	**4.58**	**5.30**	**4.02**	**4.96**	**5.89**	**3.15**	**0.62**	**0.87**	-
	SE(m)	**0.52**	**4.22**	**5.04**	**5.99**	**3.47**	**2.97**	**4.80**	**3.75**	**2.69**	**0.92**	**0.45**	-

Determination of optimum fertilizer regime for cultivation of long day garlic under Kashmir conditions

The different treatments compared are T1: FYM: 15, N: 100, P: 50, K: 50 (RDF for short day conditions as check);T2: FYM: 15, N: 120, P: 60, K: 60;T3: FYM: 15, N: 140, P: 70, K: 70;T4: FYM: 15, N: 160, P: 80, K: 80;T5: FYM: 15, N: 180, P: 90, K: 90;T6: FYM: 15, N: 200, P: 100, K: 100.There were no significant differences for marketable yield and related parameters with different fertilizer doses except % B grade bulbs by weight in CITH-G-1 and CITH-G-3 and % C grade bulbs by weight. The lowest % of D grade bulbs by weight was observed at lowest and highest fertilizer dosage in CITH-G-1. Significant differences were observed for cumulative storage losses after 4 months.Lowest storage losses were observed at lower fertilizer doses in both genotypes. Treatment T2 showed lowest storage loss of 4.32 and 5.55 respectively.Lowest weight loss was observed in T2 i.e. 5.78 and 4.67 in CITH-G-1 and CITH-G-3 (Table 27).

Table 27. Yield and storage attributes in CITH-G-1 and CITH-G-3 in response to fertilizer dosage

Genotype	Treatment	MY (t/ha)	% A grade bulbs (no.)	% A grade bulbs by weight	% B grade Bulbs (no.)	% B grade bulbs by weight	% C grade Bulbs (no.)	% C grade bulbs by weight	% D grade bulbs (no.)	% D grade bulbs by weight	Cumulative % loss after 4 months (no.)	Cumulative % loss after 4 months (wt.)	B:C ratio
CITH-G-1	**T1**	29.670	20.853	30.355	32.698	34.772	39.051	15.815	9.135	1.216	5.461	9.072	3.339
	T2	25.431	23.877	40.038	27.769	41.030	29.837	18.268	11.881	11.403	4.320	5.783	3.524
	T3	30.273	18.024	26.527	27.955	29.019	30.997	12.092	7.042	32.290	7.020	6.592	3.053
	T4	26.826	18.104	28.558	28.258	35.922	24.528	17.016	13.170	18.469	12.202	9.952	3.340
	T5	27.421	21.968	38.878	30.344	36.173	35.873	20.881	13.771	3.595	17.620	6.157	3.765
	T6	25.358	24.015	45.757	26.814	33.022	34.297	19.761	12.914	19.623	17.914	7.169	3.823
CITH-G-3	**T1**	25.398	26.530	49.463	22.944	33.529	32.134	15.870	11.981	1.072	7.496	9.355	2.930
	T2	25.861	18.186	35.170	24.224	35.223	29.716	16.387	14.885	13.155	5.554	4.673	3.198
	T3	29.245	24.385	42.155	25.484	31.971	32.475	22.880	11.797	2.830	13.530	7.173	2.562
	T4	26.836	19.994	37.311	22.994	33.379	32.749	20.818	13.835	8.413	10.702	6.443	3.174
	T5	28.271	18.751	28.215	24.502	34.767	24.502	12.963	13.702	23.938	12.282	10.535	3.744
	T6	30.757	20.465	30.814	25.425	32.840	25.425	15.263	18.719	20.687	10.195	8.895	3.782
Genotype	**CD**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**3.96**	**N.S.**	**1.54**	**3.27**	**1.58**	**0.87**	**N.S.**	-
	SE(d)	**3.68**	**4.09**	**6.06**	**5.34**	**1.75**	**5.32**	**0.68**	**1.45**	**0.70**	**0.33**	**0.99**	-
	SE(m)	**2.60**	**2.89**	**4.28**	**3.77**	**1.21**	**3.76**	**0.48**	**1.02**	**0.49**	**0.23**	**0.70**	-
Treatment	**CD**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**2.13**	**2.57**	**2.98**	**0.97**	**0.66**	**0.65**	-
	SE(d)	**1.99**	**4.69**	**7.33**	**1.34**	**1.07**	**0.94**	**1.13**	**1.32**	**0.43**	**0.25**	**0.24**	-
	SE(m)	**1.40**	**3.32**	**5.18**	**0.95**	**0.75**	**0.66**	**0.80**	**0.93**	**0.30**	**0.17**	**0.17**	-
GXT	**CD**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**1.78**	**3.45**	**1.77**	**0.89**	**N.S.**	-
	SE(d)	**4.25**	**7.58**	**9.45**	**4.88**	**2.44**	**2.11**	**0.89**	**2.11**	**0.45**	**0.69**	**0.54**	-
	SE(m)	**3.12**	**5.36**	**7.22**	**3.12**	**1.50**	**1.32**	**0.77**	**1.45**	**0.52**	**0.39**	**0.32**	-

ICAR-CITH, RS Mukteshwar (Uttarakhand)

All India Network Research Project on Onion & Garlic (Long Day)

Long Day Garlic: Among the twelve genotypes under IET long day garlic, GN-19-30 was found top ranking in term of bulb yield (3.24 kg/plot and 216.0 q/ha), followed by GN-19-35 and GN-19-12 with 2.09 kg and 1.07 kg bulb yield/plot and 139.8 q/ha and 71.3 q/ha, respectively. In AVT-II, total seven genotypes were evaluated and GN-19-50 was found best in term of bulb yield (2.782 kg/plot and 185.5 q/ha) followed by GN-19-52 and GN-19-44 with 2.553 kg and 1.067 kg bulb yield/plot and 170.2 q/ha and 71.13 q/ha, respectively. The total soluble solid content was found maximum in genotype GN-19-52 (38.47 ^{0}B) followed by GN-19-50 (37.70 ^{0}B) and GN-19-38 (37.17 ^{0}B). Apart from this, among two hybrids, Bhima Purple reported highest bulb yield 0.75 kg/plot and 75.0 q/h. followed by Bhima Omkar 74.4 q/h.

Long Day Red Onion: Among the IET, nine lines were evaluated and LORVA-19-09 was gave highest bulb yield (5.49 kg/plot and 244.22 q/ha) followed by LORVA-19-06 and LORVA-19-07 with 4.859 kg & 3.508 kg bulb yield/plot and 215.96 q/ha & 155.91 q/ha, respectively. However, highest TSS was recorded in LORVA-19-18 (12.8) followed by in LORVA-19-14 (11.2). In AVT-I, total seven genotypes were evaluated and highest bulb yield(6.034 kg/plot and 268.18 q/ha) was recorded in LORVB-19-30 followed by LORVB-19-28 and LORVB-19-25 with 4.889 kg & 4.017 kg bulb yield/plot and 217.29 q/ha & 178.53 q/ha, respectively. The highest TSS was recorded in LORVB-19-24 (11.23^{0}B) followed by in LORVB-19-20 (10.47^{0}B). Likewise in AVT-II, seven genotypes were compared and highest bulb yield (4.961 kg/plot and 220.49 q/ha) was recorded in LORVC-19-44 followed by LORVC-19-42 and LORVC-19-37 with 2.829 kg & 2.389 kg bulb yield/plot and 125.73 q/ha and 106.18 q/ha, respectively. The highest TSS (^{0}B) was recorded in LORVC-19-32 (12.07^{0}B) followed by in LORVC-19-35 (11.57^{0}B). In IET on long day Red Onion Hybrid, total seven genotypes were evaluated and highest bulb yield of 1.281 kg/plot and 56.93 q/ha was recorded in LORAH-19-65 followed by LORAH-19-51 and LORAH-19-55 with 1.134 kg & 0.933 kg bulb yield/plot & 50.40 q/ha and 41.47 q/ha, respectively. Maximum TSS was recorded in LORAH-19-51 (11.10^{0}B) followed by in LORAH-19-57 (10.50^{0}B).

Long Day White Onion: Among the IET five lines, genotype highest bulb yield (0.429 kg/plot and 19.07 q/ha) was recorded in LOWVA-19-70 followed by LOWVA-19-66 and LOWVA-19-68 with 0.239 kg &0.211 kg bulb yield/plot and 10.62 q/ha & 9.38 q/ha, respectively. The highest TSS was recorded in LOWVA-19-74 (11.10 ^{0}B) followed by in LOWVA-19-68 (10.57^{0}B).In AVT-I, total five genotypes were evaluated and highest bulb yield (0.984 kg/plot & 43.73 q/ha) was recorded in genotype LOWVB-19-77 followed by LOWVB-19-75 and LOWVB-19-84 with 0.925 kg and 0.752 kg bulb yield/plot and 41.11 q/ha and 33.42 q/ha, respectively. The highest TSS was recorded in LOWVB-19-77 (10.77^{0}B) followed by in LOWVB-19-84 (10.40^{0}B). In long day white-HTSS-IET, total seven genotypes were tested and highest bulb yield (1.471 kg/plot and 65.38 q/ha) was recorded in LOWTA-1989 followed by LOWTA-1991 and LOWTA-1987 with 1.464 kg & 1.341 kg bulb yield/plot and 65.07 q/ha and

59.60 q/ha, respectively. However, highest TSS was recorded in LOWTA-1994 (12.00 ^{0}B) followed by in LOWTA-1996 (11.40 ^{0}B).

