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ICAR-Central Institute of Temperate Horticulture

K.D. Farm, Old Air Field, Rangreth,
Srinagar-191132 (J&K), India

Annual Report

2022



ICAR-Central Institute of Temperate Horticulture

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Front: Gala Redlum and Super Chief apple varieties under Tall Spindle System (HDP)

Back: Vertical expansion of apple rootstock (Air Layering)

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EXECUTIVE SUMMARY



Temperate horticulture is the backbone of economy for farmers in hilly states and it is the major source of livelihood. ICAR-Central Institute of Temperate Horticulture, Srinagar (J&K) along with its two Regional Stations Mukteshwar (Uttarakhand) and Dirang (Arunachal Pradesh) has focused on generation of need based technologies in different temperate horticultural crops to boost the productivity of quality produce in horticultural crops because the productivity in temperate horticultural crops in India is still low as compared to advanced countries. To fulfill this requirement of temperate region, Institute is carrying out research on various aspects like improvement, production, protection & post harvest management since its inception. Institute has now become as a technological hub in various temperate horticultural crops. The number of technologies generated at ICAR-CITH are increasing year after year and their implementation at farmers field is generating significant returns to growers of temperate region of the country. To cater the need of farmers associated with temperate horticultural crops, the research and extension work carried out by the Institute and its Regional Stations during 2022 are briefly summarized below:

Crop Improvement and Biotechnology

The plant genetic resources are among the precious resources of any country to cater their present and future need. ICAR-CITH, Srinagar is National Active Germplasm Site for temperate fruit crops. 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 2022, 67 germplasm of different fruit, vegetable and ornamental crops were collected and introduced at ICAR-CITH, Srinagar in the form of plant/ scionwood/ bulbs/ runners/seeds while at ICAR-CITH, Regional Station, Mukteshwar, 65 germplasm were planted in the field. The fruit germplasm was also added at ICAR-CITH Regional Station, Dirang and work on establishment of mother orchards is going on. The evaluation work was also carried out in different crops to screen out the elite genotypes for commercial cultivation. Some of the introductions made few year back planted at ICAR-CITH, Srinagar started fruiting in different crops like apple, pear, peach, plum, plumcot, apricot etc and many seems to be promising for commercial cultivation in future.

In apple, Genotyping by Sequencing (GBS) in apple was done in, 120 apple genotypes for understanding the genetic architecture of fruit quality traits to target and augment breeding of apple cultivars. Study on combining genotyping-by-sequencing (GBS) generated single nucleotide polymorphism (SNP) markers with fruit quality traits. Keeping in view the significant diversity of sequenced apple germplasm, GWAS studies for disease resistance, VOC content, phenols, flavonoids, colour, date of harvest etc will be done. In addition information related to SNP detection, annotation, quality distribution etc, phylogenetic tree analysis, population structure analysis, principal component analysis; ploidy level and heterozygosity plots for 120 genotypes will be obtained. Grouping of genotypes through cluster analysis will be correlated to phenotypic data and SNP data generated accordingly will be utilized for future breeding programmes for desired traits. In pear, 8 Asian and 17 European pear were evaluated for various traits and maximum fruit weight, fruit length and fruit

diameter was recorded in Badshah Nakh In case of European pear, maximum fruit weight (184.80g) was recorded in Max Red Bartlett. In apricot, 60 varieties/ genotypes were evaluated for various fruit traits and CITH A 1 was found superior to others. The varieties/ genotypes having better size were CITH A 1, Balcota, Harcot, Rival, Chinese Apricot, CITH A 8, Vivagold and CITH A 35. In peach and nectarine, 24 varieties/ genotypes were evaluated and Fantasia in Nectarine Cresthaven, Glohaven & Early Grande in peach were found promising. In plum, 26 varieties were evaluated and cultivar Durate, Mariposa, Friar, Santa Rosa and Stanley were found promising. In olive, out of 18 cultivars, 16 fruited and maximum fruit weight fruit length and fruit diameter were recorded in cultivar Cipressino. The pulp: stone ratio was maximum (6.84) in Messinese. In persimmon, two cultivars namely Hachiya and Fuyu were evaluated for fruit traits. The fruit weight, length and diameter were 176.43 g, 70.66 mm & 62.21 mm in cv. Hachiya and 125.62g, 45.70 mm & 67.11 mm in cv Fuyu. The value of TSS and firmness were higher in cv Fuyu.

In almond, 10 varieties and 17 Selections were evaluated for nut and kernel traits. Among varieties, nut weight ranged from 1.71g (Non Pareil) to 2.87 g (Makhdoom) while kernel weight from 0.667g (Non Pareil) to 1.47 g (Pranyaj). The kernel percentage was heighest in Pranyaj (52.69%). Similarly among 17 Selections, nut weight ranged from 1.47 g(CITH-A-10) to 3.27 g (CITH-A-13) while the kernel weight varied from 0.48 g(CITH-A-20) to 1.02 g(CITH-A- 11). The highest kernel percentage was recorded in CITH-A-10 (39.74%). In walnut, 221 varieties/ genotypes were evaluated and six genotypes produced nuts having weight more than 20 g and 60 genotypes having nuts with kernel recovery more than 50 percent. Similarly 6 genotypes produced nuts having kernel weight more than 10g. Based on desirable nut and kernel traits, some genotypes were identified as promising genotypes for further evaluation and release in future. In Pistachio, 5 female selections were evaluated and the selections which produced sound nuts were CITH Pistachio 1, CITH Pistachio 2, CITH Pistachio 3 & CITH Pistachio 6. The heaviest nuts

(0.86g) were produced by CITH Pistachio 3 while heaviest kernel weight (0.44g) were produced by CITH Pistachio 3& 6. The kernel percentage was maximum (54.48%) in CITH Pistachio 2. In hazelnut, 8 cultivars were evaluated and nut weight ranged from 2.1 (Gentile delle Langhe) to 4.2 g (Ennis). Maximum nut length (25.7 mm), nut diameter (21.7 mm) and kernel weight (1.6 g) were recorded in cultivar Ennis while maximum kernel percentage (47.61%) was recorded in cultivar Gentile delle Langhe. In pecan, four seedling selections fruited and maximum nut weight (4.4g) was recorded in Selection 3 and kernel recovery was recorded at the tune of 52.38% in Selection 2.

In vegetables, germplasm of kale, pea, root and exotic vegetables were and evaluated under field conditions and elite genotypes were identified for further studies. In Kale the leaf yield ranged from 11.13-52.94 q/ ha with coefficient of variation 10.01 per cent. In radish, 9 varieties/genotypes were evaluated and CITH-R-6 was found best for root yield. In turnip, 27 genotypes including two checks Nigeen-1 and Pusa Chandrima were evaluated and yield ranged from 199.41 to 573.46 q/ha with 18 genotypes performing better than better check Nigeen-1. The top three performers were Sel-2, PTGG) and Green Top. Among leafy, exotic and *Brassica* crops, Chinese cabbage line CITH-CC-1 expressed 434.52 q/ha of net head yield. In broccoli line CITH-Broccoli-1 gave net head yield of 203.26 q/ha while in Swiss chard, CITH-SC-Green and CITH-SC-Red yielded 253.61 and 248.22 quintal leaves per hectare. The biochemical evaluation for DPPH scavenging activity and FRAP was also done. In cabbage, Golden Acre and CITH-Cabbage Hybrid-1 were evaluated for head traits and CITH-Cabbage Hybrid-1 was found superior. SSR genotyping of kale germplasm comprising 62 lines was done with 66 markers.

ICAR-CITH, Rs Mukteshwar

In last year 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 and about 65 genotypes were collected and

planted/ propagated in the nursery. Evaluation work were done under different fruit crops such as apple, peach, plum, and kiwi fruit for various physio-chemical traits under mid hill conditions of Uttarakhand.

In apple, 18 apple cultivars belonging to Delicious group, spur type and colour strains were evaluated for various qualitative & quantitative traits during 2022. The maximum fruit weight was recorded in Mollies Delicious (196.3 g) and Oregon Spur (176.4 g) respectively. The maximum fruit diameter (77.5 mm) and fruit length (64.2 mm) was recorded in Golden Delicious and Oregon Spur, respectively. The maximum fruit T.S.S. (18.5 °B) was recorded in Oregon Spur as compared to other apple cultivars.

In peach, total ten cultivars namely Red June, FLA-16-33, Flordasun, Flordaking, Reliance, Rio-Oso-Gem, Red Nectarine, Canedian, Sharbati & Paradelux were evaluated. The maximum fruit weight (149.9 g), fruit diameter (64.2 mm), fruit length (65.1 mm) and acidity (1.6 %) were recorded in Red June and the maximum T.S.S. (15.1 °B) and total sugar (6.5 %) were recorded in Red Nectarine and Paradelux as compared to other cultivars respectively.

In plum, total seven cultivars were evaluated and based on the physico-chemical characteristics of fruits, the highest fruit weight (41.3 g), T.S.S. (16.2 °B) were reported in New Plum and Plum Local as compared to other plum cultivars respectively.

In apricot, total nine cultivars evaluated for physico-chemical characteristic of fruits. The highest fruit weight (47.3 g) and TSS (18.3 °B), were found in Safeda as compared to other cultivars, respectively.

In kiwifruit, total five cultivars were evaluated for their physico-chemical characteristics of which were found superior in Abbot, Bruno and Hayward as compared to other cultivars. The highest fruit weight (98.6 g) and TSS (11.5 °B), were found in Abbot as compared to other cultivars, respectively.

Among vegetables, twelve germplasm of

cherry tomato were evaluated under polyhouse at ICAR- CITH, Regional Station, Mukteshwar and highest yield in cherry tomato was recorded in CT-2 Red (52.7 q/ha). In capsicum, total seven genotypes were evaluated under protected condition and highest yield was recorded in Selection-6 (100.8 q/ha). In garlic, six genotypes were evaluated and highest total soluble solid were recorded in SEL-10 (42.8 °B) and highest yield in Sel-12 (63.5 q/ha). At ICAR- CITH,RS Dirang exploration and introduction work is going on and many germplasm has been planted for establishment of mother blocks.

In characterization and diversity analysis of flowering related gene/ genes in almond, transcriptomic analysis of almond cultivars “Waris” & Ferralise” with differential flowering time was done. In development of superior cultivars/ hybrids in temperate fruits through conventional and non-conventional methods, hybridization work was carried out in almond and walnut. The evaluation work was carried out for about 42 budded apple mutants and more than 30 of them were found superior to parent “CITH-Ambri-1” with respect to colour and mutant AM-51 showed highest “a” value (51.85) against parent CITH-Ambri-1 (7.67). The comparative transcriptome reveals specific genes and transcription factors linked to aroma, color, shelf life and crispiness of Ambri (CITH-Ambri-1) Apple. In pear, from the earlier crosses, one hybrid CITH-PEAR-H-01 was found superior for various fruit traits compared to parents. In rootstock breeding of apple, the hybrid population was evaluated for multiplication and population was categorized as very weak, weak, medium and strong. Rooting in hybrid rootstocks CITH-A-RS-M6m-42, CITH-A-RS-M6m-33, CITH-A-RS-M6m-40, CITH-A-RS-M6m-29, CITH-A-RS-M6m-03, and CITH-A-RS-M6m-44 was found better.

In development of CMS lines in onion (*Allium cepa* L), the seeds obtained in 2021 from F1s created from crossing intermediate day male sterile lines and Brown Spanish in 2020 were sown in 2021 whose bulbs were obtained in 2021 (F1 bulbs). The seeds from these bulbs were obtained in 2022 after massing (F2M1) and

sown in 2022 itself to obtain F2M1 bulbs in 2023 in order to obtain segregants desirable for yield, bulb trait uniformity and storage. In a separate crossing programme, seeds from F2M1 bulbs with desired storability (i.e. derivatives of MS-1 x Brown Spanish and MS-2 x Brown Spanish, MS-2 x CITH-O-33) were obtained in 2022 by massing method and again sown in the same year to obtain bulbs of F3M2 generation in 2023. In breeding for nutra-rich varieties/hybrids in root crops, the progenies of first as well as advanced generations of single crosses attempted in radish to obtain multi-nutritional and health promoting factors in single genotype were obtained. Progenies were found to be visually similar across crosses in terms of pigmentation shades and pattern. These progenies were then segregated into different categories on the basis of root surface color, skin color in transverse section and pith color by which 13 new lines were constituted.

Crop Production

During 2022, institute has supplied about 16678 plants of different temperate fruit crops besides the supply of 11803 scionwood; 876 plants & 6295 seedlings of flowers; about 30 kg vegetable seeds & 16760 vegetable seedlings besides 3 kg onion seedlings to different stakeholders, vegetable growers & research organization etc. During the year 2022, besides above planting material supplied about 3000 grafted plants of walnut were provided to Uttarakhand Forest Resource Management Project for establishment of mother orchards as well as for planting in farmers field under project promotion of walnut in Uttarakhand funded under Japan International Cooperation Agency (JICA). The revenue generated during the financial year from all resources was 69.23 lakhs (2022-23).

In a study on effect of thinning on quality in apple cvs Gala Redlum and Super Chief minimum % fruit drop and maximum yield per plant was recorded in Treatment 1 (1 fruit per cluster) followed by Treatment 2 (2 fruits per cluster) and maximum fruit drop and minimum yield per plant was recorded in control in both the cultivars. Under the development of different

techniques for enhancing the multiplication rate of temperate fruits under protected/open conditions, technology for vertical expansion of nursery through air layering in open field conditions was tried and five clonal rootstock viz MM-111, MM-106, M-9-T337, M9-Pajam and M-26 were taken for study. Among 5 rootstocks the rooting success percentage varied from 13.33% to 99.17% with maximum percentage in MM-106 and minimum in M9-T337. Keeping in view the advantages, this technology can be directly replicated by the nursery growers as the increase in production in some rootstocks is almost double or can further be increased if one more tier is tied so that an additional 2-3, rootstocks can be harvested from the same piece on nursery area. In Air layering in apple rootstocks raised through cuttings in soil less beds in greenhouse conditions in MM 106 rootsock, two additional plants were harvested in comparison to single rootstocks. This technology will be very useful in promoting the vertical expansion of the nursery in greenhouse conditions for rootstock propagated through cutting in soilless beds.