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

In this project following experiments were conducted at ICAR-CITH, Srinagar

Germplasm collection, conservation and utilization in chilli, capsicum, pepper and leafy vegetable except amaranth

No new collections in chilli, capsicum and pepper were made. However, in kale, Kawdari was collected from farmer's field and evaluated in field conditions (Table 28 & 29).

Table 28. Evaluation of Kawdari for yield traits

Collection name	Crop	Source	Performance
Kawdari	Kale	Farmer's field	Leaf yield (q/ ha):395.012 Leaf length(cm):18.250 Leaf width(cm):13.502

Table 29. Evaluation of chilli collections made in 2019-20

Collection name	Fruit length (cm)	Fruit width (cm)	Fruit yield (q/ha)
CITH Chilli-2	5.350	0.500	57.800
CITH Chilli-3	5.290	0.910	73.900
CITH Chilli-4	5.470	0.770	93.000

Varietal and hybrid trials

The following varietal and hybrid trials were conducted during the year 2020 and number of entries tested is presented in Table 30.

Table 30. Number of entries under different varietal and hybrid trials

Crop	Trial	Number of entries tested
Chilli	IET hybrid	6
	AVT-I hybrid	9
	AVT-II hybrid	6
	IET variety	5
	AVT-I variety	6
Determinate tomato	IET hybrid	8
	AVT-II hybrid	4
	IET variety	10
	AVT-I variety	6
	AVT-II variety	10
Indeterminate tomato	AVT-I variety	8
Cherry tomato	AVT-I variety	4
Capsicum	AVT-I variety	5
Round brinjal	AVT-II variety	8
Long brinjal	AVT-I variety	11
Long brinjal	AVT-I variety	8
Small round brinjal	AVT-II variety	4

ICAR-CITH, Mukteshwar

All India Co-ordinated Research Project on Vegetable Crops (Volunteer Center)

Garden Pea Early (AVT-II): Seven genotypes of Garden pea were evaluated during Kharif 2020 and maximum plant height (67.1 cm) was recorded in 2018/PEVAR-5, whereas maximum pod length (10.7 cm) was recorded in 2018/PEVAR-6 while number of pods/plot (149.0), pod weight (702g)/plot &yield (70.2q/h) were recorded in 2018/PEVAR-7.

Garden Pea Mid (AVT-II): Seven genotypes of Garden pea were evaluated during Kharif 2020 and number of pods/plot (85.0), pod weight (407 g)/plot, yield (40.7q/h) were recorded in 2018/PMVAR-4, respectively. However maximum pod length (10.8 cm) was recorded in 2018/PMVAR-6.

Garden Pea Edible Pod: Eight genotypes of Garden pea were evaluated and highest number of pods/plot (201.0), pod weight (871.0 g) and yield (87.1q/h) were reported in 2018/PEDAVR-2.

Radish: Total seven genotypes were evaluated during kharif 2020 and highest root length (31.2cm) and number of leaves/ plants (77.0) were recorded in 2018/RADVAR-2.

Laipatta: Total four genotypes were evaluated during kharif 2020 and highest leaf length (33.3 cm, leaf width (21.4 cm) and weight of five leaves (144.0 g) were genotypes, 2018/MGVER-4 was recorded as compared to other genotypes.

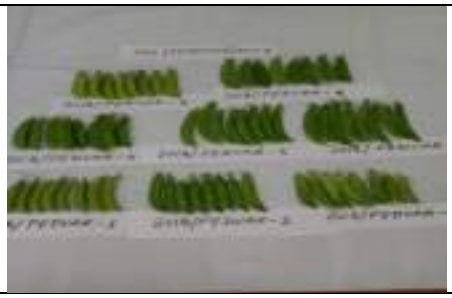
State Varietal Trial of Pea and Bean (Volunteer Center)

Garden Pea: Ten genotypes of Garden pea were evaluated during Kharif 2020 and highest number of pods/plot (237.0) was recorded in VP-1511 followed by Arkel (232.0). The highest yield (5.547 kg/plot & 184.9q/h) was recorded in VSM-14 genotype.

French bean: Nine genotypes of French bean were evaluated during Kharif 2020 and maximum pod weight/plot (7.419 kg), yield (247.3q/h) and pod/kg (99.5) were recorded in genotype CITH-FB-1 as compared to other genotypes.

Garden Pea Early under AVT-II

Garden Pea Mid under AVT-II



Garden Pea (Edible Pod) under AVT-II

Radish under AVT-II

Meetings and Events

During the year 2020, due to COVID 19 pandemic, restrictions and lockdown, fewer events could be organized as compared to other years. However Institute has made efforts to organize some meetings and events by following the guidelines issued time to time. The events and meetings organized by ICAR- CITH, Srinagar and its Regional Stations *viz*. Mukteshwar & Dirang are presented below and summarized in the Table 31.

4th QRT Meeting

The 4th Quinquennial Review Meeting of ICAR-CITH, Srinagar was held on 19th December, 2020 under the Chairmanship of Dr V S Thakur, Former Vice Chancellor, Dr YSP UH&F Solan. The other members of the QRT were Dr S N Pandey, Dr R K Jain, Dr S K Dash, Dr P Kalia and Dr J I Mir (Member Secretary). Dr D B Singh, Director and Scientists of Institute participated in the meeting. The Action taken report of previous QRT and progress made during five years was also presented before the committee. A detailed discussion was held and recommendations were finalized and compiled document was submitted to the Council.

16th IRC Meeting

The 16th Institute Research Council Meeting was held on 10th July, 2020 under the chairmanship of Dr D B Singh, Director ICAR-CITH Srinagar. All the scientists participated in the meeting by following proper social distancing keeping in view the COVID-19 pandemic. 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 Chairman gave critical inputs on experimentation for obtaining realistic and reproducible results. Some projects were extended to obtain reproducible results and some new project were also discussed and approved in the house.


Discussion during 16th IRC meeting

Nursery Accreditation

Nursery accreditation committee constituted by NHB having expert member visited ICAR-CITH, Srinagar on 13th October, 2020 for renewal of accreditation/ ranking of the fruit nursery of the Institute. The members were made aware of various components of nursery like mother block, rootstock bank, polyhouse facilities, virus indexing facility, mist chambers, tissue culture lab and quality planting material production capacity of the institute by Dr O C Sharma and Dr S N Kirmani. All details needed as per their format were provided and shown to the committee.

The committee was highly satisfied with all components of nursery and Institute got highest ranking viz ***Three Star*.**

Table 31. List of various events organized during the year 2019-20

S. No	Event	Date	Organizers/ Coordinators
1	16th Institute Research Council Meeting	10th July, 2020	O C Sharma
2.	4th QRT	19th December, 2020	J I Mir
2	Constitution Day	26th November, 2020	W H Raja
3	Vigilance Awareness Week	27th October to 2nd November, 2020	O C Sharma
4	International Yoga Day	21st June, 2020	Celebrated at home
	National Unity Day/ Rashtriya Ekta Diwas	31st October, 2020	O C Sharma
6.	Celebration of two year long commemoration of 150th Birth Anniversary of Mahatama Gandhi Ji and Swachchata Abhiyaan	25th September to 2nd October, 2020	Eshan Ahad, Reyaz Mir & O C Sharma
7.	Hindi Week	14th September to 21st September, 2020	Geetika Malik
8.	Nursery Accreditation committee visit	13th October, 2020	O C Sharma & Shoaib Kirmani
9	*Kisan Diwas/* Farmers Day	23rd December, 2020	W H Raja and Sajad Un Nabi
10	Swachhta Pakhwada	16th to 31st December 2020 (Srinagar)	Dr W.H.Raja & Mr Eshan Ahad,
		16th December to 31st December, 2020 (Mukteshwar	Arun Kishore & Staff



Glimpses of visit by Accreditation committee to different units at ICAR-CITH

Farmers Day/ *Kisan Diwas*

ICAR-CITH, Srinagar organized Farmers Day on 23rd December, 2020. In this programme about 40 progressive farmers from district Pulwama and Ganderbal participated. The programme was inaugurated by Dr D B Singh, Director and in his address, he highlighted the contribution and role of farmers for making our country self sufficient in fruit production. Other scientists also shared their views regarding the role of farmers for the development of the country. The farmers also shared the views regarding research needs for their farms. At last the farmers were honoured by providing a kit containing farm tools and seeds.

National Unity Day/ Rashtriya Ekta Diwas

ICAR- CITH, Srinagar celebrated National Unity Day/ Rashtriya Ekta Diwas on 31st October, 2020. During the programme Dr O C Sharma, Principal Scientist told that Unity Day is celebrated on the occasion of birth anniversary of Sardar Vallabhbhai Patel. He also highlighted and acknowledged the struggle and sacrifices of Sardar Patel and importance of unity day. The staff of the Institute took pledge for their dedication to preserve the unity, integrity and security of Nation. After the Pledge, discussion was held on the work done for integration of Nation by Saradar Balbhbhai Patel. Dr D B Singh, Director told that the country like India is full of diversity in relation to religion, casts, languages, civilization and culture. So to integrate the country the contribution of Saradar Balbhbhai Patel will be always remembered. The major reforms made in his life were also discussed. Lastly, Director urged the staff to work for integration and development of the Nation. National Unity Day/ *Rashtriya Ekta Diwas* was also celebrated at Regional Station, Mukteshwar (Uttarakhand).

Vigilance Awareness Week

ICAR- Central Institute of Temperate Horticulture, Srinagar observed Vigilance Awareness Week from 27th Oct., to 2nd Nov., 2020. The theme of the Vigilance Week was □□□□□ □□□□, □□□□□□ □□□□ –Satark Bharat, Samriddh Bharat (Vigilant India, Prosperous India). The various programmes were organized to make the staff aware of various practices and measures to fight against the corruption. The programme was started with welcome address and importance of vigilance week by Vigilance Officer on 27th October followed with address by Director to adopt various practices for achieving transparency, accountability and corruption free governance. A Pledge ceremony was held in which all staff took pledge. The posters were displayed in different areas of campus for creation of awareness for making vigilant and prosperous India. Besides this, the poster prepared by the contractual staff were also displayed

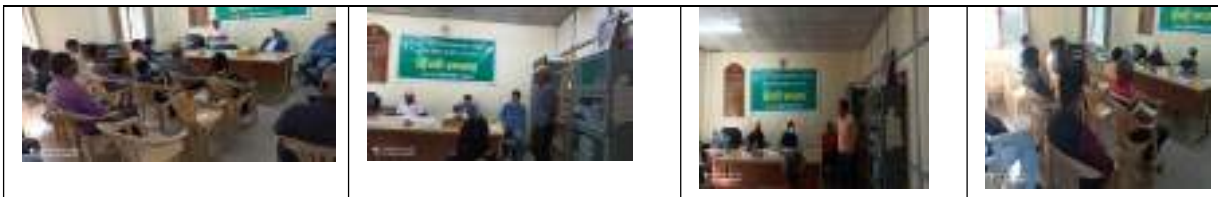
which highlighted the ways of corruption and its consequences on society and country. The staff of NBPGR, Regional Station also participated in the programme. Keeping in view, the pandemic of COVID 19, some staff who were directed to work from home took pledge at home. The staff members assured to remain vigilant to make the country prosperous. Pledge and awareness programmes were also organized at Regional Station, Mukteshwar (Uttarakhand).

Address, discussion and Pledge during Vigilance Awareness Week

Hindi Week

Hindi Week was celebrated at ICAR-CITH, Srinagar from 14th September to 21st September, 2020. The celebration commenced with inaugural function on 14th September, 2020 in which long discussion was held on importance and usages of Hindi by various members. The function ended with the words of wisdom by Hon'ble Director who encouraged the officers and officials to enhance their knowledge of Hindi language for increased usage at the institute. During the week, different activities like essay writing, translation, extempore, poster making and antakshari competitions were held to celebrate the *Hindi Saptah*. The staff members participated with fervour in the programmes organized from 15th September, 2020 to 21st September following Covid-19 guidelines while conducting all events. The celebrations ended with prize distribution and conclusion ceremony on 21st September, 2020. Hindi week was also observed at ICAR-RS, Mukteshwar from 14th September to 20th September, 2020. The inauguration of Hindi week was done on 14th September in which all staff member participated. Three competition namely essay writing, ex tempore competition and debate competition were organized on different days in which permanent and contractual staff of station participated. The winners of various competitions were awarded with cash prizes.

Glimpses of events and prize distribution in Hindi Week at ICAR-CITH, Srinagar



Glimpses of Hindi Week at ICAR-CITH, Regional Station, Mukteshwar

Celebration of two year long commemoration of 150th Birth Anniversary of Mahatama Gandhi Ji and Swachchata Abhiyaan *w.e.f.* 25th Sept. to 2nd Oct., 2020

Swachchata week was organized at ICAR-CITH, Srinagar and its Regional Station Mukteshwar w.e.f. 25th September to 2nd October, 2020. During this week, various programmes on cleanliness were planned and organized. At ICAR-CITH Srinagar, a plantation drive was initiated by planting of olive plant by Dr D B Singh Director, ICAR-CITH, Srinagar on 25th September, 2020. On 26 September the cleaning in front of office was done by the staff. All the garbage including plastic was collected from various places from campus periphery. On 27th September, cleaning drives were carried out by the staff at their homes and *mohallas*. On 28th September, keeping in view the Covid-19 pandemic, spraying was done in office building. On 29th September, field waste was collected and put for its management through vermin composting. On 30th September sanitization was done in all buildings in the premises of campus and cleaning drive was done in office chambers by the staff. On 1st October, a poster show was organized in

which the work of Mahatama Gandhi Ji was highlighted. On 2nd October, 2020, on line meeting of staff was organized and Swachchata Pledge was taken by the staff. Dr D B Singh, Director and Dr Manoj Kumar, Head KVK Baramulla highlighted the life of Mahatama Gandhi. Some staff also wrote essay on Mahatama Gandhi. The Director emphasized to continue the Swachchata drive in our daily life.

Glimpse of activities during celebration 150th Birth Anniversary of Mahatama Gandhi Ji and Swachchata Abhiyaan at ICAR-CITH, Srinagar

At ICAR-CITH, Regional Station, Mukteshwar, cleaning and sanitization of the station premises was done and March on cleanliness was done on 25th September. Cleaning and sanitization of residential premises, office main road, Bhateliya/Sargakhet road, Mahadev temple road/, Gross Bazar, Khan Mohalla, and Surmane Band on different dates. An essay competition programme on Father of the Nation Mahatma Gandhi and Gandhian Ideology was organized on 1st Oct. 2020 in which all the staff including contractual participated. Celebrated 150th birth anniversary of father of the nation Mahatama Gandhi Ji on 2nd October, 2020 and organized awareness programme cum workshop on importance of Swachchhta in curtailment of Covid-19 pandemic, in which all the staff including contractual participated and. The participants who participated in the essay competition were also awarded with certificate and prize.

Glimpse of activities during celebration 150th Birth Anniversary of Mahatama Gandhi Ji and Swachchata Abhiyaan at at ICAR-CITH, Regional Station, Mukteshwar

Constitution Day

Constitution Day was celebrated at ICAR-CITH, Srinagar and its Regional Station, Mukteshwar on 26th November, 2020. During this day the address of various dignitaries were displayed and various staff shared their views. Director ICAR-CITH, Srinagar highlighted the importance of the day and a pledge was taken by all the staff.



Glimpses of programme organized on Constitution Day

Swachh Bharat Mission

A 16 days programme of **"Swachhta Pakhwada"** from "16th to 31st December 2020" was organized at ICAR-CITH, Srinagar. As per the programme staff members of the institute participated in the programme actively by following the SOPs of MOH, Govt of India regarding Covid. The staff took the Swachhta pledge, the oath was administered by the worthy Director ICAR-CITH, Srinagar. The programs included day-wise activities which comprised the plantation drive, sanitation drives, waste disposal, and other off-campus activities. Kisan Diwas was also celebrated on 23rd December 2020 involving progressive farmers to create general awareness on farmer rights. Swachh Bharat Mission was organized in the institute during the year 2020.the programme was organized by Dr W.H.Raja, Mr Eshan Ahad, Mrs Iqra Qureshi




Pledge and other activities carried out under Swachh Bharat Mission 2020

Swachh Bharat Mission Abhiyan

In Swachh Bharat Mission Abhiyan **(***Swachhta Hi Seva)* was celebrated from 16th December to 31st December, 2020 was organized at ICAR-CITH, RS, Mukteshwar. Day to day cleaning of the

station premises was done during all the working days in which roads, channels, temple, water bodies as well as office, chambers, laboratories, farm office, surrounding the residential quarters of the premises were cleaned and collected garbage, plastic, etc. Besides, awareness was created on Swachchta, harmful effect of plastic and single use plastic, garbage, and dirtiness. An emphasis has been also given on not to use single use plastic and join the Swachchta Abhiyan.. During the activity conducted under Mera Gaon Mera Garurav in Sunkiya village, awareness on Swachchta and not use single use plastic was also created.

Meeting organized for exploring possibilities of Horticulture and establishment of NRC Apricot in Ladakh

In order to explore the possibilities of R&D in Horticulture a meeting was organized at by ICAR-CITH, Srinagar at LAHDC office on 17th September, 2020 under the chairmanship of Shri Feroz Ahmad Khan, Chief Executive Councilor, Ladakh Autonomous Hill Development Council, Kargil. In this meeting various issues of the public representatives regarding exploring possibilities for establishment of NRC on apricot or Centre for Excellence on apricot or Regional Station of ICAR-CITH, Srinagar or strengthening of existing Government infrastructure for promotion of research in apricot were discussed. Besides the members from ICAR-CITH, Srinagar, the other members who participated in the meeting were Sh. Mohd Ali Chandan, Executive Councilor (Health / Revenue / Agriculture / Forest & Soil Conservation Forestry / Wild life / Industrial Training Institute) LAHDC Kargil, CHO, Kargil, members from SKUAST-K and other officials working in Horticulture sector in Kargil on 17th September, 2020 at Kargil. During the meeting discussion was made on existing status of research in apricot and limitation thereof. Status of area, production, productivity, processing, value addition and marketing were discussed. Committee explored the possibilities for identifying the role of ICAR in promoting research support for upliftment of apricot in Ladakh. Shri Feroz Ahmad Khan, Chairman/Chief Executive Councilor, Ladakh Autonomous Hill Development Council, Kargil and Mohd Ali Chandan, Executive Councilor (Health / Revenue / Agriculture / Forest & Soil Conservation Forestry / Wild life / Industrial Training Institute) LAHDC Kargil felt that research support for upliftment of apricot in Kargil is pivotal and establishment of research centre in any form should cater the needs for improvement in apricot productivity, quality and trade. CEC and EC, LAHDC assured full support for establishment of the research centre in either form at Kargil. A report covering all aspects discussed during the meeting was prepared by ICAR-CITH and was submitted to the Council.