To develop the rootstock proliferation technology for climate resilient agriculture, an experiment was started to study the impact of combined application of phosphorus and silicon on apple rootstock performance under various soil moisture regimes. The soil and plant samples were collected regularly and lab analysis is going on. For Development and evaluation of integrated nutrient management module for high-quality temperate vegetables production, treatments comprising of organics and inorganics combinations was under taken in temperate vegetables crops like Long day Onion, Garlic and Kale. In assessment of soil carbon dynamics and carbon sequestration potential of selected temperate fruit crops of Arunachal Pradesh, about 324 soil samples were collected from the apple, kiwi fruit and walnut orchards (108 samples/crop) of the Arunachal Pradesh from different layers (0 to 20, 21 to 40, 41 to 60 and 61 to 100 cm) in order to analyze the different soil C fractions to harness the potentiality of the these temperate fruit crops in carbon sequestration potential and

C stock analysis. Under evaluation of integrated nutrient management of vegetables as intercrop in apple orchard, the technology was demonstrated among farmers under MGMG and SCSP scheme at Sunkiya, Nainital and Odlohar-Simsyari, Bageshwar villages during 2021&22 respectively 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.

In canopy management and canopy architectural engineering in temperate fruits, two crops viz apple & pear were taken for experimentation at Srinagar. In canopy architectural engineering experiment in apple; six training systems (vertical axis, cordon, espalier, head & spread, spindle bush and modified central leader system) with two cultivars (Oregon Spur & Red Delicious) on four rootstocks (Seedling, MM 111, MM 106 & M 9) were evaluated for various fruit and yield traits. Among all systems, varieties and rootstocks, maximum yield was recorded in Oregon Spur (70.85 t/ha) on MM 111 rootstock trained on vertical axis system followed by Oregon Spur (65.16 t/ha) on MM 106 rootstock trained on Vertical Axis, Red Delicious on MM 106 (60.13 t/ha), Oregon Spur on M 9 (59.93 t/ha) on vertical Axis, Oregon Spur on MM 111 (54.36 t/ha) in Spindle Bush and Red Delicious on MM 111 (54.19 t/ha) rootstock on Vertical axis system. In canopy Architectural engineering in pear experiment, 4 varieties (Red Bartlett, Starkrimson, William Bartlett & Kashmiri Nakh), 2 rootstocks (BA 29 C & Q C) and 4 training systems (Vertical Axis, Espalier, Tatura Trellies and Modified Central Leader System) were used for experimentation. Among all varieties, rootstocks and training systems, highest productivity was recorded in William Bartlett trained on Vertical Axis on Q C rootstock followed by Red Bartlett (35.55 t/ha) on BA 29C rootstock. In overall, different varieties on BA 29 C rootstock gave more average productivity as compared to QC rootstock. In development of almond based intercropping system involving saffron, different type of varieties having varied growth habit viz. erect, semi erect and spreading

type were tried along with sole saffron crop. The highest almond yield (t/ha) was recorded in erect type (1.93 t/h) followed by spreading type (1.90t/ha) and semierect (1.66 t/h) while the highest cumulative yield were recorded under spreading type followed by erect, semi erect type & sole.

For off-season cultivation of onion in Kashmir valley, a study was conducted at the institute involving different day length responsive varieties collected from other states in combination with different dates of bulbset planting so as to identify a combination that may allow harvesting commercial bulbs during off-season (i. e. October to December) in the field. In the third year of testing, one more planting date was added to the technical program for evaluation of varietal performance for splitting percentage and marketable yield during offseason. Punjab White yielded the highest marketable bulbs for all the dates.

Crop Protection

The seasonal population fluctuation of green apple aphid was studied in medium and high-density apple orchards throughout the year. The incidence of green apple started from the third week of March as occasional colonies, mostly on spots that did not receive delayed dormant horticultural mineral oil spray. The incidence continued as wingless viviparous females for two generations and by the 2nd week of April, the production of winged spring migrants started. The aphid population peaked during mid-June and subsequently decreased towards the third week of August. Population dynamics of spiraea aphid was monitored in Vanhoutte spiraea bushes (*Spiraea × vanhouttei*) throughout the year to explore the possibility of cross infestation of apple trees by the spiraea aphid. The spiraea aphid population reached a peak in the month of July and gradually declined afterwards. The spiraea aphids remained in asexual mode though the year, including winter, and did not undergo sexual reproduction on the Vanhouttespiraea bushes. The oviposition of green apple aphids was studied from October to December in early-bearing apple plants. After the appearance of oviparae and males

in the 1st week of October, the first egg deposition was observed in the 2nd week of October. The freshly laid eggs were green in colour and turned shiny black within 3-5 days. The number of eggs laid increased gradually till the last week of October and remained very high till the middle of November. The dispersion of the eggs of green apple aphid was studied on current year shoots of apple when the oviposition was completed (last week of December). The total number of eggs per segment varied from 0 to 355, averaging at 87.18 ± 3.29 (mean \pm SE). The highest number of eggs was found on the subterminal segments 2 – 5 (20 to 60 cm). The top most segment carried slightly lower number of eggs. Similarly, the number of eggs per segment decreased gradually from 6th segment downwards. An online survey program was conducted to understand the perception of apple orchardists of Kashmir valley about the incidence and management of green apple aphid, *Aphis pomi*.

In plant pathology, during 2021 and 2022, total 203 apple cultivars maintained in field gene bank at ICAR-CITH Srinagar, were screened under field conditions for powdery mildew of Apple incited by *Podosphaera leucotricha*. Out of 203 lines 88 were found immune whereas ten were found resistant, 26 were moderately susceptible, 62 lines were found susceptible and 17 were found highly susceptible. The symptoms of mosaic or necrosis occur due to alteration of various physiological, biochemical and metabolic processes within the infected plants. An investigation was conducted on eight cultivars of apple during summer 2022, for quantitative estimation of total chlorophyll, catalase (CAT), superoxide dismutase (SOD), Malondialdehyde (MDA) activities etc to elucidate their role in mosaic infected apple plants. Significant reduction in chlorophyll content was observed in mosaic infected cultivars as compared to asymptomatic ones. The activity of CAT was more in mosaic infected cultivars than in healthy cultivars. Mosaic-infected cultivars experienced more oxidative stress due to the virus, therefore produced more CAT and were having a higher initial rate of CAT activity compared to the healthy apple cultivars.

Decreased SOD activity contributes to the increased susceptibility of mosaic-infected apple cultivars to oxidative stress and damage. The activity of malondialdehyde (MDA) in mosaic infected apples and healthy apples were different, as MDA is a biomarker of oxidative stress and lipid peroxidation. Results have shown that the activity of MDA was higher in mosaic-infected apples compared to healthy apples. This indicates that viral infection causes oxidative stress and lipid peroxidation in apple plants, leading to increased MDA activity.

The transmission for ApNMV in mixed infection with ApMV was conducted, through grafting and budding in apple. Eight and three rootstocks were used for grafting and budding respectively with scion wood from ApMV and ApNMV infected apple cultivar Golden Delicious. Development of mosaic symptoms was scored over time and symptoms were first seen on two rootstocks MM106 and MM111 after 60 and 280 days after grafting and budding respectively. The comparative transmission efficiency of mosaic associated viruses was found more in grafted plants (61.5%) than budded plants (25%) on three rootstocks studied in both approaches. The results demonstrated that grafting/budding inoculation methods are efficient for transmission of both the viruses (ApMV and ApNMV) and the established protocol will help in maintaining the virus isolates for long term as well as help in screening the germplasm for resistance. In another investigation to detect and quantify ApMV and ApNMV from different plant parts (spatial) in two cultivars (Oregon Spur and Golden Delicious) of apple trees during different seasons (temporal) for optimization of tissue and time for their rapid and early detection. Detection and relative quantification using molecular diagnostic techniques viz., Reverse Transcription-PCR and RT-qPCR in various plant parts (leaf, whole flower, sepal, petal, anther, stigma with style, bark, fruit, seed and root) during different seasons was done. During all the three seasons, both ApMV and ApNMV were detected in leaves in measurable titre using RT-qPCR, however via RT-PCR, both the viruses remained undetected

during summer season. Hence leaves during spring season can be directly used as detection material for their early and rapid detection of both the viruses. The morphological and molecular characterization of *Alternaria* spp. associated with *Alternaria* Leaf Blotch disease of temperate fruits was done for thirty isolates from Apple, pear, almond and walnut. The isolated pathogens were grown in potato dextrose broth for DNA isolation. DNA of all thirty cultures was isolated and PCR amplification was done using ITS Primers and the product was sequenced. The BLASTn analysis revealed that our isolates showed sequence similarity with three *Alternaria* species viz, *Alternaria alternata*, *Alternaria angustivoides*, *Alternaria tenuissima* infecting these crops. The *Alternaria alternata* was predominant species infecting all the crops. The rhizospheric and endophytic microbial communities of two apple rootstocks (M27 and MM106) were isolated and evaluated against *Dematophora necatrix*, a root rot causing pathogen in apple. Total 475 microorganisms were isolated and among them 203 were isolated from M27 and 272 from MM106. Out of 475 microorganisms 267 were bacterial isolates and 208 were fungal isolates. All the microbiota was evaluated using dual culture technique and out of 475 only 18 was showing inhibition of *Dematophora necatrix*. A total of 9 bacterial and 9 fungal isolates that were showing percent inhibition of greater than 70 % were selected for further tests. These best performing 18 isolates were subjected to test for production of volatile and non- volatile compounds. These microorganisms also performed better in volatile test with highest inhibition of 83 % and 76 % in case of bacterial and fungal isolates respectively.

Post-Harvest Management

In development of edible coating with enriched anti-microbial bio-active compounds for various stone fruits, the microbial culture development on the storage of cherry in ambient conditions was done and found that the sweet cheery is prone to development of *Penicillium* during spoilage. The other preliminary research

activities carried out during the year are effect of combined application of sonication and chemical treatment on shelf life in cherry at room temperature and cold storage. In combined application of sonication and chemical treatment on shelf life in cherry at room temperature it was observed that maximum firmness was preserved in oxalic acid at 5% after storage of 20 days in Stella and firmness preserved was minimal in case of Lambert. In combined application of sonication and chemical treatment on shelf life in cherry under cold storage conditions, it was found that the samples sonicated either in only cold water (control) or oxalic acid maintained at 4 °C resulted in retention of highest quality of fruits during the storage period. In osmo-dehydration of kiwifruit (cv. Allison) four independent variables viz. osmo-dehydration time, concentration of osmo-dehydration sucrose solution, amplitude of sonication and sonication time were taken and it was found that the colour of slices faded due to loss of chlorophyll pigments in osmo-sonication treatment. The maximum loss of colour pigment was recorded in slices treated with 60 amplitude for period of 20 minute in 50 °B followed by osmo-dehydration for 160 minutes and least colour change recorded in slices treated with 45 amplitude for period of 10 minutes in 50 °B solution and osmo-dehydrated for 160 minutes.

Extension and other activities

ICAR-CITH, Srinagar and its Regional Stations are continuously transferring various generated technologies using various extension means for popularization of technologies. During the year, about 19 meetings/events were organized in which Famers, Kisan Board Members, Development Department Officials and Scientists/Experts Interface meeting at ICAR- CITH, Srinagar and an Apple Day/show cum workshop at ICAR-CITH, RS Mukteshwar were the mega events. ICAR- CITH, Srinagar has organized 2 training programme of five days duration each for officers from Department of Horticulture Himachal Pradesh. Five one day training programme on walnut propagation were conducted for forest departmental personnel

in various nurseries (Maldevta, Magra, Sony, Silalekh and Ladiyakata in Uttarakhand. One day training/ visit were organized for participants of short course. A training programme of two days duration on Use of molecular biology techniques in Horticulture under DST- SERB, Scientific Social Responsibility (SSR) initiative was organized for students/ research scholars. Besides this six training / visit of one day duration were organized for students of different schools/ colleges. Besides this 14 programmes were organized for the farmers sponsored by various agencies and scientists of Institute participated in two programmes organized by other agencies as resource person. Similarly at Regional station Mukteshwar, one programme for NABARD Officers of Uttarakhand, five students visits and 26 extension programmes (trainings/ demonstrations etc) were conducted besides the display of two exhibition at various occasions. At RS Dirang, under NEH scheme, 4 programmes in Meghalya, 8 programmes in Arunachal Pradesh and 11 programmes in Assam were conducted in which training as well as farm inputs were provided for

the farmers of NEH region. In TSP, 3 programmes were conducted in Poonch and Ganderbal district and farmers were provided with farm inputs/ planting material and trainings. The activities were also carried out under MGMG in Uttarakhand in which eight trainings, 2 diagnostic/field visits three demonstrations were conducted and more than 75 farmers of Sunkiya village were benefited. Under SCSP scheme, 8 programmes were organized in Jammu & Sambha district of J&K and Bageshwar district of Uttarakhand in which 715 farmers were benefited with the farm inputs/ planting material and trainings. During the year , scientists of Institute published 19 research papers, 3 review papers, one book, 11 book chapters and 10 popular articles/ pamphlets etc. In addition to various appreciations, the scientists of ICAR- CITH, Srinagar received 7 awards during the year. Besides providing need based information through various social media, scientists of Institute have delivered 22 TV/Radio talks. About 8525 farmers/ visitors visited ICAR- CITH, Srinagar during 2022 which is an increase of 17.04 % compared to last year.