Meeting held by ICAR-CITH, Srinagar with LAHDC, Kargil

Extension and other programs

Extension Activities

ICAR-CITH, Srinagar has emerged as a hub for generating farmer-friendly technologies through research on various aspects of temperate horticultural crops which in turn will boost the productivity of quality produce and benefit the farmers with higher returns. There is a lot of scope for the increasing area, production and productivity of quality produce of temperate horticultural crops in different regions of the country having temperate climatic conditions. The technologies generated need to be popularized among the stakeholders through various extension agencies/ means for uplifting the socio-economic status of farmers. The Central Institute of Temperate Horticulture, Srinagar and its regional stations are putting continuous efforts to make the farmers/ officers of line departments and other stakeholders apprised about various new technologies generated in temperate horticultural crops for improving the productivity of quality produce. The Institute has always strived to disseminate various technologies through various means of extension. But due to the conditions that prevailed during the last year because of the Covid 19 pandemic/ lockdowns comparatively less awareness could have been possible but in spite of that Institute and its Regional stations have actively worked for the benefits of farmers and many programmes were organized and awareness and dissemination of advisories have also been done through print, electronic and social media

The details of various programmes organized by ICAR-CITH during 2020 are presented under various heads.

ICAR-CITH, Srinagar

Training programmes organized for officers

The details of various training programmes organized during 2020 for officers and other staff of different line department is summarized in Table 32.

Table 32. List of training programmes organized for officers/ staff of line department by ICAR-CITH, Srinagar

Sr No.	Name of Programme	Venue	Date	No. of Participants	Organizers/ coordinators
1.	Vegetative Propagation in Walnut for the gardeners from Department of Forest, Uttarakhand	ICAR-CITH, Srinagar	18th to 27th February, 2020	9	O C Sharma J I Mir and W H Raja
2.	Walnut Propagation	Magra	5th Feb,2020	44	O C Sharma
3.	Walnut Propagation	Sony	7th Feb, 2020	32	O C Sharma
4.	Walnut Propagation	Silalekh	9th Feb, 2020	68	O C Sharma
5.	Packaging, handling and transportation of grafted plants	ICAR-CITH, Srinagar	3rd to 5th December, 2020	4	O C Sharma. J I Mir & W H Raja

Ten days training programme on vegetative propagation in walnut

ICAR-CITH, Srinagar organized a ten-day training programme on walnut propagation for staff members of the Department of Forest, UFRMP, Uttarakhand from 18th to 27th February 2020. Total 9 staff members participated and the programme was organized during peak grafting season of walnut at Srinagar. The programme was inaugurated by Dr D B Singh, Director ICAR-CITH, Srinagar, who highlighted the activities of the Institute going on in walnut propagation and production. He urged the participants to acquire a skill and try to gain maximum from the training programme. The participants were trained on various aspects of walnut propagation like seed sowing, stratification, raising of rootstocks, planting of rootstock, selection of scion wood, grafting techniques and other nursery management techniques. These techniques were both theoretically and practically demonstrated to the trainees by various scientists and technical staff of the institute. The progress of learning was also monitored by Sh S K Singh from UFRMP-JICA, Dr N C Nainwal and Range Officers from Uttarakhand from time to time. At the end of the programme, the participants became proficient in walnut propagation technique as evident by the success percentage of plants grafted by trainees.

Glimpses of ten days training programme for gardners

Three off campus training programmes organized in Uttarakhand

Three, one-day training programmes on walnut propagation and cultivation were organized at Magara, Sony, and Silalekh nurseries on 5th, 8th and 9th February 2020 in collaboration with UFRMP, Dehradun in which 44, 32 and 68 officers from the Department of Forest and some progressive farmers participated. Training and demonstrations were provided on various propagation methods suitable for walnut multiplication in Uttarakhand and other aftercare measures to be taken in walnut nursery production under protected conditions.

Demonstration on grafting during training at Magra, Sony and Silalekh

Training on Packaging, handling and transportation of grafted plants

A three days training programme was organized for the staff of UFRMP, Dehradun who visited ICAR-CITH, Srinagar from 3rd to 5th December, 2020 for lifting the planting material of walnut. The staffs was apprised for various aspects like uprooting, packaging, tagging, transportation and care to be taken during transportation of grafted walnut plants for their better survival in the field.

Training programme/ students visit

The experimental orchard blocks of different crops and well-equipped labs of various disciplines had made the Institute as center of learning for students from various schools, colleges and universities. During the year 5 visits/ training were organized for students. The details of students visit/ training from different organizations are presented in Table 33**.**

Table 33. List of schools/colleges who visited the ICAR-Central Institute of Temperate Horticulture during the year 2020

Date	Name of School/ University	No. of Students	Facilitated By
20th January,2020	SKUAST-K Shalimar, Srinagar (J&K)	30	Desh Beer Singh, W.H. Raja, Salwee Yasmin & Iqra Qureshi
21st January,2020	SKUAST-K, Shalimar, Srinagar (J&K)	25	J I Mir
25th January,2020	SKUAST-K, Shalimar, Srinagar (J&K)	25	J I Mir
14th February,2020	SKUAST-K, Shalimar, Srinagar (J&K)	25	O C Sharma
18th February,2020	SKUAST-K, Shalimar, Srinagar (J&K)	22	O C Sharma, J I Mir, W H Raja & Shoaib Nisar Kirmani

Visit of various student groups to ICAR-CITH.



Programme organized for farmers from Ladakh

Training programme/ Farm visit organized for Farmers of Ladakh

A three-day training programme was organized for the farmers of Ladakh (UT) from 1st to 3rd December 2020 on canopy management in temperate fruits. In this programme, 4 farmers from district Kargil participated and provided awareness on different training and pruning practices adopted for different temperate fruit crops especially apple, pear, apricot, peach, plum, and cherry. The participants were provided with practical demonstrations on these aspects as well. The concept of high density and the role of rootstocks in temperate fruits was also discussed in detail with the trainees by various scientists (Table 34).

Table 34. Training organized for farmers from Ladakh

Date	Topic	Area	No. of Farmers	Facilitated By
1st December to 3rd December, 2020	Canopy management in temperate fruits	Kargil (Ladakh)	4	O C Sharma, J I Mir and W H Raja

Glimpses of training programme for farmers of Ladakh

Training programme/ Farm visit organized for Farmers of Jammu and Kashmir

During the year, nine farmer groups sponsored by various agencies visited the Institute for a day training/ farm visit. The farmers were apprised about various technologies generated at ICAR-CITH in various horticultural crops. The details of various programmes are presented in Table 35.

Table 35. List of visits/ trainings organized for farmers at ICAR-Central Institute of Temperate Horticulture during the year 2020

Date	Department/Organization	Zone/ Area	No of participants	Facilitator/ Coordinator
10th February,2020	Department of Horticulture, J&K	Pulwama	100	W H Raja
17th February,2020	Department of Horticulture, J&K	Sumbal, Hajin, Bandipora, Aloosa	20 20 15 15	W H Raja
19th February,2020	Department of Horticulture, J&K	Kulgam	100	O C Sharma
6th March,2020	KVK Baramulla, J&K	Kunzer	26	O C Sharma
7th March,2020	Department of Horticulture, J&K	Ganderbal	70	W.H. Raja
7th March,2020	Department of Horticulture, J&K	Ganderbal and Kangan	61	K.L. Kumawat
25th November, 2020	KVK Kupwara	Kupwara	20	O C Sharma
25th November, 2020	KVK Kupwara	Kupwara	20	O C Sharma & J I Mir
24th December,2020	Deptt of Agriculture	Narbal Budgam	25	O C Sharma & J I Mir

		
10th February,2020	10th February,2020	7th March,2020
		
7th March,2020	19th February,2020	19th February,2020
		
6th March,2020	6th March,2020	6th March,2020
		
25th November, 2020	25th November,2020	25th Novembe,2020
Glimpses of varios farmers visits/ trainings		

Extension and other programmes organized at ICAR-CITH Regional Station Mukteshwar

The ICAR-CITH, Regional Station, Mukteshwar is also continuously disseminating the technologies through various extension activities on regular basis. In spite of all odds during the

year regional station, Mukteshwar has organized many programmes for officers, students, and farmers. The details of these programmes presented below.

Programmes organized for Officers

During 2020, two training programmes/ visits of one day duration were organized for Subject Matter Specialist of KVK's & officers from UFRMP, department of Horticulture & progressive farmers and detail of programmes is presented in Table 39

Training programme on walnut propagation

ICAR-CITH, Regional Station, Mukteshwar organized a one-day training programme on walnut propagation technique for quality planting material production in which 41 participants from the department of Forest, department of Horticulture and progressive farmers participated. The participants were apprised in detail about the importance of walnut cultivation and vegetative propagation for boosting the quality production of walnut. Participants were apprised practically regarding various propagation aspects like raising of rootstock, scion wood selection, propagation methods & time as well as the aftercare of plants in the nursery.

Exposure visit of SMSs of KVKs of ICAR-ATARI Zone VII Umiam, NEH Region

ICAR- CITH, Regional station, Mukteshwar organized a visit of SMSs of KVKs of ICAR-ATARI Zone VII Umiam, NEH Region to the station on 13th February, 2020 in which 17 participants participated. The participants were apprised regarding the various research activities going on temperate horticultural crops and technologies generated for the benefits of the farmers(Table 36).