INTRODUCTION



To harness the immense potential of temperate horticultural crops in India, ICAR-Central Institute of Temperate Horticulture is continuously working on promotion of elite varieties and proven technologies in entire temperate region of the country. 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. Due to suitability of climate North Western and Eastern Himalayan states have monopoly in production of temperate horticultural crops 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 12 million people and generating revenue of about Rs. 15,000 crore 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. During 2021-22 apple crop covered an area of 313 thousand ha and 2437 thousand MT national production. Walnut being second important crop covering an area of 109 thousand ha with 282 thousand MT production at national level. Other important temperate crops include almond with 10,000 ha area and 11, 000 MT production, pear with 42, 000 ha area and 279, 000 MT

production, peach with 18, 000 ha area and 108, 000 MT production, plum with 23, 000 ha area and 78, 000 MT production and strawberry with 3, 000 ha area and 14000 MT production etc. No doubt, there has been manifold increase in area, production and productivity but as compared to average world productivity our position is far behind. 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 and for their nutritional and economic security, ICAR- Central Institute of Temperate Horticulture, Srinagar with its two regional stations at Mukteshwar, (Uttarakhand) and Dirang, (Arunachal Pradesh) is continuously working on development of technologies, varieties, production models, QPM production, human resource development etc under crop improvement, crop production, crop protection and post-harvest management areas of research & development. Institute is mainly focussing on research and development in temperate fruits, nuts, vegetables, ornamentals, medicinal & aromatic plants and saffron.

In order to narrow down the productivity gap and achieve the best quality produce in temperate horticultural crops, Institute is carrying out the research both at Srinagar main campus and at its Regional Stations located at Mukteshwar and Dirang 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.

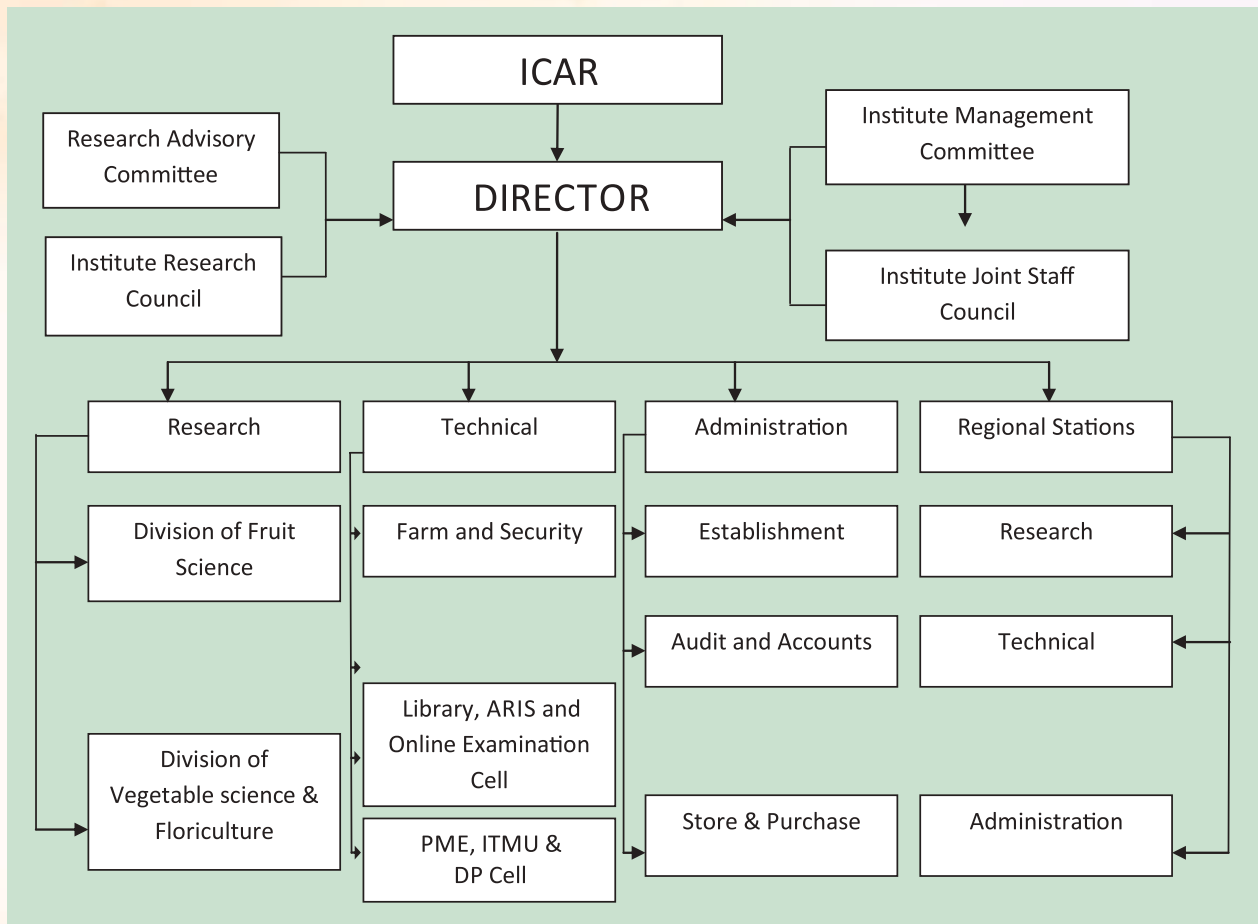
Staff Position (2022)

Category	Sanctioned	Filled (31 st December, 2022)	Vacant (31 st December, 2022)
Scientific	33+1RMP	10+0	23+1
Administrative	19	10	09
Technical	16	09	07
Supporting	11	11	00
Total	79+1	40+0	39+1

Financial Statement (2022-23)

S. No.	Head	Expenditure (Rs in Lakh)
1	ONEH-Capital	22.85
2	ONEH-General	260.00
3	NEH-Capital	83.00
4	NEH-General	149.75
5	TSP-General	10.00
6	SCSP-General	29.95
7	Non-Scheme General	67.28
8	Pension	8.41
9	Salary	500.60
Total		1131.84

ORGANOGRAM OF CITH



RESEARCH ACHIEVEMENTS



1. Crop Improvements

Horticulture enterprise is growing at a faster rate due to higher returns as well as its importance in nutritional security. The increase in area and production in horticultural crops is going on year after year. The area in horticultural crops in India increased to 28.04 million hectare in 2021-22 with approximately 2.05% increase from 2020-21. Similarly the production was about 334.6 MT in 2020-21 which increased to 347.18 MT in 2021-22 with approximately 3.75 % increase. The commercial production and the returns of any crop largely dependent upon the genetic potential of the variety/ genotypes. Hence the, crop improvement plays an important role by producing elite genotypes through various breeding methods and tools. Breeding of genotypes in fruit crops with desirable traits is a complex and time consuming process due to long juvenility period. For any breeding programme, the variability is a prerequisite for the breeding of elite genotypes. The Himalayan states are suitable for cultivation of large number of temperate fruits, vegetables, ornamentals, medicinal and aromatic crops as well as much other horticulture based enterprises. Some pockets of these hilly states are famous for offseason production of many crops especially vegetable and ornamental crops and their supply to plains leads to fetching of handsome price in market. In these area many temperate horticultural crops like apple, pear, plum, apricot, cherry, peaches, walnut, almond, kiwifruit, persimmon, strawberry and other minor temperate fruit & nut crops are being grown. But as far as area, production and share is concerned; apple, walnut and up to limited extent pear have monopoly in area and production followed by plum, peach, almond and kiwi fruit. The productivity of temperate fruits crops in India is low as compared to other advanced countries

due to many reasons and superior cultivar with high productivity potential is one of them. ICAR-CITH, Srinagar along with its Regional Stations situated at Mukteshwar (Uttarakhand) and Dirang (Arunachal Pradesh) are continuously engaged for identification/ production of superior cultivar/ genotypes and have played a great role in past by recommending region specific cultivars for boosting farmers economy. The research work carried out during 2022 at main campus and its regional stations is presented project wise below:

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

The plant genetic resources are among the precious resources of any country to cater their present and future need. India is country having diverse climatic conditions, suitable for growing a large number of horticultural crops and has great diversity in many crops. But the diversity in some exotic crops in india is less as compared to indigenous crops. ICAR-CITH, Srinagar is National Active Germplasm Site for temperate fruit crops. 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 2022, 67 germplasm of different fruit, vegetable & ornamental crops were collected and introduced at ICAR- CITH, Srinagar in the form of plant/ scionwood/ bulbs/ runners/seeds etc. The details of new germplasm added in various categories is presented in Table 1. To enrich the germplasm status of ICAR-CITH, Regional Station, Mukteshwar, 65 germplasm were collected

in the form of scion wood/ plants. Some of the introductions made few year back and planted at ICAR-CITH, Srinagar started fruiting in different crops like apple, plum & plum cot. Data were recorded on various parameters and some of them seems to be promising.

Table 1. Germplasm status at ICAR-CITH, Srinagar (2022)

Sr No	Group	Germplasm Status (2021)	Added during 2022	Germplasm Status (2022)
1	Fruits	1348	48	1396
	Pome fruits	459	17	476
	Stone fruits	279	17	296
	Nuts	403	10	413
	Others	207	4	211
2	Vegetables	1133	17	1150
3	Ornamentals	341	2	343
4	Medicinal and aromatic plants	33	-	33
Total			67	2922

Apple

Genotyping by Sequencing (GBS) in apple

During 2022, genotyping by sequencing (GBS) of 120 apple genotypes was done for understanding the genetic architecture of fruit quality traits to target and augment breeding of apple cultivars. Sequencing of 120 genotypes was done and phenotype information (Fruit weight & TSS) of these varieties was generated from different apple growing sites. Study on combining genotyping-by-sequencing (GBS) generated single nucleotide polymorphism (SNP) markers with fruit quality traits. Keeping in view the significant diversity of sequenced apple germplasm, GWAS studies for disease resistance, VOC content, phenols, flavonoids, colour, date of harvest etc will be done. In addition information related to SNP detection, annotation, quality distribution etc, phylogenetic tree analysis, population structure analysis, principal component analysis; ploidy level and heterozygosity plots for 120 genotypes will be obtained. Grouping of genotypes through cluster analysis (Fig 1) will be correlated to phenotypic

data and SNP data generated accordingly will be utilized for future breeding programmes for desired traits.

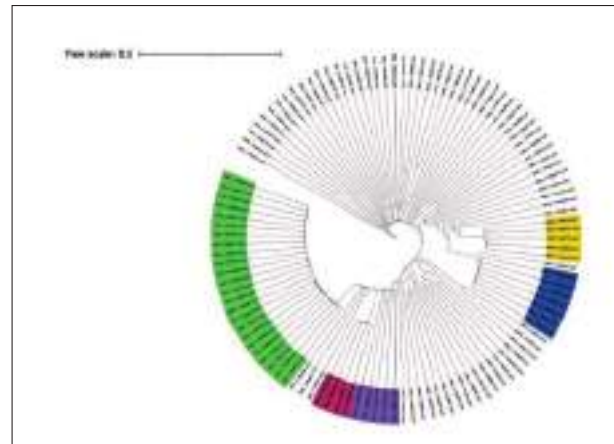


Fig 1. Genetic diversity and grouping among 120 apple genotypes revealed through genome sequencing

Pear

During the year 2022, eight Asian pear (*Pyrus pyrifolia*.) varieties were evaluated for different quality related attributes and maximum fruit weight (115.77g), fruit length (62.77mm) and fruit diameter (60.91mm) was recorded in Badshah Nakh. Maximum pedicel length (46.82mm) was recorded in Kashmiri Nakh and minimum (27.20mm) in Bagugosha. Maximum pedicel diameter (4.15mm) was recorded in Punjab Gold and minimum (1.93mm) in Punjab soft. Among color characteristics, L* values ranged from (52.37) in Kashmiri Nakh to (66.42) in Punjab Beauty, a* value ranged from (0.50) in Babugosha to (2.21) in Punjab Nectar while the values for b* ranged from (25.69) in Kashmiri Nakh to (46.58) in Punjab Soft and no accession showed negative b* value indicated that there is no blue colored variety. The value for Tint ranged from -23.64 in Punjab Nectar to 1.13 in Punjab Beauty. Maximum values for chroma (47.04) was recorded in Punjab Soft while as minimum value (26.16) was recorded in Kashmiri Nakh. Maximum value for Hue angle (89.20) was recorded in Babugosha while minimum (79.03) was recorded in Punjab Beauty and maximum value for color Index (3.69) was recorded in Kashmiri Nakh. Fruit firmness in pear cultivars ranged from 52.53 in Punjab Beauty to 61.17 RI in Babugosha. Highest TSS (15.70° B) was recorded in Kashmiri Nakh and lowest

(12.50°B) was recorded in Chinese Sand Pear. Highest acidity (1.25%) was recorded In Punjab Soft and lowest (0.90%) in Punjab Beauty.

Among 17 European pear (*Pyrus communis*) cultivars, of maximum fruit weight (184.80g) was recorded in Max Red Bartlett and fruit length (77.70mm) in Santya Braskaya while maximum fruit diameter (70.89mm) was recorded in cultivar Mayan. Maximum pedicel length (50.43mm) was recorded in Zypaceac Hypacea Copeace and minimum (19.66mm) in Pyasua Behapa. Maximum pedicle diameter (5.21mm) was recorded in Starkrimson and minimum (2.09mm) in Kosui. Among the colour characteristics, L* values ranged from 27.64 in Starkrimson to 68.97 in Coscia-C, a* value ranged from 2.52 in Max Red Bartlett to 30.9 in Starkrimson. The value for b* scale ranged from 14.36 in Starkrimson to 40.10 in Zypaceac Hypacea Copeace. The values for Tint ranged from -159 in Starkrimson to 3.14 in Pyasua Behapa. Maximum values for chroma (43.97) was recorded in Zypaceac Hypacea Copeace while as minimum value (20.05) was recorded in Gent Drouard, Maximum value for Hue angle (84.88) was recorded in Max Red Bartlett while minimum (24.91) was recorded in Starkrimson and maximum value for color Index (77.90) was recorded in Starkrimson and minimum value (1.70) was recorded in Coscia-C. Fruit firmness

in pear cultivars ranged from 51.03 in Kosui to 65.10 RI in King Pear. Highest TSS (17.13° B) was recorded in Starkrimson and lowest (11.07° B) was recorded in Fertility. Highest Acidity (1.62%) was recorded in Mayan and lowest (0.75%) was recorded in Coscia-C.

Apricot

In apricot, 60 varieties/ genotypes were evaluated for various fruit traits and CITH A 1 was found superior to others as far as fruit weight (69.33 g) and fruit width (49.92mm) is concerned while longest fruits were produced by Balcota (44.33 mm). TSS varied from 8.43 °B (CITH A 29) to 21.57°B (Sateni).The colour parameters also varied from genotype to genotype The varieties/ genotypes having better size were CITH A 1, Balcota, Harcot, Rival, Chinese Apricot, CITH A 8, Vivagold and CITH A 35. Among all genotypes, 16 were free stone. Among all 49 genotypes produced kernel of sweet taste while 11 were bitter in taste besides this some genotypes also produced double kernels.

Peach

In peach and nectarine, 24 varieties/ genotypes were evaluated for various fruit traits. Among all, heaviest fruits (87.15g) were produced by Fantasia followed by Cresthaven (82.97g), Early Grande (81.60g) and Glohaven (80.54 g) and minimum



Punjab Soft



Punjab Gold



Punjab Nectar

Fruiting in some Asian Pears



Max Red Bartlett



Santya Braskaya



Hayward

Fruiting in some European pears

in Peshawari. Hence in Nectarine Fantasia and in peach Cresthaven, Glohaven & Early Grande were found promising.

Plum

In plum, 26 varieties were evaluated for various fruit traits. Based on fruit size cultivar Red Beauty, Durate plum, Mariposa, Friar, Santa Rosa and Stanley were found promising. The categorization was also done on the basis of flesh colours viz red or yellow.

Olive

During 2022, out of 18 olive cultivars 16 fruited and were evaluated for fruit and stone traits. Maximum fruit weight (7.06 g) fruit length (25.73mm) and fruit diameter (29.95 mm) were recorded in cultivar Cipressino while these were minimum in cultivar ottobratica (1.56g, 13.8 mm & 12.15 mm, respectively). Maximum TSS was recorded in Biancolilla (17.56 °B) while it was minimum in Cerignola (12.23 °B). The fruit firmness ranged between 26.4 (Tonda Iblea) to 73.4 (Zaituna). Variations were also recorded for various colour traits like L,a,b & tint. The stone weight was minimum (0.5 g) in Ottobratica and maximum in Cipressino (1.7g). The Pulp: Stone ratio was maximum (6.84) in Messinese and minimum (3.12) in Ottobratica. The pulp percentage varied between 67.95 in Ottobratica to 85.38 in Messinese.

Almond

In almond, 10 varieties and 17 Selections were evaluated for nut and kernel traits. Among varieties, nut weight ranged from 1.71g (Non Pareil) to 2.87g (Makhdoom) while kernel weight from 0.667g (Non Pareil) to 1.47 g (Pranyaj). The kernel percentage was highest in Pranyaj (52.69%) followed by Shalimar (49.54%), Makhdoom (48.28%), Primorskij(45.77%) and IXL (42.25%). Similarly among 17 Selections, nut weight ranged from 1.47 g(CITH-A-10) to 3.27 g (CITH-A-13) while the kernel weight varied from 0.48 g(CITH-A-20) to 1.02 g(CITH-A-11). The highest kernel percentage was recorded in CITH-A-10 (39.74%) followed by CITH-A-4 (38.68%) and CITH A-11 (37.68%) while other produced nuts having lesser kernel recovery (<35 %).

Walnut

In walnut, 221 varieties/ genotypes were evaluated for various nut and kernel traits. Out of 221, six genotypes produced nuts having weight more than 20 g and 60 genotypes having nuts with kernel recovery more than 50 percent. Similarly 6 genotypes produced nuts having kernel weight more than 10g. Based on desirable nut and kernel traits some genotypes were identified as promising genotypes for further evaluation and release in future.

Pistachio

In Pistachio, there are 5 female and two male selection and out of these 5 female selections, CITH Pistachio 4 produced blank nuts in this year may be due to pollination problem (non synchronization of flowering with male selection). The Selections which produced sound nuts were CITH Pistachio 1, CITH Pistachio 2, CITH Pistachio 3 & CITH Pistachio 6. The heaviest nut and (0.86) were produced by CITH Pistachio 3 while heaviest kernel weight (0.44g) were produced by CITH Pistachio 3& 6. The kernel percentage was maximum (54.48%) in CITH Pistachio 2.

Hazelnut

In hazelnut, 8 cultivars were evaluated and significant differences were recorded for most of the physical nut& kernel parameters. Nut weight ranged from 2.1 (Gentile delle Langhe) to 4.2 g (Ennis). Maximum nut length (25.7 mm), nut diameter (21.7 mm) and kernel weight (1.6 g) were recorded in cultivar Ennis while maximum kernel percentage (47.61%) was recorded in cultivar Gentile delle Langhe.

Pecan

In pecan, four seedling selections fruited and maximum nut weight (4.4g) was recorded in Selection 3, 3.63g in Selection 1, 3.57g in Selection 2 and 3.40 g in Selection 4 while kernel weight recorded were 1.86g, 1.87g, 2.3 g & 1.46 g in Selection 1,2,3 & 4. The kernel recovery was recorded at the tune of 52.38% in Selection 2 while it was 51.27% in Selection 3 and 51.23 in Selection 1 and minimum (32.33%) in Selection 4.

Persimmon

In persimmon, two cultivars namely Hachiya and Fuyu were evaluated for fruit traits. The fruit weight, length and diameter were 176.43 g, 70.66 mm & 62.21mm in cv. Hachiya and 125.62g, 45.70 mm & 67.11 mm in cv Fuyu. The value of TSS and firmness were higher in cv Fuyu.

ICAR-CITH, Rs Mukteshwar

In last year 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 and about 65 genotypes were collected and planted/ propagated in the nursery. Evaluation work were done under different fruit crops such as apple, peach, plum, and kiwi fruit for various physio-chemical traits under mid hill conditions of Uttarakhand.

In apple, 18 apple cultivars belonging to Delicious group, spur type and colour strains were evaluated for various qualitative & quantitative traits during 2022. The maximum fruit weight was recorded in Mollies Delicious (196.3 g) and Oregon Spur (176.4 g) respectively. The maximum fruit diameter (77.5 mm) and fruit length (64.2 mm) was recorded in Golden Delicious and Oregon Spur, respectively. The maximum fruit T.S.S. (18.5 °B) was recorded in Oregon Spur as compared to other apple cultivars.

In peach, total ten cultivars namely Red June, FLA-16-33, Flordasun, Flordaking, Reliance, Rio-Oso-Gem, Red Nectarine, Canedian, Sharbati & Paradelux were evaluated. The maximum fruit weight (149.9 g), fruit diameter (64.2 mm), fruit length (65.1 mm) and acidity (1.6 %) were recorded in Red June and the maximum T.S.S. (15.1 °B) and total sugar (6.5 %) were recorded in Red Nectarine and Paradelux as compared to other cultivars respectively.

In plum, total seven cultivars were evaluated and based on the physico-chemical characteristics of fruits, the highest fruit weight (41.3 g), T.S.S. (16.2 °B) were reported in New Plum and Plum Local as compared to other plum cultivars respectively.

In apricot, total nine cultivars evaluated for physico-chemical characteristic of fruits. The highest fruit weight (47.3 g), TSS (18.3 °B), were found in Safeda as compared to other cultivars, respectively.

In kiwifruit, total five cultivars were evaluated and their physico-chemical characteristics of fruits were found superior in Abbot, Bruno and Hayward as compared to other cultivars. The highest fruit weight (98.6 g) and TSS (11.5 °B), were found in Abbot as compared to other cultivars, respectively.

ICAR-CITH, RS Dirang

Besides the establishment of mother block of different fruit crops and propagation of quality planting material of temperate horticultural crops following activities were also carried out at this station in kiwi fruit and persimmon which have emerged as major fruit crops in the region and are getting popularity among the growers of this region.

Response of kiwi fruit varieties for physiological loss

Kiwi has a reputation as a health food, because of its high vitamin C content. The study was carried out to evaluate the physiological loss during the post-harvest storage at room temperature on keeping quality of 04 Kiwi varieties, at CITH RS-Dirang, West Kameng District of Arunachal Pradesh from the month of November to December 2022. Observations were recorded at weekly intervals starting from first week of November and it was revealed that there was a continuous decrease in fruit weight, fruit length and fruit diameter in all varieties. Significant increase in TSS among all the varieties has been recorded up to 35 days of storage, after that, decrease in TSS has been recorded in all varieties. The average mean fruit weight at the time of storage was 73.96g and after 07 weeks it has reduced to 62.14g during the storage period in all varieties. The maximum fruit weight loss (%) was recorded in Monty (18.24%) and minimum in Hayward (14.93%). The maximum TSS increase (%) was recorded in variety Hayward (42.23%) and minimum in Bruno (27.07%). It is clear from

the above data that different varieties of kiwi fruit showed different response in ambient temperature conditions.

Response of Persimmon varieties for physiological loss

Persimmon is sweet, versatile fruit full of vitamins, minerals, fiber, and beneficial plant compounds. The study was carried out to assess the physiological loss during the post-harvest storage at room temperature on keeping the quality of two persimmon varieties, at CITH RS-Dirang, West Kameng District of Arunachal Pradesh from September to October 2022. Important quality parameters of fruit were recorded at weekly intervals starting from the first week of September. From the data, it was revealed that there was a continuous decrease in fruit weight, fruit length, and fruit diameter. A significant increase in TSS among all the varieties has also been recorded. The average mean fruit weight at the time of storage was 199.70g and after 04 weeks it has reduced to 164.23g during the storage period in all varieties under ambient storage conditions. The maximum fruit weight loss (%) was recorded in Hachiya (19.33%) and the minimum in Fuyu (15.08%). The maximum TSS

increase (%) was recorded in the variety Hachiya (38.78) and the minimum in Fuyu (22.54). It is clear from the above data that different varieties of Persimmon showed different responses in ambient temperature conditions.

Vegetable Crops

ICAR-CITH, Srinagar

In vegetables, Germplasm of kale, pea, root and exotic vegetables were maintained and evaluated under field conditions and data are presented in following tables .

In evaluation of kale, the range, mean and coefficient of variation for various traits are presented in Table 2. In evaluation of radish, 9 germplasm were evaluated and data is presented in Table 3. In turnip, 27 genotypes including two checks Nigeen-1 and Pusa Chandrima were evaluated for root yield and root morphological parameters. The yield of the germplasm ranged from 199.41 to 573.46 q/ha (CD @ $p < 0.05 = 65.92$; CV = 7.53%) with 18 genotypes performing better than better check Nigeen-1 (279.88). The top three performers were Sel-2 (573.46), PTGG (571.54) and Green Top (562.72).

Table 2. Mean , range and coefficient of variation for various traits in kale

S. No.	Trait	Mean \pm SD	Range	Coefficient of Variation (%)
1	Plant height (cm)	50.56 \pm 9.69	20.80-90.60	2.82
2	Canopy diameter (cm)	53.34 \pm 6.22	27.86-67.24	3.30
3	Leaf blade length (cm)	20.10 \pm 2.51	14-29.20	4.10
4	Leaf blade width (cm)	14.41 \pm 2.14	9.60-22	4.54
5	Leaf blade no. of incisions	19.27 \pm 11.07	0.00-60	6.48
6	Leaf blade thickness (mm)	0.36 \pm 0.1036	0.15-0.81	8.41
7	Number of leaves	30.52 \pm 17.04	13.20-131.20	4.05
8	Number of lobes	0.65 \pm 1.88	0.00-7.40	17.05
9	Petiole length (cm)	11.65 \pm 3.15	5.80-25.60	7.40
10	Petiole diameter (cm)	10.57 \pm 1.58	5.73-13.77	4.48
11	Vegetative stem length (cm)	22.59 \pm 12.25	13.80-87.80	8.63
12	Vegetative stem width (cm)	64.49 \pm 16.78	20.06-93.71	4.65

S. No.	Trait	Mean \pm SD	Range	Coefficient of Variation (%)
13	Size of floral buds (mm)	7.45 \pm 1.36	4.48-11.12	2.18
14	Floral stalk length (cm)	1.57 \pm 0.35	1-2.77	4.68
15	No. of buds/ plant	1737.14 \pm 1086.08	299-4116	0.29
16	Time of flowering (days from transplanting)	252.37 \pm 5.03	235-267	0.74
17	End of flowering (days from transplanting)	286.45 \pm 7.33	274-302	0.70
18	Flowering period (days)	34.26 \pm 8.14	15-60	7.49
19	Siliqua length (cm)	5.67 \pm 1.11	2.83-9.37	4.15
20	Siliqua width (cm)	3.13 \pm 0.77	1.40-4.82	6.49
21	No. of seeds/siliqua	16.90 \pm 4.24	8.20-29.40	5.74
22	Days to maturity	321.85 \pm 4.83	311-331	0.56
23	Seed weight (g)	4.71 \pm 1.12	2.10-7.80	3.21
24	Leaf yield (t/ha)	22.86 \pm 8.70	11.13-52.94	11.01

Table 3. Root yield, root length and root diameter of different radish germplasm

S. No.	Genotypes	Root yield (q/ha)	Root length (cm)	Root diameter (cm)
1	CITH-R-7	110.25	8.86	6.98
2	CITH-R-8	218.25	9.72	7.21
3	CITH-R-6	480.75	8.64	8.06
4	JWL	219.80	24.22	4.10
5	Palam Hriday	267.50	10.33	7.14
6	Sopori	427.25	10.62	6.77
7	Scarlet Globe	234.00	4.58	4.55
8	Pusa Himani	226.25	15.24	4.64
9	CITH-R-5	309.00	9.69	7.44
	CD (p<0.05)	107.32	6.49	1.23
	CV (%)	16.54	24.51	8.32

Among leafy, exotic and *Brassica* crops, Chinese cabbage line CITH-CC-1 expressed 434.52 q/ha of net head yield. The head height was recorded as 25.62 cm, head width 18.21 cm, net head weight if 1.540 kg and TSS was 5.12 ° B. Broccoli line CITH-Broccoli-1 gave net head yield of 203.26 q/ha with a head height of 14.25

cm, head width of 15.23 cm, net head weight of 0.512 kg and TSS of 12.51 ° B. In Swiss chard, CITH-SC-Green and CITH-SC-Red yielded 253.61 and 248.22 quintal leaves per hectare. Also, their biochemical evaluation for DPPH scavenging activity and FRAP values are given in Table 4

Table 4. DPPH scavenging activity and FRAP in Swiss chard

S. No.	Genotype	DPPH Scavenging activity	FRAP
1	CITH-SC-Green	2.534	2.032
2	CITH-SC-Red	4.985	2.961

In cabbage, Golden Acre and CITH-Cabbage Hybrid-1 were evaluated for head traits and yield and data is presented in Table 5.