Glimpses of training programme at ICAR-CITH, Mukteshwar

Table. 36. Training programmes organized for officers at ICAR-CITH, R S Mukteshwar

Sr No	Name of programme	Venue	Date	Partici pants	coordinators	Organizer/
1	Walnut propagation for quality planting production	ICAR-CITH RS, Mukteshwar	10th February, 2020	30	Dr Raj Narayan Dr Arun Kishor & Dr O C	Dr Raj Narayan Dr Arun

					Sharma	Kishor & Dr O C Sharma
2	Exposure visits of SMSs of KVKs of ICAR-ATARI Zone VII Umiam, NEH Region	ICAR-CITH RS, Mukteshwar	13th February,2020	17	Dr Raj Narayan Dr Arun Kishor	Dr N.K. Hedau, ICAR-VPKAS, Almora

Training programme/ students visit

During the year, one training/ visits for students were organized at ICAR-CITH, RS Mukteshwar in which 44 students participated and details of programmes is presented in the Table 37.

Table 37. Visits/ training organized for students ICAR-CITH, RS Mukteshwar

Date	Name of School/ College/ University/ Institute	Number	Facilitated By
29th February,2020	B.A. (H) Geography students of Shyama Prasad Mukherji College for Women (University of Delhi)	44	Akhil Thukral & Puran Chandra

Farmers Visit

During the year one group of farmers visited ICAR-CITH, RS Mukteshwar for awareness of various technologies in temperate horticultural crops (Table 38).

Table 38. Farmers visit to ICAR-CITH, Regional station, Mukteshwar

Date	Department/ Organization	Zone/District	Number	Facilitator/ Coordinator
25.05.2020	Exposure visit-cum training on Water management on the occasion of Jal Diwas.	Nainital	10	Dr Raj Narayan, Dr Arun Kishor

Farmers Training, Demonstration and awareness programmes

ICAR-CITH, RS Station Mukteshwar has organized number of training programmes (on & off campus) for farmers of different areas of Uttarakhand. The list of various programmes is presented in Table 39.

Table 39. One day trainings, demonstrations and awareness programmes and lectures delivered by CITH RS, Mukteshwar

Training/Demonstration/Day etc.	Date	Date & Venue	No of participants	Nodal Person

Training, pruning and propagation of temperate fruit crops	3rd January,2020	ICAR-CITH RS, Mukteshwar	23	Dr Arun Kishor
Training on Training, pruning and propagation of fruit crops	4th January,2020	ICAR-CITH RS, Mukteshwar	39	Dr Arun Kishor
FAP on Training, Pruning and propagation of Temperate fruit crops	21st Janary,2020	ICAR-CITH RS, Mukteshwar	12	Dr Arun Kishor
Collaborative training – demonstration on propagation of horticultural crops and animal health management	22nd January, 2020	Jurkafun	12	Dr Arun Kishor (CITH RS, Mukteshwar), Dr C. Jana (IVRI, Mukteshwar)
FAP on Training, pruning in temperate fruit crops and scientific method of potato cultivation	1st February, 2020	Sunkiya	24	Dr Raj Narayan Dr Arun Kishor
FAP on training & pruning of temperate fruit and Demonstration on Potato planting and cultivation	3rd February, 2020	Sunkiya		Dr Raj Narayan Dr Arun Kishor
Training on Gunvatta ropan samagri hetu akhrot pravardhan taknik	10th February, 2020	ICAR-CITH RS, Mukteshwar	41	Dr Raj Narayan, Dr Arun Kishor, Dr O.C. Sharma
Training on Sabji phasal utpadan mein vividhikaran taknikiyan	12th February, 2020	ICAR-CITH RS, Mukteshwar	60	Dr Raj Narayan Dr Arun Kishor
Training on Lagat anurup sabji phasal evam paudh utpadan taknikiyan	13th Februay, 2020	ICAR-CITH RS, Mukteshwar	68	Dr Raj Narayan Dr Arun Kishor
FAP-Demonstration on Potato planting and cultivation	24th February, 2020	Sunkiya Naveen	24	Dr Arun Kishor
ATMA Collaborative training Fruit and vegetable cultivation techniques	4th March, 2020	Kanarkha, Sarna	25	K.K. Pant (ATMA, Nainital) Dr Raj Narayan, Dr Arun Kishor
FAP-Demonstration on Capsicum planting and cultivation	23rd May, 2020	Sunkiya	11	Dr Arun Kishor
Visit farmer field under MGMG scheme	10th June, 2020	Naveen Sunkiya	5	Dr Raj Narayan Dr Arun Kishor
Visit of farmer field under MGMG scheme	7th august, 2020	Sunkiya	5	Dr Raj Narayan Dr Arun Kishor
Visit of farmer field under MGMG scheme at adopted village Sunkiya	21st August, 2020	Sunkiya	4	Dr Raj Narayan Dr Arun Kishor

Delivered lecture on advanced production techniques of temperate fruits in the 7 days training programme organized by department of horticulture Bhimtal for the covid-19 affected farmers/non-resident farmers at Aksaura, Padampuri.	16th September, 2020	Aksaura, Padampuri	20	Dr Arun Kishor
Delivered lecture on advanced production techniques of temperate fruits in the 7 days training programme organized by department of horticulture Bhimtal for the covid-19 affected farmers/non-resident farmers at Bohrakun, Bhimtal.	17th September, 2020	Bohrakun, Bhimtal.	20	Dr Arun Kishor
National Women Kisan Divas in collaboration with ICAR-DFMD, Mukteshwar	15th October, 2020	Pangrari	11	Dr Arun Kishor Dr C. Jana
Visit of farmer field & FAP-Demonstration on Garlic planting and cultivation under MGMG scheme	17th October, 2020	Sunkiya	11	Dr Arun Kishor
Delivered lecture on advanced production techniques of temperate fruits in the 7 days training programme organized by department of horticulture Bhimtal for the covid-19 affected farmers/non-resident farmers at Nathuakhan, Ramgarh.	18th October, 2020	Nathuakhan, Ramgarh.	20	Dr Arun Kishor
Delivered lecture on advanced production techniques of temperate fruits in the 7 days training programme organized by department of horticulture Bhimtal for the covid-19 affected farmers/non-resident farmers at Ladfaura, Padampuri.	4th November, 2020	Ladfaura, Padampuri.	20	Dr Arun Kishor
Visit of farmer field & FAP-Demonstration on Garden Pea planting and cultivation under MGMG scheme	11th November, 2020	Sunkiya	11	Dr Arun Kishor Sh. Narayan Singh
Kisan Diwas in collaboration with ICAR-DFMD, Mukteshwar pangrari Village.	23rd December, 2020	Pangrari	20	Sh. Puran Chandra Sh. Narayan Singh Dr. C. Jana

Glimpses of training programme in Uttarakhand

ICAR-CITH, Regional Station, Dirang

The various extension activities carried out at regional station Dirang are briefly summarized below.

- To expand area under temperate fruit crops, 1575 grafted apple and 1000 grafted walnut plants were supplied to District Horticulture Officer Bomdila on 19th Feb., 2020 for distribution among the farmers of West Kameng district of Arunachal Pradesh.
- Programme were organized for Creation of awareness among the farmers of Chug village, West Kameng district about temperate fruit production and vegetable seed kits (20 vegetables crops) was distributed among 50 farmers on 28th Feb., 2020.
- Gap filling has done at Namthung and Zimthung village demonstration site (established during Jan. – Feb. 2019) on 27th Feb., 2020 and 1st March, 2020 respectively.
- On farm training on pruning in temperate fruit crop was done at one of the demonstration site at Zimthung village on 1st March.
- Participated in N.F.D.B. sponsored Skill development/Training programme as Guest of Honour which was organized by Krishi Vigyan Kendra, West Kameng, on 28th February, 2020 at Chug village. Created awareness among the farmers about temperate fruit production and distributed vegetable seed kits among 50 participants.

Implementation of Tribal Sub Plan (TSP)
District Rajouri and Poonch

Workshop cum Training Programme at Tribal Region of Poonch

ICAR-Central Institute of Temperate Horticulture, Srinagar organized one day workshop on "Plant Variety Protection and Farmer's Right Act" on 22nd February, 2020 at district Poonch of Jammu &Kashmir. The workshop was organized in collaboration with KVK, Poonch for identification, protection, registration and promotion of farmers varieties in temperate fruits and nuts. Since this district is located in the frontier border area where awareness about identification and utilization of elite farmers varieties is lacking and therefore the need for identification, protection, registration and large-scale promotion was felt for upliftment of the farmers in the region. Thus, keeping in view, the unutilized resources of this district scientific team from ICAR-CITH, Srinagar comprising of Dr Javid Iqbal Mir, Senior Scientist &Nodal Officer TSP, Dr Wasim Hassan Raja, Scientist & In-charge TSP for Poonch and Dr Muzaffer Ahmad Mir, SMS (Fruit Science), KVK, Poonch organized this workshop to provide awareness among more than one hundred farmers about the importance of varietal protection with particular reference to walnut, pecan nut and apricot. At present farmers of the region are growing these crops as non-descriptive genotypes and thus get produce as mixture which has minimum market demand and least consumer acceptance. Therefore, it was emphasized that identification, protection and utilization of specific elite varieties in these crops can increase the value of produce manifolds and provide special denomination with recognition to the farmer in general and the region in particular. Farmers showed keen interest in protection of their precious resources by adopting mode of varietal protection through PPV&FRA. As a part of the TSP programme planting material of elite cultivars of apple, apricot, walnut and pear developed by the Institute was distributed among the tribal farmers of the region to improve their livelihood.

Training on high density plantation and canopy management and distribution of planting material under tribal farmers at Rajouri

A one-day training programme on high-density plantation and canopy management was organized at Rajouri on 20th February 2020 under the TSP scheme. The training was imparted to 50 tribal farmers of the region by Dr Javid Iqbal Mir, Senior Scientist, ICAR-CITH, Srinagar and Dr Wasim Hassan Raja, Scientist, ICAR-CITH, Srinagar. During the event planting material of apple, apricot, cherry, pear, etc was also distributed among 50 tribal farmers of the Rajouri district. The programme was organized in collaboration with the department of Horticulture, Rajouri.

Demonstration of CITH walnut varieties and distribution of planting material among tribal farmers under TSP scheme at Poonch.

Demonstration of ten walnut varieties (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 & CITH-W-10) was laid on farmer's field at Poonch. Four tribal farmers of Poonch were identified by Dr Javid Iqbal Mir, Senior Scientist, ICAR-CITH, Srinagar and Dr Wasim Hassan Raja, Scientist, ICAR-CITH, Srinagar in coordination with Dr Muzaffer Ahmad Mir, SMS (Fruit Science), KVK, Poonch for laying down the demonstrations in walnut varieties on 21st February 2020. On the same date planting material of apple, apricot, pear and cherry were distributed among forty tribal farmers of district Poonch under the TSP scheme. Training and awareness about planting, orchard management and canopy management were imparted to 40 tribal farmers on 21st February 2020.

Implementation of Mera Gaon Mera Gaurau Programme

Jammu & Kashmir

Anantnag

For implementation of Mera Gaon Mera Gaurav programme planting material of apple, apricot, almond, cherry, plum and pear were distributed among 100 beneficiaries at Hatigam village of district Anantnag, Jammu & Kashmir on 9th March, 2020. Team comprised of Dr Javid Iqbal Mir, Dr Wasim Hassan Raja and other staff members of ICAR-CITH, Srinagar implemented this programme at Hatigam village under which various visits were made for generating awareness among the farmers of the village about MGMG scheme. On 9th March, 2020 team distributed 1500 apple plants on clonal rootstock, 750 apple plants on seedling rootstock, 300 almond plants, 200 pear plants, 200 cherry plants, 250 plum plants and 350 plants of apricot among the 100 beneficiaries.

Uttarakhand

Mukteshwar

Mera Gaon Mera Gaurav: ICAR- CITH RS, Mukteshwar has adopted Sunkiya village under Mera Gaon Mera Gaurav. The village is situated at 1750 meters above mean sea level (29° North latitude and 79° East longitudes) in Dhari tehsil of Nainital district. Two no of trainings, four diagnostic/field visits were conducted and four demonstrations were laid in which 68 farmers were covered. The farmers of the village were also supported with different technological literatures on temperate fruits and vegetables. Further, a mobile-based advisory was also provided to the farmers of the village as and when approached/ required.

Field visits and training programmes under MGMG

Radio/ TV Talks

Due to pandemic prevailed during the year, the less physical programme could have been possible but to cater to the need of farmers time to time advisories were issued through various media. To disseminate the technologies through mass media for their adoption on a larger scale, scientists of ICAR-CITH, Srinagar continuously delivered need-based talks on various topics beneficial for farmers and line departments. A total 19 no of TV/Radio talks were delivered by various scientists during the year is presented in Table 40.

Table 40. Radio/ TV talks delivered by scientist of ICAR-CITH during 2020

Sr No	Name of Scientist	No. of talks
1	Dr D B Singh	2
2	Dr O C Sharma	2
3	Dr J I Mir	2
4	Dr Geetika Malik	1
5	Dr W H Raja	9
6	Sh Sajad Un Nabi	3
	Total	**19**

Trainings and Capacity Building

The staff of ICAR-CITH is continuously deputed to attend various training programmes organized by various organizations to upgrade their knowledge and skill. During 2020, four scientists and one Sr. Technical officer were deputed for below mentioned trainings and have successfully completed the trainings.

Trainings attended by Scientific Staff

Dr Geetika Malik, Scientist (Vegetable Science)

- Attended Ten days online national workshop on 'Underutilized Plant Species: Future Smart Crops for Food, Nutritional Security and Income Generation organized by AICRP on Vegetable Crops, Srinagar Centre, Division of Vegetable Science in collaboration with IDP-NAHEP, SKUAST-K from 20th to 29th August, 2020.

Dr K L Kumawat, Scientist (Fruit Science)

- Attended winter school on Non-Conventional Approaches for Genetic Improvement of Perennial Horticultural Crops organized by Division of Fruit Science, IARI, New Delhi *w.e.f.* 17th January to 6th February, 2020.

Dr Sajad Un Nabi, Scientist (Plant Pathology)

- Attended workshop on Virus Diagnostics and Metagenomics For Virus Discovery from 21st to 22nd February, 2020 at ICAR-IARI, New Delhi

Sh. Madhu G S, Scientist (Plant Pathology)

- Attended 110th FOCARS **(**Foundation Course for Agricultural Research Services**)** training program in NAARM, Hyderabad from 7th January, 2020 to 30th March,2020.
- Attended three months professional attachment training in ICRISAT on 'Detection and diagnosis of plant viruses and aflatoxins from 12th September, 2020 to 12th January, 2021.

Trainings attended by Technical Staff

Dr Shoaib Nissar Kirmani, Senior Technical Officer

- Attended two weeks training programme on General Management Programme for Scientists held at Administrative Staff College of India, Billa Vista, Hyderabad sponsored by Department of Science and Technology, GOI, New Delhi from. 24th February to 6th March, 2020. The expenditure incurred is presented in Table 41.

Table 41. HRD Fund Allocation and Utilization

Head	Allocation	Expenditure (Rs in Lakhs)
	0.009	0.009

Awards/ Rewards/ Recognition

Dr J I Mir

- Received recognition for esteemed contribution, dedicated and tireless efforts during 21 days National Innovative Training Programme on "Recent technologies of agribusiness management and agri entrepreneurship" jointly organized by RVSKVVG, MP and NADCL, Baramulla from 8th to 28th October, 2020.
- Received recognition for highly esteemed contribution, sincere efforts and unending support in implementing and conducting 21 days advanced national training programme on "Recent scientific interventions and practices of sugarcane breeding, production, protection and utilization for doubling farmers income" jointly organized by ICAR-SBI, Coimbatore and NADCL, Baramulla from 1st to 21st December, 2020.

Dr Arun Kishor

- Received Young Scientist Award in the 11th International Conference on "Agriculture Horticulture and Plant Sciences India organized by The Society of Tropical Agriculture, New Delhi from 19th to 20th December, 2020 at STA Office, New Delhi,

Sh. Sajad Un Nabi Naingroo

- Received best oral presentation award for paper presentation on Morpho-molecular characterization of *Diplodia* spp. associated with apple canker disease in India in IPSCONF 2020 held at ICAR-IARI, New Delhi, India from 16th to 20th January 2020.

Dr Sovan Devnath

- Received best poster presentation award for the paper entitled "Is zinc and iron good cousin in cereals bred over decades since the Green Revolution in India?" presented in the National Webinar on "Agrochemicals for up keeping environment" organized by the Society for Fertilizers and Environment in collaboration with Bidhan Chandra Krishi Viswavidyalaya on 27th August, 2020.

Publications

Research Papers (International/ National)

- Debnath S, Attri B L, Kumar A, Kishor A, Narayan R, Sinha K, Bhowmik A, Sharma A and Singh D B 2020. Influence of peach (*Prunus persica* Batsch) phenological stage on the short-term changes in oxidizable and labile pools of soil organic carbon and activities of carbon-cycle enzymes in the North-Western Himalayas. Pedosphere. 30(2): 1–13.
- Debnath S, Narayan R, Kumar A, Kishor A and Singh D B 2020. Are horticulture-based land uses benign for fertility and health of soils in mid to high hills of the north-western Himalayan region? Soil Science and Plant Nutrition (DOI:10.1080/00380768.2020.175311 0)
- Dubey A K, Saritha R K, Nabi S U and Barnwal V K 2021. Seed transmission and effect of leaf crinkle disease on seed quality in urdbean (Vigna mungo L. Hepper) under controlled environment. Indian Phytopathology 74 : 277-281 (https://doi.org/10.1007/s42360-020-00316-w)
- Kumar A, Attri B L, Kishor A, Debnath S, Mer M S and Narayan R 2020. Influence of rootstocks on white root rot (Dematophora necatrix) resistance in apple (Malus baccata). Indian Journal of Agricultural Sciences, 90(1): 53-57
- Kumawat K L, Raja W H, Singh D B, Chand L, Mir J I, Rai K M and Kirmani S N 2020. Effects of plant growth regulators applications on induction of lateral branching in Oregon Spur apple nursery trees. Indian J. Hort. 77(1): 72-79
- Malik G, Shabir A, Shah R A, Nissar R, Masoodi L, Selvakumar R, Nabi S U and Kirmani S N 2020. Sugars and pungency of different day length adapted onions (Allium cepa L.) grown in long day temperate climate of Kashmir valley. International Journal of Chemical Studies 8(4): 3790-3794 (DOI: https://doi.org/10.22271/chemi.2020.v8.i4av.10234)
- Mir J I, Ahmed N, Singh D B, Sharma O C, Raja W H, Shafi W, Zaffer S, Jan S and Kirmani S N 2020. Canopy management to improve fruit quality of Coe Red Fuji, Granny Smith and Spartan varieties of apple (Malus domestica). Indian Journal of Agricultural Sciences 90 (8): 1397–1401
- Mir J I, Jan A, Rashid M, Singh D B, Raja W H, Sharma O C, Sharma A, Lal S, Kumawat K L, Nabi S U and Chand L 2020. Genetic variability studies for various morphological and quality traits in apple. Indian J. Hort. 77(2): 227-236
- Nabi S U and Baranwal V K 2020.First report of Apple Hammerhead Viroid infecting apple cultivars in India. Plant Disease 104 (11) (https://doi.org/10.1094/PDIS-12-19-2731-PDN)
- Nabi S U, Baranwal V K, Yadav M K, Rao G P 2020. Association of Apple necrotic mosaic virus (ApNMV) with mosaic disease in commercially grown cultivars of apple (Malus domestica Borkh) in India. 3 Biotech 10 (3): 1-9.(https://doi.org/10.1007/s13205-020-2117-6)