Table 5. Yield and related traits of Golden Acre and CITH-Cabbage Hybrid-1

Genotype	Head height (cm)	Head width (cm)	Net head weight (Kg)	Net head yield (q/ha)
CITH-Cabbage Hybrid-1	15.85	15.80	1.21	482.53
Golden Acre	15.35	14.43	0.96	385.73
CD (p<0.05)	NS	1.25	NS	NS
CV (%)	2.87	2.19	13.04	13.04

Molecular characterization in kale

SSR genotyping of kale germplasm comprising 62 lines was done with 66 markers. As a first of its kind in vegetable kale belonging to Kashmir valley, this study helped in assessing the extent of genetic diversity, population structure and development of LD pattern with respect to 24 traits. Sixty-six cross species markers within *Brassica* genus amplified 269 alleles. Their polymorphic information content (PIC) ranged from 0.00078 to 0.953 with an average of 0.407. The population structure analysis and neighbor joining tree clustering categorized the germplasm into 3 sub-populations. AMOVA revealed more within-population variance (67.73%) than among-populations (32.27%) variance. Association mapping with respect to 24 agronomical traits using mixed linear model and general linear model revealed six overlapping significant marker-trait relationships with five being significant at probability value of 0.001/0.0001. The highly significant associations of two SSRs with economically important traits (siliqua length and seed weight) significantly

correlated/ related with leaf yield and seed yield for their possible utilization in marker assisted breeding for higher leaf yield and seed yield (Table 6 & Fig 2) . The understanding of kale germplasm developed and maintained at the institute will assist in its meaningful exploitation as a genetic stock for breeding and trait improvement.

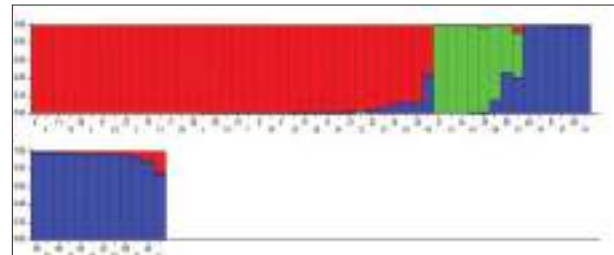


Fig. 2 Population structure of kale germplasm based on SSR data

Table 6. Details of the overlapping significant marker-trait association between two models

Chromosome no.	Marker	Trait	GLM	MLM	Average P value
4	ssr7	Plant height	**	**	**
17	ssr27	Plant height	***	***	***
16	ssr13	Petiole diameter	***	**	**
11	ssr9	Flowering period	*	**	*
1	ssr29	Siliqua length	***	**	**
11	ssr9	Seed weight	***	**	**

ICAR-CITH, RS Mukteshwar

In vegetable crops, cherry tomato, capsicum and garlic was evaluated at Mukteshwar and salient findings are presented below:

In cherry tomato, twelve germplasm were evaluated under polyhouse conditions at Mukteshwar. Most of the germplasm exhibited significant differences in various qualitative and quantitative characters. Among all genotypes, the maximum plant height was recorded in CT-6

(199.1 cm) followed by VLCT-1 (2188.7 cm) and CT-2 -Red (186.4 cm) respectively. The highest total soluble solid was recorded in CT-7 (12.0 °B) followed by CT-6 (11.0 °B), and VLCT-1 (10.1 °B) respectively. The highest yield was recorded in CT-2 Red (52.7 q/ha) followed by CT-4 (47.2 q/ha), CT-6 (39.4 q/ha) and VLCT-1 (33.8 q/ha) respectively.

In capsicum, total seven genotypes were evaluated under protected condition and highest yield was recorded in Selection-6 (100.8 q/ha) followed by CITH SEL-5 (96.8.0 q/ha). In garlic, six genotypes were evaluated and highest total soluble solid was recorded in SEL-10 (42.8 °B) followed by SEL-12 (39.8 °B) & SEL-11 (37.6 °B) respectively. The highest yield was recorded in Sel-12 (63.5 q/ha) followed by SEL-11 (56.5 q/ha) and SEL-7 (41.4 q/ha) respectively.

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

During 2022, activities related breeding programmes for apple, walnut and almond were performed as under:

Apple

In apple hybrids obtained from previous crosses were evaluated for qualitative and quantitative traits to identify the superior hybrids with respect to traits like scab resistance, fruit quality, pollinizer ability etc. Six identified apple hybrids were again evaluated for different traits to check the stability in expression. In three hybrids, Priame (Prima x Ambri), Pride (Prima x Red Delicious) and Pritor (Prima x Top Red) scab

resistance trait was confirmed based on presence and expression studies of *Vf* gene. Two hybrids, Ammol (Ambri x Mollies Delicious) and Ambrit (Ambri x Top Red) were found to have superior fruit qualities than parents and are potential improvements over indigenous apple cultivar “Ambri (CITH-Ambri-1)”. Hybrid Golden Snow (Golden Delicious x Snow Drift) is an improvement over Golden Delicious with better fruit quality parameters than both the parents. Based on performance of these hybrids and stability in expression of superior traits, these are being registered through NBPGR for obtaining INGR numbers. Already two hybrids “Ammol” (Ambri x Mollies Delicious) and “Pride” (Prima x Red Delicious) have been registered with INGR numbers as INGR21070 and INGR21071 for fruit quality and scab resistance traits respectively. Further the crossing populations (CITH-Ambri-1 x Prima, CITH-Ambri-1 x Oregon Spur, CITH-Ambri-1 x Redlane and CITH-Ambri-1 x *Malus floribunda*) are being evaluated through molecular means for QTL analysis and linkage map development. Mutant population generated (gamma radiation and EMS) was evaluated for fruit quality traits (Table 7). About 42 budded apple mutants were evaluated and more than 30 of them were found superior to parent “CITH-Ambri-1” with respect to colour and mutant AM-51 showed highest “a” value (51.85) against parent CITH-Ambri-1 (7.67). During 2023-24 more number of mutants in bearing will be evaluated for colour development and other important traits. Our main aim to develop the mutant of Ambri apple with improvement of colour trait in particular and fruit quality in general.



Improvement in colour trait in mutants (1-4) over parent (CITH-Ambri 1)

Table 7. Fruit quality analysis of mutant population of Ambri (CITH-Ambri-1)

Treatments	Fruit weight (g)	Fruit Length (mm)	Fruit breadth (mm)	Fruit: depth of eye basin (mm)	Width of Eye Basin (mm)	Firmness of flesh (psi)	Length of Stalk (cm)	Fruit: depth of stalk cavity (cm)	Tint	Colour		
										L	a	b
CITH-Ambri -1(Parent)	149.66±2.66	71.48±0.61	66.52±0.52	7.90±0.17	24.00 ±0.11	76.13±1.53	1.61±0.04	1.32±0.04	-34.31±0.60	59.34±0.40	7.67±0.60	33.48±0.39
AM-81	137.66±0.88	69.49±0.34	62.12±1.14	4.51±0.27	23.61±0.39	59.27±0.46	2.26±0.08	1.49±0.00	-68.39±0.39	56.46±0.35	17.75±0.29	29.03±0.46
AM-133	124.66±1.45	72.91±3.30	72.64±0.43	7.79±0.56	26.93±0.10	60.90±1.53	2.17±0.06	1.54±0.04	-45.8±0.72	61.00±0.29	10.63±0.42	28.01±0.09
AM-132	185.33±8.84	72.76±0.55	73.7±0.35	5.63±0.22	28.43±0.26	62.36±0.44	1.76±0.02	1.27±0.01	-13.87±0.63	63.77±1.15	-2.53±0.67	39.34±0.39
AM-158	161±1.115	67.96±0.49	68.67±0.34	7.59±0.08	31.34±0.32	58.38±2.63	1.89±0.05	1.38±0.01	-52.48±1.55	57.55±0.44	10.50±0.39	34.94±1.35
AM-134	163±0.57	68.54±0.36	71.71±0.24	5.97±0.02	28.24±0.33	57.14±0.49	2.1570.02	1.44±0.02	-87.77±0.23	57.5±0.65	26.74±1.00	23.87±0.18
AM-12	171.33±0.88	77.89±0.31	70.92±0.23	7.59±0.15	29.50±0.36	53.49±2.04	2.52±0.04	1.57±0.16	-55.92±1.69	61.63±0.43	13.84±0.08	29.6±0.35
AM-172	117.37±2.15	55.64±0.56	65.35±0.49	4.20±0.05	23.48±0.15	56.35±0.27	2.26±0.00	0.84±0.03	-60.92±2.09	63.26±0.49	11.56±1.95	35.07±1.24
AM-174	118.33±1.73	56.593±0.30	62.23±0.53	4.62±0.14	28.39±0.35	51.65±2.20	1.87±0.02	0.92±0.03	-100.6±0.35	52.98±1.76	27.24±0.89	22±0.61
AM-257	148.33±2.40	71.21±0.55	67.73±0.23	8.25±0.24	28.60±0.08	66.44±0.90	1.97±0.02	1.17±0.04	-126.40±0.24	47.61±0.80	33.84±0.23	24±0.16
AM-258	137.03±2.59	82.00±0.70	69.76±0.22	7.51±0.03	29.83±0.06	62.13±0.68	1.73±0.02	1.34±0.01	-119.27±1.16	51.53±0.72	33.57±0.27	23.89±0.14
AM-263	111.6±3.21	62.45±0.49	64.51±0.31	5.14±0.13	24.77±0.12	65.5±0.35	1.85±0.03	0.85±0.03	-100±0.57	54.21±1.15	26.95±0.57	28.8±0.58
AM-114	194.33±2.72	77.86±0.30	76.43±0.30	8.72±0.13	30.59±0.38	72.36±0.60	1.82±0.07	1.62±0.02	-106.31±2.24	51.78±0.79	31.69±0.35	18.70±0.11
AM-179	128.13±0.98	63.35±0.44	68.13±0.41	6.82±0.02	27.29±0.04	68.33±0.57	1.37±0.00	1.45±0.03	-20.83±43.16	59.32±0.58	15.57±0.57	33.64±0.33
AM-360	149.33±1.85	69.5±0.34	67.68±0.61	6.27±0.06	29.00±0.16	78.57±0.87	1.95±0.02	1.45±0.01	-66.00±1.48	69.20±0.49	17.2±0.36	28.91±0.61
AM-320	141±1.52	68.35±0.20	70.75±0.21	5.73±0.07	27.96±0.10	56.88±0.12	2.27±0.03	1.35±0.01	-82.45±0.31	54.82±0.02	23.41±0.38	23.78±0.46
AM-98	114.33±3.48	60.07±0.99	64.36±0.47	7.46±0.16	23.77±0.23	70.06±1.39	1.41±0.24	1.1±0.05	-65.23±1.44	54.60±0.89	14.87±0.17	30.57±0.19
AM-318	117.66±1.76	61.31±0.62	48.06±12.91	8.40±0.21	25.46±0.39	68.33±0.66	2.17±0.01	1.22±0.06	-33.89±1.79	61.58±0.43	7.10±1.47	35.51±1.69
AM-171	120±4.72	62.19±0.63	65.78±0.92	5.29±0.01	25.07±0.43	62.63±2.38	2.12±0.03	1.09±0.01	-8.54±0.92	64.02±2.80	-3.76±0.96	38.24±0.57
AM-321	97.33±2.33	58.217±1.08	56.23±0.46	6.37±0.11	24.94±0.20	71.63±0.99	2.43±0.07	1.04±0.03	-86.50±0.50	55.84±0.81	22.77±0.19	27.83±0.65
AM-165	123±2.30	66.22±1.06	63.78±0.29	4.61±0.22	25.45±0.37	75.06±2.42	2.70±0.08	1.41±0.38	-35.81±1.56	67.73±0.58	8.2±1.02	36.11±1.55