- Nabi S U, Sheikh M A, Raja W H, Mir J I, Sharma O C, Singh D B, Yousuf N, Shafi M, Khan K A, Yadav M K, Kamil D 2020. Morphological and molecular characterization of Diplodia spp. associated with apple canker disease in India. Crop Protection 137: 105238 (https://doi.org/10.1016/j.cropro.2020.105238).
- Sheikh A A, Jabeen N, Yousuf N, Rasool A, Sofi P A, Nabi S U and Bhat T A 2020. Stability analysis in French bean genotypes for different traits under temperate conditions of Kashmir valley, The Pharma Innovation Journal 9(1): 230-234
- Sheikh M A, Mushtaq K, Mir J I, Amin M and Nabi S U 2020. Introgression of scab resistance gene Vf (Rvi6) in commercially grown susceptible cultivar Fuji Azitec of apple (Malus domestica) using Marker Assisted Selection. Research Journal of Biotechnology 15 (9):50-56.
- Sheikh M, Sharma V, Mudasir A. Mir J I, Nabi S U, Ahmed N, Alkahtani J, Alwahibi M S, Masoodi K Z 2020. Quantification of polyphenolic compounds and relative gene expression studies of phenylpropanoid pathway in apple (Malus domestica Borkh) in response to Venturia inaequalis infection, Saudi Journal of Biological Sciences 27(12): 3397-3404
- Singhal P, Nabi S U and Yadav M K 2020. Mixed infection of plant viruses: diagnostics, interactions and impact on host. J Plant Dis Prot. https://doi.org/10.1007/s41348-020-00384-0
- Verma M K, Sharma V K, Lal S, Mir J I, Sofi A A, Singh D B, Husain P A, Mir M A, Mir A and Bhat H A 2020. Quality profiling of Indian walnut (Juglans regia L) from Kashmir valley. Indian Journal of Agricultural Sciences 90 (3): 573–6

Review Papers

- Ahmad N, Malik A A, Hussain K, Malik G, Wani S A, Rather A M and Magaray M (2020) Nutraceutical and bioactive healthy compounds in vegetable crops. International Journal of Chemical Studies 8 (4): 3078-3086.(DOI: 10.22271/chemi.2020.v8.i4ak.10120)
- Madhu G S, Nabi S U, Mir J I, Raja W H, Sheikh M A, Sharma O C, Singh D B 2020. Alternaria leaf and fruit spot in apple: Symptoms, cause and management. European Journal of Biotechnology and Bioscience 8(3): 24-26

Books

- Desh Beer Singh, O C Sharma and J I Mir 2020. Post harvest handling and value addition of temperate fruits and nuts. Daya Publissing House, Astral International Pvt Ltd, New Delhi
- S P Kanaujia, C S Maiti and R Narayan 2020. Text Book of Vegetable Production (2nd Edition). Today and Tommorow's Printers and Publishers, Dariyaganj, New Delhi, 442p.

Book chapters:

- Kishor A, Narayan R and Tripathi A 2020. Canopy Management Practices and their Importance in Temperate Fruit Crops. *In:* Climate Smart Agriculture. Biotech Books, New Delhi, pp 51-70

- Jayalakshmi K, Bhaskar B, Lakshmi M A, Maharana C, Acharya L K , Madhu G S**,** Saranya R, Licon A and Madhvan 2020. Impact of Climate Change on Host-Pathogen Interactions and its Implications on Crop Disease Management. In**:** Climate Change and Indian Agriculture: Challenges and Adaptation Strategies. NAARM, pp 271-294.

Technical bulletins/ pamphlet/folders

- K.L. Kumawat, W.H. Raja, D.B. Singh, O.C. Sharma, J.I. Mir, A. Sharma, Sajad Un Nabi and S.N. Kirmani. 2020. Tall Spindle- A promising high density orchard planting system for apple. Technical Bulletin. ICAR-CITH, Srinagar
- O C Sharma, D B Singh, J I Mir, K L Kumawat, Wasim H Raja, Sajad Un Nabi, Raj Narayan, Arun Kishor, S N Kirmani, Danish Bashir, Saima Zahoor, Nida Yousuf and M A Sheikh 2020. Quality Planting Material Production in Walnut. Technical Bulletin (English). ICAR-CITH, Srinagar
- O C Sharma, D B Singh, J I Mir, K L Kumawat, Wasim H Raja, Sajad Un Nabi, Raj Narayan, Arun Kishor, S N Kirmani, Danish Bashir, Saima Zahoor, Nida Yousuf and M A Sheikh (2020). Akhrot mein gunvata ropan samagari ka utpadan. Technical Bulletin (Hindi). ICAR-CITH, Srinagar
- A Kishor, R Narayan, , R K Singh and V Chandra 2020. Akhrot pravardhan ki vanaspatik. *vidhiyan*. ICAR-CITH Regional Station, Mukteshwar, Nainital (UK), Leaflet No. 05/2020.

Popular articles

- R Narayan, M Mer, R K Singh and A Kishor 2020. *Sabji matar ki vaigyanik kheti*. *Phal Phool* (March-April), 26-28.

Participation in Workshops/ Conference/ Meeting

Dr D B Singh, Director

- Attended Director's meet/ conference (video conferencing) on 18th & 19th March, 2020
- Attended 68th meeting of Board of Management of SKUAST-K, Srinagar on 11th January, 2020 at Shalimar, Srinagar.
- Attended and delivered Guest lecture on Bio security during in home training on Bio security on 30th January, 2020 organized by Livestock Development Board (NPcBB) at Srinagar.
- Attended Grand Finale of Agriculture Quiz (Yus Kari Gongul Siu Kore Kraav) as chief guest organized by Parsar Bharti Doordarshan Kendra Srinagar on 17th February, 2020 at Srinagar.
- Attended Directors Conference (online) on 5th December, 2020.
- Attended ICAR-RCM-1 (online) on 30th June, 2020.

Dr O C Sharma, Principal Scientist (Horticulture)

- Attended meeting organized for exploring possibilities of Horticulture/establishment of NRC Apricot in Ladakh held on 17th September, 2020 with LAHDC, Kargil.
- Attended Director's meet/ conference (video conferencing) on 18th & 19th March, 2020
- Attended Directors Conference (online) on 5th December, 2020.
- Attended ICAR-RCM-1 (online) on 30th June, 2020.

Dr J I Mir, Sr Scientist (Plant Biotechnology)

- Attended meeting organized for exploring possibilities of Horticulture/establishment of NRC Apricot in Ladakh held on 17th September, 2020 with LAHDC, Kargil.
- Attended and organized 4th QRT meeting of ICAR-CITH, Srinagar (online) on 19th December, 2020
- Attended online meeting on Third Party Evaluation of ICAR Schemes on 16th September, 2020.
- Attended first zoom webinar and training on DUS data management/Automation/Image analysis on 6th & 7th October, 2020.
- Attended Director's meet/ conference (video conferencing) on 18th & 19th March, 2020
- Attended Directors Conference (online) on 5th December, 2020.
- Attended ICAR-RCM-1 (online) on 30th June, 2020.

Dr Arun Kishore, Scientist (Fruit Science)

- Attend International E-Conference on 'Advances and Future Outlook in Biotechnology and Crop Improvement for Sustainable Productivity' organized by the Department of Biotechnology and Crop Improvement, College of Horticulture, UHS Campus, GKVK Post, Bengaluru during 24th to 27th November, 2020
- Attended International Plant Physiology Virtual Conference (IPPVC-2020) on "Prospects of Plant Physiology for Climate Proofing Agriculture" organized by Sher-e-

Kashmir University of Agricultural Science & Technology, Jammu and Indian Society for Plant Physiology, New Delhi on 6th & 7th December, 2020.

- Attended XXXVIII Group Meeting of All India Coordinated Research Project on Vegetable Crops held on 25th to 27th September, 2020 in Virtual Mode.

Sh. Sovan Debnath, Scientist (Soil Science)

- Attended national webinar on 'Agrochemicals for upkeeping environment' organized by Society for Fertilizers and Environment held on 27th August, 2020 at BCKV, Mohanpur
- Participated in 'International webinar on plant physiological paradigms towards agricultural sustainability under climate change' held on 15th September, 2020 at BAU, Sabour

Dr Geetika Malik, Scientist (Vegetable Science)

- Attended Online Workshop on Nutraceuticals and Bioactive Health Compounds in Vegetable Crops: An immune boosting food to combat COVID-19 organized by Division of Vegetable Science in collaboration with NAHEP, SKUAST-K, Shalimar from 15th to 17th June, 2020.