Treatments	Fruit weight (g)	Fruit Length (mm)	Fruit breadth (mm)	Fruit: depth of eye basin (mm)	Width of Eye Basin (mm)	Firmness of flesh (psi)	Length of Stalk (cm)	Fruit: depth of stalk cavity (cm)	Tint	Colour		
										L	b	
AM-69	121±1.15	63.71±0.56	62.89±0.04	4.66±0.24	28.58±0.32	75.96±1.09	3.23±0.03	1.12±0.01	-93.45±0.37	52.13±1.00	28.01±0.05	15.50±0.33
AM-102	98.66±1.20	57.29±0.32	59.48±0.46	5.64±0.16	27.38±0.26	68.13±0.66	1.86±0.05	1.03±0.04	-77.06±0.87	56.05±0.70	20.05±0.60	31.47±0.41
AM-296	99±2.08	58.56±0.95	64.53±0.40	5.40±0.24	23.84±0.38	72.93±3.02	1.20±0.04	1.09±0.04	-110.04±1.19	55.05±1.95	34.37±1.57	25.07±2.14
AM-177	148.33±2.40	71.49±0.41	70.54±0.33	7.76±0.10	25.39±0.27	68.43±0.39	2.59±0.23	1.31±0.01	-59.64±0.42	57.43±0.46	15.86±0.73	29.50±0.3
AM-251	93.66±1.76	56.78±0.94	58.97±0.57	5.83±0.05	21.28±0.30	70.38±0.40	2.41±0.13	0.86±0.03	-63.53±0.32	60.57±0.30	15.62±1.48	35.86±1.19
AM-259	74±2.30	53.77±1.81	58.01±0.99	3.82±0.06	22.58±0.30	71.49±3.01	1.48±0.02	0.86±0.05	-46.39±0.23	60.76±0.35	6.85±2.87	33.98±0.52
AM-261	93.33±1.20	60.58±0.66	57.02±0.33	4.57±0.18	26.86±0.14	70.31±0.55	2.64±0.02	1.01±0.00	-46.28±1.04	65.82±0.77	11.87±0.28	29.70±0.43
AM-285	86.66±1.45	55.16±1.09	61.95±0.6	4.84±0.04	23.66±0.27	70.56±0.37	1.63±0.00	1.01±0.00	-67.73±2.00	64.36±1.63	20.37±0.30	27.78±0.18
AM-101	153.33±2.02	62.91±0.81	69.6±0.38	8.46±0.18	29.50±0.20	72.92±0.93	2.39±0.01	1.28±0.00	-45.96±1.14	61.43±0.45	9.46±0.41	33.20±1.01
AM-10	120.667±1.45	66.39±0.55	65.07±0.32	7.29±0.23	26.67±0.74	75.5±1.70	1.9±0.00	1.06±0.02	-96.10±1.31	54.56±0.74	26.47±0.45	25.01±0.29
AM-103	87.33±0.88	59.32±0.32	57.14±0.49	5.74±0.1	22.57±0.31	73.47±0.59	2.12±0.02	0.93±0.02	-58.32±0.64	57.38±0.36	13.55±0.17	30.5±0.30
AM-117	150±1.52	76.68±0.78	75.18±5.0	5.88±0.01	24.93±0.19	69.03±0.70	1.72±0.07	1.16±0.02	-55.41±1.36	62.67±1.8	16.53±2.43	25.13±0.44
AM-126	138±0.57	65.347±1.42	66.49±0.86	5.86±0.12	29.97±0.031	70.33±1.45	2.06±0.01	1.23±0.01	-69.17±0.37	57.86±0.54	18.19±0.57	32.37±0.48
AM-153	98±0.57	58.35±0.59	60.41±0.41	8.807±0.07	27.88±0.07	73.38±0.54	2.77±0.02	0.84±0.05	-21.16±1.53	49.52±0.42	34.08±0.52	20.35±0.42
AM-135	123.33±1.85	59.61±0.37	68.23±0.16	6.05±0.03	26.13±0.46	75.73±1.20	0.88±0.06	1.11±0.00	-102.35±0.54	50.85±0.57	28.83±0.63	20.74±0.62
AM-74	100±0.57	55.95±0.21	61.97±0.22	5.58±0.05	26.28±0.00	73.33±0.38	1.53±0.00	1.25±0.05	-28.48±0.31	61.81±0.91	4.51±0.60	35.31±1.40
AM-51	104.33±2.40	58.73±0.70	62.4±0.634	4.02±0.46	18.40±0.60	76.63±1.14	2.08±0.02	1.05±0.02	-116.76±1.54	51.85±0.70	56.74±1.56	21.47±0.75
AM-137	133.66±1.66	64.37±0.43	62.99±0.68	4.74±0.21	20.22±0.55	67.10±0.69	2.48±0.05	1.27±0.03	-50.95±2.64	62.30±1.15	10.42±0.55	34.65±2.30
AM-29	93.33±20.28	61.41±0.7	59.59±0.35	4.62±0.13	20.70±0.8	73.95±1.24	2.47±0.02	1.01±0.00	-84.06±0.15	54.62±2.13	23.61±0.43	26.42±0.32
AM-124	88±0.57	60.05±0.18	59.07±0.10	5.35±0.05	23.94±0.57	67.57±1.60	1.63±0.17	0.85±0.04	-35.75±0.23	62.51±0.36	7.86±1.12	35.29±1.42
AM-170	160.66±4.25	69.3±0.46	66.13±0.6	7.86±0.12	32.94±0.49	78.33±0.43	1.80±0.14	1.08±0.03	-47.58±0.67	59.48±0.27	9.94±0.09	32.59±0.38
AM-214	119.66±1.76	68.4±0.77	64.73±0.80	7.38±0.19	22.19±0.41	70.06±1.07	1.02±0.00	1.64±0.02	-99.38±0.37	55.89±1.06	27.55±0.83	29.59±0.28

Almond

Under almond breeding programme crossing was continued between late flowering almond varieties with important commercial varieties with the object to introgress the late flowering trait in the commercial varieties of almond. The various crosses done during 2021 and 2022 include:

- Tardy non Pariel × Pranyaj
- Ferralise × Waris
- Ferralise × California Paper Shell
- Ferragnese × Waris

The hybrid seedlings obtained from the crosses are being maintained for further evaluation.

Walnut

In walnut breeding populations development between crosses (CITH walnut released varieties with lateral bearing varieties “Serr” & “Payne”) have been grafted on seedling rootstock and are being maintained for further evaluation with respect to nut quality and bearing habit. Our aim to improvement CITH released walnut varieties (CITH-W-1 to CITH-W-10) for yield and quality. Lateral bearing walnut variety “Chandler” has been imported through DBT funded project and has been established in field gene bank of the Institute. This variety is having higher lateral bearing potential than the existing variety available in field gene bank and hence in future breeding for introgression of lateral bearing trait in CITH released varieties will be done using “Chandler” as the donor.



Hybrid seedling of almond and walnut hybrids planted in the field for further evaluation

Comparative transcriptome reveals specific genes and transcription factors linked to aroma, color, shelf life and crispiness of Ambri (CITH-Ambri-1) Apple

The quality of fruit is mainly determined by appearance, texture, flavor and nutritional properties. In order to explore the molecular mechanisms underlying differences in flavor, color and crispiness between Ambri and Red Delicious, RNA-sequencing (RNA-Seq) was utilized to obtain genome-wide gene expression profiles during fruit development. Total RNA was extracted from the fruits of Ambri and Red Delicious using RNA extraction Kit (Qiagen). NEBNext® Ultra II Directional RNA library Prep Kit was used to prepare high quality libraries, according to manufacturer’s protocols and paired end sequencing reads of read length 151bp was generated with Illumina HiSeq-X sequencing platform. The raw reads quality was evaluated using the FastQC software. After filtering, 16.1 million and 26.9 million clean reads were obtained in Ambri and Red Delicious respectively. Filtered reads were mapped to *Malus x domestica* reference assembly (GDDH13 V1.1) using Hisat2 program. The DESeq R package was used to identify differentially expressed genes (DEGs). Comparative transcriptome analysis between Red Delicious and Ambri revealed 2180 upregulated and 2105 downregulated genes. Significant up and down regulated genes from each experiment were mapped for GO enrichment to the GDR database. Genes involved in the flavanoid biosynthesis pathway, due to their potential roles in fruit quality and color were analyzed. In comparison to the Red Delicious, DEGs encoding PAL, 4CL and CHS were found to be upregulated in Ambri. Dihydroflavanols can be oxidized by flavanol synthase (FLS) to form flavanols. Subsequently, expression of FLS was found to be upregulated in Ambri in comparison to Red Delicious. Sesquiterpenes are the most prominent terpenoids in apples with nine enzymatic steps involved in their biosynthetic pathway. Compared to Red Delicious, DEGs encoding HMG-CoA synthase (HMGS), Mevalonate Kinase (MVK), iso pentenyl-diphosphate delta-isomerase (IDI)

exhibited higher expression levels in Ambri. However, DEG encoding an enzyme of MEP pathway, 2-C-methyl-D-erythritol 4-phosphate reductoisomerase (DXR) was found to be upregulated in Red Delicious in comparison to Ambri. In Red Delicious, DEG encoding sugar transporter protein, SWEET 12 was found to be highly expressed. In contrast, Sugar transporter proteins SWEET 7, SWEET 15, ST 2, ST7 and SS4 were found to be more expressed in Ambri. Ripening is characterized by ethylene burst which triggers losses in firmness and crispness and auxin counteracts this process. Red Delicious and Ambri exhibit distinct expression of DEGs related to ethylene and auxin signaling pathway. Most auxin related genes ARF, AUX/IAA, SAUR and GH3 were highly expressed in Ambri. In contrast, ethylene related genes ACS, ACO, ERS, ERFs were found to be expressing more in Red Delicious (Fig 3). Cell wall related genes are also associated with the texture of apple fruit. DEGs encoding cellulose synthase, β -galactosidases, pectin methyl esterase were found to be differentially expressed in Ambri and Red Delicious. One of the candidate genes involved in fruit ripening, JMT was found to be upregulated in Ambri. Expression changes

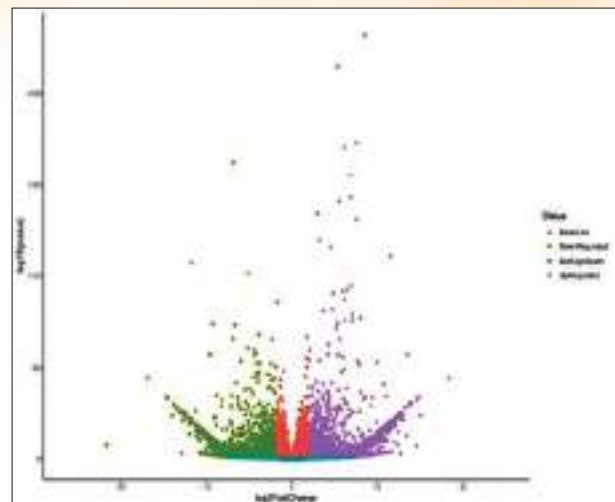
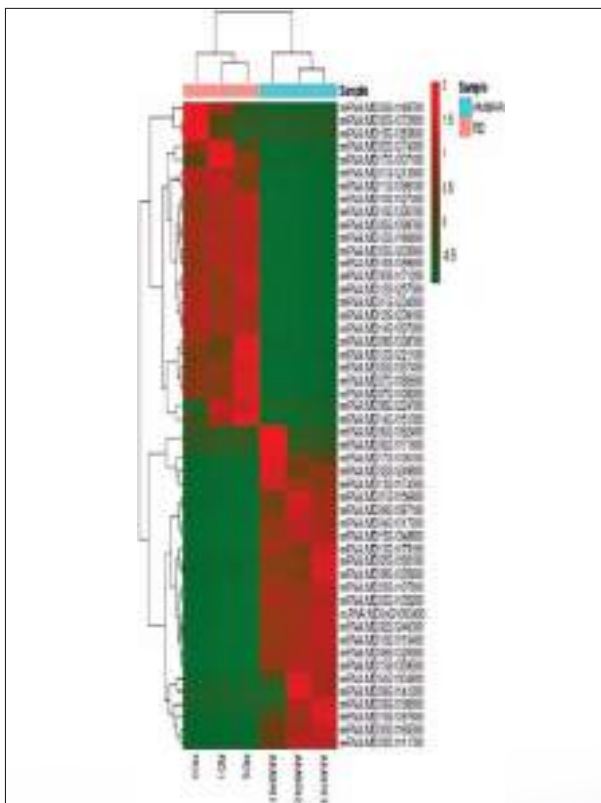


Fig 3. Differential gene expression pattern between apple cultivar Red Delicious and Ambri (CITH-Ambri-1)

in several aroma related genes and transcription factors were observed. The expression level of DEG encoding a aroma related transcription factor, ERF 9 was found to be upregulated in Ambri.

Pear

In the ongoing pear improvement program, previous years, the number of crosses performed and the population showing superior morphological traits was top worked in the pear breeding block. During the year 2022, a hybrid (CITH-PEAR-H-01) on quince rootstock came into fruiting and the fruit were evaluated for some fruit traits and organoleptic tests were compared to parents. The other hybrids will come to bearing in coming years and will be subjected to evaluation.

CITH-PEAR-H-01

This hybrid is derived from the cross between Kosui and Chinese Sand Pear. The hybrid was evaluated for fruit quality and shelf life potential. The hybrid is a prolific bearer, taste is moderate between Kosui and Patharnakh, the shape is round and firmness (73.27 RI) is excellent. It ripens late in the season and its fruits were ready for harvesting by the last week of September, 2022. Grit cells are fewer as compared to Patharnakh. The fruit size is medium (175.93 g) having attractive yellowish peel color and white flesh color on maturity. It has total soluble solids (12.8°B) and moderate acidity

of 0.29 per cent. The pedicel length (39.63mm) is comparatively long in comparison to the parents. The juice content of the fruit was recorded as 65.10 per cent. It has good flavor with a long shelf-life at room temperature after ripening. The fruit can be kept for >2 weeks at room temperature and 4 to 6 months in low temperate (refrigerator) without much quality deterioration and firmness. During the first year of evaluation, the hybrid was showing resistance to black leaf spots which will be confirmed, by pathological and molecular approaches.

The most important trait of any fruit variety besides other traits is consumer acceptability, so organoleptic sensory evaluation of pear parents and hybrid was conducted in Fruit Science Lab on 19th September 2022. A panel of six members was invited to conduct the sensory evaluation on the Five Point Hedonic Scale. The average score of all the parameters indicates the (Hybrid) showed better performance than the parents. The overall acceptability of Hybrid was (3.5) which was far better than Kosui (1.6) and Chinese Sand Pear (2).