Sh Sajad Un Nabi, Scientist (Plant Pathology)

- Attended 7th International conference on Phytopathology in achieving UN Sustainable Development goals held from 16th to 20th January, 2020 at New Delhi, India and delivered Oral presentation on Morpho-molecular characterization of Diplodia spp. associated with apple canker disease in India,
- Attended Virocon-2020 on international conference on evolution of viruses and viral diseases held at INSA New Delhi from 1818th to 20th February, 2020 and delivered oral presentation on "Virome analysis in apple using next generation sequencing: insights into the etiology of apple mosaic disease and development of virome based multiplex PCR
- Attended National Symposium on Modern trends and bioprospecting of fungi on 16th December, 2020 organized by Indian Phytopathological Society in virtual mode.
- Attended National webinar on Management of root rot diseases of horticultural crops on 24th November, 2020 organized by Department of Horticulture, Rajendra Prasad Agricultural University Pusa, Bihar

Mr Madhu G S, Scientist (Plant Pathology)

- Attended International E-Conference on "Multidisciplinary approaches for plant disease management in achieving sustainability in agriculture" organised by Department of Plant Pathology, College of Horticulture, Bengaluru, University of Horticultural Sciences, Bagalkot, India from 6th to 9th October, 2020.
- Attended 110th FOCARS **(Foundation Course for Agricultural Research Services)** training program in NAARM, Hyderabad from 7th January 2020 to 30th February, 2020.
- Attended three months professional attachment training in ICRISAT on 'Detection and diagnosis of plant viruses and aflatoxins" from 12th September, 2020 to 12th January,2021.

List of Ongoing Projects

I. Institute Research Projects	
A. Project: Crop improvement and Biotechnology **Sub projects**	
1.	Survey, collection, characterization and documentation of temperate horticultural crops
2.	Breeding for development of superior varieties/hybrids in solanaceous vegetables
3.	Development of superior cultivars/ hybrids in temperate fruits through conventional and non conventional methods
4.	Characterization and diversity analysis of flowering related gene/ genes in almond
5.	Development of CMS lines in long day onion [Allium cepa L]
6.	Breeding of nutrarich varieties or hybrids in root vegetable crops.
B. Project: Crop Production and Propagation **Sub projects**	
1.	Development of almond based saffron inter cropping system
2.	Standardization of integrated nutrient management of vegetables as intercrop in apple orchard
3.	Enhancement in multiplication rate of clonal rootstocks for production of quality planting material under protected conditions
C. Project: Crop Protection **Sub projects**	
1.	Diagnosis and prognosis of apple viral diseases – Spatial and temporal variation in virus infection in apple
2.	Elucidating the diversity, species spectrum and screening of germplasm against Alternaria spp. infecting temperate fruits
D. Project: Post Harvest Management **Sub projects:**	
1.	Refinement of process technology and up-scaling of product for demonstrations and exhibitions
E. Ongoing externally funded projects **Sub projects**	
1.	Network project on onion and garlic (co-operation centre)
2.	All India Coordinated Research Project (Vegetable Crops)
3.	Intellectual property management and transfer/ commercialization of agricultural technology scheme (NAIF)
4.	Challenge programme on canopy management and plant architectural engineering in temperate fruits
5.	DUS testing centre for temperate fruits
6.	Development of an electronic nose sensor to determine the optimum harvesting time for apple and papaya
7.	Walnut propagation for production of quality planting material
8.	Validation and development of DUS testing guidelines for olive

Research Review and Management Committees

Research Advisory Committee

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. V. 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 Sh. Shyam Lal Panjla, Tehsil 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** Deptt of Horticulture, Deharadun, Uttarakhand		Member
4.	**Dr Mohannad Salim Mir** Associate Director Research , SKUAST-K, Shalimar		Member
5.	**Dr. S K Singh** Head, Division of Fruit and Horticulture Technology, IARI, New Delhi.		Member
6.	**Dr. Subhash Chander** Professor, Division of Entomology ICAR-IARI, New Delhi		Member
7.	**Dr. Sheikh Mohd Sultan** I/C Scientist ICAR-NBPGR, Regional Station, Srinagar (J&K)		Member
8.	**Dr. Javid Iqbal Mir** Senior Scientist (Biotechnology), ICAR-CITH, Srinagar (J&K)		Member
9.	**Dr. Hina Shafi Bhat** D/O Sh. M.S. Bhat R/O M.P. Lane Kursoo, Rajbagh, Srinagar -190008		Member / Progressive Farmer
10.	**Sh. Desh Kumar Nehru** S/O Sh. Shyam Lal Panjla, Tehsil Rohama , Distt. Baramullah (J&K)		Member / Progressive Farmer
11.	**Asstt. Director General (HSII)** ICAR, KAB-II, Pusa, New Delhi-110012		Member/Council representative
12.	**Sh Fayaz Ahmad Dar** **AF&AO**		Co opted Member
13.	**Administrative Officer** ICAR-CITH, Srinagar (J&K)		Member Secretary

Quinquennial Review Team

1.	**Dr Vijay Singh Thakur** Former Vice- Chancellor Dr YSP University of Horticulture and Forestry, Solan	Chairman
2.	**Dr S N Pandey** Ex-ADG, ICAR, New Delhi	Member
3.	**Dr. P Kalia** Ex-Head, Vegetable Division, IARI, New Delhi	Member
4.	**Dr S K Dash** Former Dean, College of Agricultural Engg and Technology, OAUT Bhubaneshwar	Member
5.	**Dr R K Jain** Former Dean, IARI New Delhi	Member
6.	**Dr Javid Iqbal Mir** Sr Scientist, ICAR-CITH, Srinagar	Member Secretary

Personnel

ICAR-CITH Head Quarter, Srinagar

RMP

- Dr. Desh Beer Singh, Director

Scientific

- Dr. O. C Sharma, Principal Scientist (Horticulture)
- Dr. J.I. Mir, Senior Scientist (Plant Biotechnology)
- Dr. Geetika Malik, Scientist (Vegetable Science)
- Dr. Wasim Hassan Raja, Scientist (Fruit Science)
- Dr. Sajad Un Nabi Naingroo, Scientist (Plant Pathology)
- Sh. Madhu G S, Scientist (Plant Pathology)

Administrative

- Sh. Fayaz Ahmad Dar, FAO
- 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
- Sh. Khushi Ram, LDC

Technical

- Dr. Shoaib Nissar Kirmani, Senior Technical Officer (T-6)
- Sh. Eshan Ahad**,** Tech. Officer (T-5)
- Dr. Muneer Ahmad Sheikh, Technical Officer(T-5)
- Sh. Mehraj-ud-Din Bhat, Sr. Technical Assistant (T-4,Driver)
- Sh. Farman Ali, Sr. Technical Assistant (T-4, Driver)
- Sh. Mohammad Ramzan Wani, Technical Assistant (T-1-3.)
- Smt. Mubeena, Technician (T-3)
- Sh Ishtiyaq Ahmad Sheikh, Sr.Technician (T-2, Field)

Skilled Supporting Staff

- Sh. Ajaz Ahmad Wani, SSS

- Sh. Bashir Ahmad Dar,SSS
- Sh. Showkat Ahmad Dar, SSS
- Sh. Abdul Rashid Bhat, SSS
- Sh. Bashir Ahmad Ganai, SSS
- Sh. Zubair Ahmad Swathi, SSS
- Sh. Madan Lal, SSS
- Sh. Ghulam Nabi Bhat, SSS

ICAR-CITH-RS, Mukteshwar (Uttarakhand)

Scientific Staff

- 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 (T-5)
- Sh. Puran Chandra, Technical Assistant (T-1-3)

Skilled Supporting Staff

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

Transfers/ Promotions/ New Joining/Probation Clearance/ MACP

Transfers

- Dr. Raj Narayan, Principal Scientist (Vegetable Science) transferred from ICAR-CITH, Regional Station Mukteshwar to ICAR-ATARI, Jodhpur (Rajasthan) on 11th September, 2020 (A/N).
- Dr. Kishan Lal Kumawat, Scientist (Fruit Science) transferred from ICAR-CITH, Srinagar to ICAR-CIAH, Bikaner (Rajasthan) on 14th August, 2020(A/N)).

Promotions

- Dr. Wasim Hassan Raja Scientist (Fruit Science) promoted under CAS in Research Level-10 to 11 (Scientist to Scientist- Sr. Scale) *w.e.f.* 1st January, 2019
- Shri Fayaz Ahmad Dar, AF&AO, ICAR-CITH, Srinagar promoted to FAO, ICAR-CITH, Srinagar (Level- 8 to Level 10) *w.e.f.* 6th March, 2020
- Smt. Mubeena, Sr.Technician (T-2) promoted to Technical Assistant (T-3) Level- 4 to 5 *w.e.f.* 20th August, 2020

New Joining

- Shri Madhu G S joined as Scientist (Plant Pathology) ICAR-CITH, Srinagar on 6th April, 2020

Probation Clearance

- Dr. Shoaib Nissar Kirmani, Senior Technical Officer(T-6) cleared his probation period *w.e.f.* 13.04.2017(F/N)

Modified Assured Career Progression Scheme (MACP)

- Shri Diwan Chandra, Assistant is placed from Pay Matrix Level 6 to Pay Matrix Level 7 from 30th October, 2020 under MACP
- Shri Showkat Ahmad Mir, Assistant is placed from Pay Matrix Level 6 to Pay Matrix Level 7 from 1st November, 2020
- Shri Tariq Ahmad Mir, Jr.Stenographer is placed from Pay Matrix Level 4 to Pay Matrix Level 5 from 27th August, 2020
- Shri Pushpendra Kumar, LDC is placed from Pay Matrix Level 2 to Pay Matrix Level 3 from 13th September, 2020