Rootstock improvement in temperate fruits

Rootstock breeding in Apple (*Malus x domestica*)

The previous year's crossed population was subjected to multiplication by the method of air layering in order to reduce the period for evaluation processes. Based on the rate and ease of multiplication the hybrid populations were categorized into four different categories

depending upon the rooting abilities. *viz.*, very weak, weak, medium, and strong as per DUS guidelines. Amongst the evaluated population of rootstocks hybrids, CITH-A-RS-M6m-02, CITH-A-RS-M6m-34, CITH-A-RS-M6m-24, CITH-A-RS-M6m-36, CITH-A-RS-M6m-05, CITH-A-RS-M1m-06, CITH-A-RS-MB-15, CITH-A-RS-M6m-17, CITH-A-RS-M1m-01, CITH-A-RS-MB-05 were grouped under very weak category of rooting. The hybrid rootstocks CITH-A-RS-M6m-22, CITH-A-RS-M6m-41, CITH-A-RS-M6m-32, CITH-A-RS-M6m-35, CITH-A-RS-M6m-28, CITH-A-RS-M6m-14, CITH-A-RS-M6m-18, CITH-A-RS-M1m-07, CITH-A-RS-M1m-23 were categorized under weak rooting ability. Rooting of hybrid rootstocks CITH-A-RS-M6m-43, CITH-A-RS-M6m-38, CITH-A-RS-M6m-08, CITH-A-RS-M6m-07, CITH-A-RS-M6m-23, CITH-A-RS-M6m-27, CITH-A-RS-M6m-10, CITH-A-RS-M6m-31 were categorized under medium category. Rooting in hybrid rootstocks CITH-A-RS-M6m-42, CITH-A-RS-M6m-33, CITH-A-RS-M6m-40, CITH-A-RS-M6m-29, CITH-A-RS-M6m-03, and CITH-A-RS-M6m-44 were grouped under strong rooting ability (Table 8).

Leaf stomata studies in apple rootstocks

The study on apple rootstocks stomata were carried out in hybrid rootstock populations maintained at the greenhouse of ICAR, CITH, Srinagar, to study the effect of leaf stomata on vigor, drought tolerance and better water use efficiency etc. The selected leaf from each shoot



Fruiting, fruits and sensory evaluation of CITH-PEAR-H-01

was the fourth from the tip excluding young, rolled leaves. Collections were made towards the end of the growing season during bright sunny periods at mid-day in September and early October. Three images of each imprint were taken and stomatal density was determined directly by counting the number of stomata per image. Stomatal density (SD) and stomatal size parameters including guard cell length (Ls), and guard cell pair width (Ws) were recorded. Comparison of data on overall stomatal characters reveals that the highest stomatal area of 23282.11 μm^2 and number of

stomata was found in rootstock hybrid CITH-A-RS-M6m-08, maximum length (43.68 μm) of stomata was recorded in hybrid CITH-A-RS-M6m-07 and maximum width of 31.93 μm was recorded in hybrid CITH-A-RS-M6m-06. The lowest stomatal area (18046.22 μm^2) was recorded in CITH-A-RS-M6m-27, the lowest number of stomata (3.33), was found in hybrid CITH-A-RS-M6m-12, minimum length (14.06 μm) and width (9.26 μm) in hybrid CITH-A-RS-M6m-39 respectively.

Table 8. Categorization of various rootstock hybrids based on rooting ability through layering

S.No.	Rooting ability by air layering method.	Hybrid rootstocks
1	Very Weak	CITH-A-RS-M6m-02, CITH-A-RS-M6m-17, CITH-A-RS-M6m-34, CITH-A-RS-M6m-24, CITH-A-RS-M6m-36, CITH-A-RS-M6m-05, CITH-A-RS-M1m-01, CITH-A-RS-M1m-06, CITH-A-RS-MB-05, CITH-A-RS-MB-15
2	Weak	CITH-A-RS-M6m-22, CITH-A-RS-M6m-41, CITH-A-RS-M6m-32, CITH-A-RS-M6m-35, CITH-A-RS-M6m-28, CITH-A-RS-M6m-14, CITH-A-RS-M6m-18, CITH-A-RS-M1m-07, CITH-A-RS-M1m-23
3	Medium	CITH-A-RS-M6m-43, CITH-A-RS-M6m-38, CITH-A-RS-M6m-08, CITH-A-RS-M6m-07, CITH-A-RS-M6m-23, CITH-A-RS-M6m-27, CITH-A-RS-M6m-10, CITH-A-RS-M6m-31
4	Strong	CITH-A-RS-M6m-42, CITH-A-RS-M6m-33, CITH-A-RS-M6m-40, CITH-A-RS-M6m-29, CITH-A-RS-M6m-03, CITH-A-RS-M6m-44

*CITH-A-RS-M6m is a cross between MM-106 & M9-Pajam, CITH-A-RS-M1m between MM-111 & M9-Pajam and CITH-A-RS-MB between M.Baccata & M9-Pajam.



Rooting abilities of hybrid rootstocks categorized as per DUS guidelines

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

Transcriptomic analysis of almond cultivars “Waris” & Ferralise” with differential flowering time

Total RNA from two biological replicates of almond cultivars ‘Waris’ and ‘Ferralise’ was isolated, and used for construction of RNA-Seq libraries were constructed which were sequenced using Illumina platform. The FASTQ analysis of the raw reads revealed that all of them passed the quality check. The number of reads from each library is presented in the Table 9. The sequence length of the reads was 35-151 with a GC content ranging from 47.5-50%. The raw reads when subjected to Trimmomatic resulted in reduction of sequences for each library. The sequence length among the trimmed reads was 3-151 with a GC content ranging from 47-50%. The trimmed reads were aligned with almond genome GCF_902201215.1_AlmondV2_genomic.fna using HISAT2. The overall alignment rate for different libraries is shown in Table 10. The uniquely mapped reads among the libraries ranged from 56.33% to 71.85% while the multi-mapped reads ranged from 11.99% to 30.66%. Genome reconstruction

was achieved with Stringtie using all the HISAT2 output files. DESeq2 mediated differential gene expression with p -value of $\leq 0.05\%$ and a fold change (FC) higher than or equal to $|2|$, resulted in a total of 56 differentially expressed genes. The physical location of the differentially regulated sequences on specific chromosomes, their start and end coordinates and the genes located on these sequences are presented in Table. Chromosome 1 harbors 7 genes, Chromosome 2 harbors 8 genes, Chromosome 3 harbors 4 genes, Chromosome 4 harbors 7 genes, Chromosome 5 harbors 8 genes,, Chromosome 6 harbors 5 genes, Chromosome 7 harbors 1 gene, Chromosome 8 harbors 10 genes. Rest of the genes was assigned to various unplaced genomic scaffolds of almond genome as mentioned in the table. Of the total 56 genes, up-regulated genes were 12 while the 44 genes were down-regulated in Waris compared to Ferralise. The list of up-regulated and down-regulated genes is presented in Table 11 & 12. An interesting observation was down-regulation of three F-box proteins viz. F-box protein At2g26160 -like (LOC117629093), F-box protein At2g26160 -like (LOC117627867) and F-box protein At5g49610-like (LOC117613950. Moreover, genes like Accelerated cell death 6-like (LOC117612820),

putative E3-ubiquitin protein ligase RING 1a (LOC117629512) and autophagy related protein 8c-like (LOC117623898) were down-regulated in Waris compared to late blooming cultivar Ferralise. Other significant down-regulated genes included serine/threonine-protein phosphatase 7-like (LOC117627478 and LOC117627482) and BAHD acyltransferase At5g47980-like (LOC117612964 and LOC117612965). Gene functional classification tool identified a single cluster including six gene IDs with an enrichment score of 0.42. Functional annotation clustering identified a single cluster of 47 entries with enrichment score of 0.42. Functional annotation chart identified two chart records under category “KEGG_Pathway” and “UP_KW_Biological processes”. Genes in biological process category with term “Plant defense” included diacylglycerol kinase 1 (LOC117627151), disease resistance protein At4g27190-

like (LOC117619135) and ribosome-inactivating protein bryodin II-like (LOC117614761). Three genes in KEGG PATHWAY category with term “Nucleocytoplasmic transport” were eukaryotic initiation factor 4A-III homolog A-like (LOC117628857), importin subunit alpha-4-like (LOC117629923) and importin subunit alpha-4-like (LOC117630588). Among the up-regulated genes, two revealing molecular function under term “serine/threonine-protein kinase” included probable LRR receptor-like serine/threonine-protein kinase At4g29180 (LOC117619413) and probable LRR receptor-like serine/threonine-protein kinase At5g63710 (LOC117625953). Among the 44 down-regulated genes (Table 13), those implicated in KEGG pathway included the ones with term “Nucleocytoplasmic transport” already discussed in previous paragraph.

Table 9. Description of the raw and trimmed reads from each library used in study

	Raw read pairs			Read-pairs after trimming			% trimmed
	Number	Sequence length	%GC	Number	Sequence length	%GC	
Waris R1	12855553	35-151	50	11178042	3-151	50	13.05
Waris R2	15615082	35-151	48	13554786	3-151	48	13.19
Ferralise R1	11416648	35-151	47.5	9858792	3-151	47	13.65
Ferralise R2	15901151	35-151	48	13817457	3-151	48	13.1

Table 10. The overall alignment rate for different libraries

	Waris R1	Waris R2	Ferralise R1	Ferralise R2
Total read pairs	11178042	13554786	9858792	13817457
Unmapped read pairs	1453810	3025752	1592768	2192069
Uniquely mapped read pairs	6296746	8410059	7083781	9768971
Multi-mapped read pairs	3427486	2118975	1182243	1856417
Improperly aligned read pairs	47860	59699	41992	61862
Overall alignment rate	91.33%	82.04%	88.09%	88.59%

Table 11. Assignment of genes to various unplaced genomic scaffolds of almond genome

Sequence ID	Chromosome No.	Start	End	Gene ID
MSTRG.1918	NC_047650.1	23817948	23823696	117635690
MSTRG.4965	NC_047651.1	6033679	6050903	117613384
MSTRG.6286	NC_047651.1	22201824	22204959	117619920

Sequence ID	Chromosome No.	Start	End	Gene ID
MSTRG.1996	NC_047650.1	24571874	24574243	117627867
MSTRG.11576	NC_047654.1	1774992	1776983	117628857
MSTRG.15747	NC_047655.1	26714079	26739284	117629512; 117630588; :117632223
MSTRG.13025	NC_047654.1	16016596	16025788	117627151; 117627478; 117627482
MSTRG.823	NC_047650.1	9371326	9372901	117613950
MSTRG.20240	NC_047657.1	19906052	19907664	117638689
MSTRG.20714	NW_023010180.1	28268	30892	117613136
MSTRG.12751	NC_047654.1	14006950	14020745	117629093; LOC117628219; LOC117628218
MSTRG.4710	NC_047651.1	1996084	2001302	117617392
MSTRG.20629	NW_023010127.1	12354	32819	117612964; 117612965
MSTRG.1686	NC_047650.1	21898238	21900613	117614273
MSTRG.20659	NW_023010142.1	6372	11060	117618371
MSTRG.15746	NC_047655.1	26709612	26713723	117629923
MSTRG.16633	NC_047656.1	8602066	8603144	117635313
MSTRG.14883	NC_047655.1	19846856	19855159	117631848
MSTRG.9023	NC_047652.1	22864700	22866688	117623603
MSTRG.9435	NC_047653.1	947712	949983	117623898
MSTRG.18470	NC_047657.1	1873176	1973235	117637138; 117637142; 117636936; 117636938; 117636942; 117636967; 117636944; 117636968
MSTRG.5162	NC_047651.1	10435842	10439828	117618956
MSTRG.5004	NC_047651.1	6529285	6543086	117617401
MSTRG.4748	NC_047651.1	2471381	2472363	117619135
MSTRG.11738	NC_047654.1	4088327	4094904	117628345
MSTRG.1929	NC_047650.1	23921995	23922793	No genes
MSTRG.9519	NC_047653.1	1459862	1460915	117624158
MSTRG.18915	NC_047657.1	9563181	9564896	117637720
MSTRG.10845	NC_047653.1	13254577	13256820	117626683
MSTRG.11778	NC_047654.1	4584530	4586717	No genes
MSTRG.20609	NW_023010111.1	237	4996	117612915
MSTRG.11153	NC_047653.1	18096835	18100071	No genes

Sequence ID	Chromosome No.	Start	End	Gene ID
MSTRG.10234	NC_047653.1	6757920	6770164	117623968; 117625194; 117625195
MSTRG.2151	NC_047650.1	25785230	25786607	117614761
MSTRG.5350	NC_047651.1	13695058	13698027	117620202
MSTRG.3766	NC_047650.1	37274052	37275787	117638514; 117619413
MSTRG.7456	NC_047652.1	4520434	4533374	117623210
MSTRG.20348	NW_023010006.1	49359	50236	No genes
MSTRG.5654	NC_047651.1	17305490	17306377	117619677
MSTRG.7984	NC_047652.1	13199018	13202404	117623518; 117623523
MSTRG.11194	NC_047653.1	18933415	18933926	No genes
MSTRG.20567	NW_023010081.1	53422	56004	117612820
MSTRG.11377	NC_047653.1	23719155	23719896	117625953

Table 12. List of up regulated genes in almond cultivar Waris against cultivar Ferralise

Gene ID	Name
117619920	Clathrin light chain 2-like(LOC117619920) <i>Prunus dulcis</i>
117613136	Uncharacterized LOC117613136(LOC117613136) <i>Prunus dulcis</i>
117617392	Protein RETICULATA-RELATED 4, chloroplastic-like(LOC117617392) <i>Prunus dulcis</i>
117614273	Uncharacterized LOC117614273(LOC117614273) <i>Prunus dulcis</i>
117631848	RRP12-like protein(LOC117631848) <i>Prunus dulcis</i>
117619135	Disease resistance protein At4g27190-like(LOC117619135) <i>Prunus dulcis</i>
117626683	Chloroplastic lipocalin-like(LOC117626683) <i>Prunus dulcis</i>
117612915	Uncharacterized LOC117612915(LOC117612915) <i>Prunus dulcis</i>
117620202	Cytochrome P450 714C2-like(LOC117620202) <i>Prunus dulcis</i>
117638514	Uncharacterized LOC117638514(LOC117638514) <i>Prunus dulcis</i>
117619413	Probable LRR receptor-like serine/threonine-protein kinase At4g29180(LOC117619413) <i>Prunus dulcis</i>
117625953	Probable LRR receptor-like serine/threonine-protein kinase At5g63710(LOC117625953) <i>Prunus dulcis</i>

Table 13. List of down regulated genes in almond cultivar Waris against cultivar Ferralise

Gene ID	Name
117627151	Diacylglycerol kinase 1(LOC117627151) <i>Prunusdulcis</i>
117618956	Uncharacterized LOC117618956(LOC117618956) <i>Prunusdulcis</i>
117637138	Probable phosphoribosylformylglycinamide synthase, chloroplastic/mitochondrial(LOC117637138) <i>Prunusdulcis</i>
117637142	Uncharacterized LOC117637142(LOC117637142) <i>Prunusdulcis</i>
117612820	Protein ACCELERATED CELL DEATH 6-like(LOC117612820) <i>Prunusdulcis</i>
117638689	Glutathione S-transferase APIC-like(LOC117638689) <i>Prunusdulcis</i>

Gene ID	Name
117623968	Allantoate deiminase 2(LOC117623968) <i>Prunusdulcis</i>
117612964	BAHD acyltransferase At5g47980-like(LOC117612964) <i>Prunusdulcis</i>
117629093	F-box protein At2g26160-like(LOC117629093) <i>Prunusdulcis</i>
117612965	BAHD acyltransferase At5g47980-like(LOC117612965) <i>Prunusdulcis</i>
117623210	Uncharacterized LOC117623210(LOC117623210) <i>Prunusdulcis</i>
117614761	Ribosome-inactivating protein bryodin II-like(LOC117614761) <i>Prunusdulcis</i>
117623603	2-methylene-furan-3-one reductase-like(LOC117623603) <i>Prunusdulcis</i>
117628218	Uncharacterized LOC117628218(LOC117628218) <i>Prunusdulcis</i>
117628219	Uncharacterized LOC117628219(LOC117628219) <i>Prunusdulcis</i>
117628857	Eukaryotic initiation factor 4A-III homolog A-like(LOC117628857) <i>Prunusdulcis</i>
117628345	Uncharacterized LOC117628345(LOC117628345) <i>Prunusdulcis</i>
117618371	Uncharacterized LOC117618371(LOC117618371) <i>Prunusdulcis</i>
117636938	TMV resistance protein N-like(LOC117636938) <i>Prunusdulcis</i>
117613384	AP-4 complex subunit epsilon-like(LOC117613384) <i>Prunusdulcis</i>
117636936	TMV resistance protein N-like(LOC117636936) <i>Prunusdulcis</i>
117629512	Putative E3 ubiquitin-protein ligase RING1a(LOC117629512) <i>Prunusdulcis</i>
117636942	Uncharacterized LOC117636942(LOC117636942) <i>Prunusdulcis</i>
117636944	Toll/interleukin-1 receptor-like protein(LOC117636944) <i>Prunusdulcis</i>
117627478	Serine/threonine-protein phosphatase 7-like(LOC117627478) <i>Prunusdulcis</i>
117623898	Autophagy-related protein 8c-like(LOC117623898) <i>Prunusdulcis</i>
117627482	Serine/threonine-protein phosphatase 7-like(LOC117627482) <i>Prunusdulcis</i>
117627867	F-box protein At2g26160-like(LOC117627867) <i>Prunusdulcis</i>
117637720	Uncharacterized LOC117637720(LOC117637720) <i>Prunusdulcis</i>
117623518	LEAF RUST 10 DISEASE-RESISTANCE LOCUS RECEPTOR-LIKE PROTEIN KINASE-like2.1(LOC117623518) <i>Prunusdulcis</i>
117624158	STOREKEEPER protein-like(LOC117624158) <i>Prunusdulcis</i>
117632223	Uncharacterized LOC117632223(LOC117632223) <i>Prunusdulcis</i>
117619677	Uncharacterized LOC117619677(LOC117619677) <i>Prunusdulcis</i>
117629923	Importin subunit alpha-4-like(LOC117629923) <i>Prunusdulcis</i>
117623523	PR5-like receptor kinase(LOC117623523) <i>Prunusdulcis</i>
117636967	TMV resistance protein N-like(LOC117636967) <i>Prunusdulcis</i>
117625194	Receptor-like protein EIX2(LOC117625194) <i>Prunusdulcis</i>
117635690	Pentatricopeptide repeat-containing protein At3g22470, mitochondrial-like(LOC117635690) <i>Prunusdulcis</i>
117625195	Allantoate deiminase 2-like(LOC117625195) <i>Prunusdulcis</i>
117636968	Uncharacterized LOC117636968(LOC117636968) <i>Prunusdulcis</i>
117635313	DNA (cytosine-5)-methyltransferase 1-like(LOC117635313) <i>Prunusdulcis</i>
117617401	DExH-box ATP-dependent RNA helicase DExH11-like(LOC117617401) <i>Prunusdulcis</i>
117613950	F-box protein At5g49610(LOC117613950) <i>Prunusdulcis</i>
117630588	Importin subunit alpha-4-like(LOC117630588) <i>Prunusdulcis</i>

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 following Table 14.

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

The seeds obtained in 2021 from F1s created from crossing intermediate day male sterile lines (source PAU, Ludhiana) and Brown Spanish in 2020 were sown in 2021 whose bulbs were obtained in 2021 (F1 bulbs). The seeds from these bulbs were obtained in 2022 after massing (F2M1) and sown in 2022 itself to obtain F2M1 bulbs in 2023 in order to obtain segregants desirable for yield, bulb trait uniformity and storage.

In a separate crossing programme, seeds from F2M1 bulbs with desired storability (i.e. derivatives of MS-1 x Brown Spanish and MS-2 x Brown Spanish, MS-2 x CITH-O-33), were obtained in 2022 by massing method and again sown in the same year to obtain bulbs of F3M2 generation in 2023.

Breeding for nutra-rich varieties/hybrids in root crops

These progenies segregated into different categories on the basis of root surface color, skin color in transverse section and pith color. The primary objective of the project during the previous season were found to again segregate in the similar manner. Each progeny generated the same segregants. Therefore, in 2022, during ex-situ planting of roots for seed production, fewer than earlier color categories were made for individual seed production.

Table 14. Yield and fruit traits of some promising lines in capsicum

Crop	Genotypes	Yield (t/ha)	Fruit length (cm)	Fruit width (cm)
Capsicum	Gold-Sel-01	88.21	7.54	6.69
	CITH-SP-3-1	95.56	6.12	7.24
	CITH-N-4-1-1	112.63	7.10	6.43
	CITH-SP-4	109.15	3.46	5.38
	CITH-CW-4-1/15	96.35	7.65	7.32
	CITH-NS-284-1-1-15	91.25	7.65	7.21
	Nishat-1-Sel-05	61.24	8.82	7.96
	CD (p<0.05)	30.25	3.39	1.62

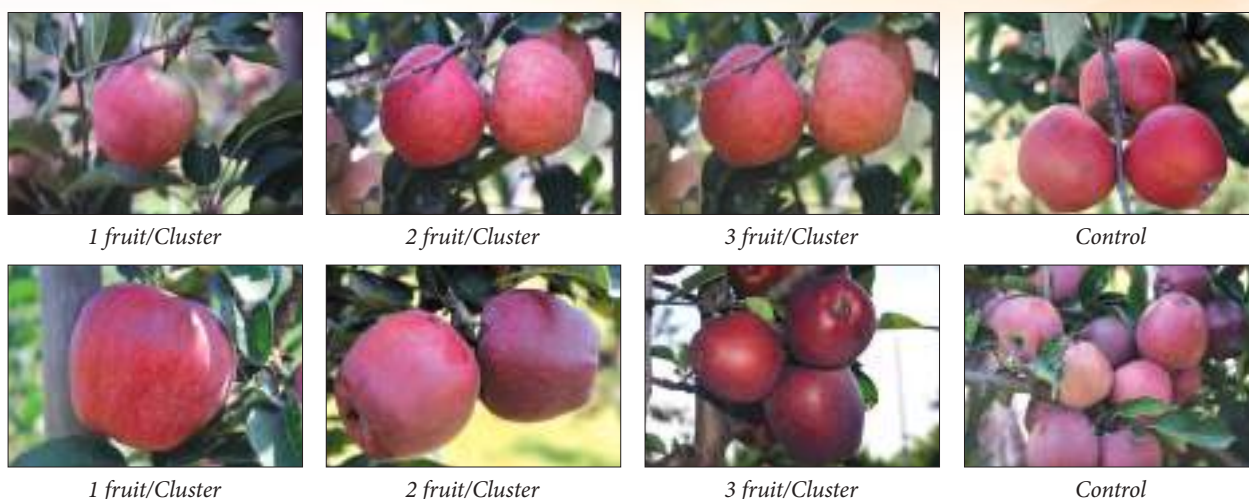
2. Crop Production

The cultivation of temperate horticultural crops in India has witnessed many problems and solution for the problems were provided by the research organizations time to time which has led to present day temperate horticulture scenario. The productivity of quality produce in temperate horticultural crops in India is still low as compared to advanced countries and the factors responsible to the low productivity are quality planting material supply coupled with non adoption of advanced production technologies in training, pruning, nutrient & water management, pollination, post harvesting handling, diseases and pest management which ultimately decides the benefit to 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 department and research organizations. The demand for institute planting material along with production technology is increasing year after year. During 2022-23, institute has supplied about 16678 plants of different temperate fruit crops besides the supply of 11803 scionwood; 876 plants & 6295 seedlings of flowers; about 30 kg vegetable seeds & 16760 vegetable seedlings besides 3 kg onion seedlings to different stakeholders, vegetable growers & research organization etc. During the year 2022, besides above planting material supplied about 3000 grafted plants of walnut were provided to Uttarakhand Forest Resource Management Project for establishment of mother orchards as well as for planting in farmers field under project promotion of walnut in Uttarakhand funded under Japan International Cooperation Agency (JICA). The revenue generated during the financial year from all resources was 69.23 lakhs. To enhance the farm output institute is continuously generating technologies for the benefit of the farmers The outcomes of various experiments on production aspect for generating farmer friendly technologies are presented below:

Pre harvest fruit drop management in apple

Effect of thinning on quality in apple

The pre harvest fruit drop is a major problem in apple leading to great losses to farmers and to address this problem, different trials was started during 2019 at ICAR-CITH, Srinagar. In this experiment, two varieties (standard and spur) of apple viz. Gala Redlum and Super Chief on M9-T339 rootstock planted at (3.0 m x 1.0 m) spacing, trained in tall spindle system were selected. Manual thinning was practiced to observe its effect on quality and pre harvest fruit drop. From the data it was observed that maximum fruit weight, fruit length and fruit diameter was recorded in the thinning treatment 1 (1 fruit per cluster) and minimum values were recorded in control. In case of variety Gala Redlum, maximum fruit weight (171.10g), fruit length (67.21mm), fruit diameter (72.31mm) and firmness (63.26) was recorded with Treatment 1 (1 fruit per cluster) whereas the minimum values for the same parameters were recorded in control. The maximum pedicle length (19.50mm) was recorded in Treatment 3 (3 fruits per cluster). Among the color characteristics (L^* , a^* b^*), L^* value ranged from 30.37 in control to 43.34 in Treatment 1 (1fruits per cluster), a^* values ranged from 26.61 in control to 40.17 in Treatment 2 (2 fruits per cluster), values for b^* scale ranged from 11.15 in control to 24.9 in Treatment 2 (bearing 2 fruits per cluster). The main objective of thinning experiment was to reduce the % fruit drop and increase the yield (kg per plant) which was successfully achieved in Treatment 1 (1fruit/ cluster) followed by 2 fruits per cluster and maximum fruit drop % and minimum yield per plant was recorded in control. In case of variety Super Chief, maximum fruit weight (198.15g), fruit length (68.21), fruit diameter (77.02mm) and firmness (76.93RI) was recorded with Treatment 1 (1 fruit per cluster) whereas the minimum values for the same parameters were recorded in control. The maximum pedicle length (14.32mm) was recorded in Treatment 2 (2 fruits per cluster). Among colour characteristics (L^* , a^* b^* and tint), L^* value ranged from 38.51 in control to 42.20 in



Apple cultivars (Gala Redlum & Super Chief) under various thinning treatments

Treatment 3 (3 fruits per cluster), a^* values ranged from 23.32 in Treatment 3 (3 fruits per cluster) to 25.42 in control and b^* ranged from 10.66 in Treatment 1 (1 fruit per cluster) to 11.58 in control. The values for tint ranged between -98.78 in Treatment 2 (2 fruits per cluster) to -87.04 in Treatment 3 (3 fruits per cluster). Similar trend of % fruit drop and yield per plant was observed for Cultivar Super Chief which recorded minimum % fruit drop and maximum yield per plant was recorded in Treatment 1 (1 fruit per cluster) followed by Treatment 2 (2 fruits per cluster) and maximum fruit drop and minimum yield per plant was recorded in control.

Development of different techniques for enhancing the multiplication rate of temperate fruits under protected/open conditions

Technology for vertical expansion of nursey through air layering in open Field conditions.

In layering the adventitious roots are initiated on a stem while it is still attached to the plant. The rooted stem (layer) is then detached, and transplanted, which later becomes a separate plant on its roots. Whilst multiplying the clonal rootstocks of apple in the open nursery, some plants grow > 3 ft in height and attain good caliper size. After these rootstocks are harvested only 6 to 9 inches (15-25 cm) is needed for grafting/budding operations & rest > 80 % is cut off and just wasted. Keeping in this view, an experiment has

been started in the year 2021 with rootstock MM-106 to initiate rooting along the entire stem at different points based on the height and thickness of the shoot so that this portion of the plant can be utilized in a most efficient way in open nursery conditions. First, those plants having a diameter of (5-7 mm) were selected and wounding/incision has been given and rooting hormones IBA (2500 ppm) was applied to the wounded portion. Small bags filled with rooting medium has been fastened at those points where rooting needs to be initiated in July. A lightweight substrate having a high water-holding capacity was used (Cocopeat). Along with staking, 4-7 closely growing rootstocks were tied together in single polythene bags to save time, cost of inputs, labor, etc, and keep the rootstock in a fixed position. Watering at regular intervals was done to keep the rooting media moist. Five clonal rootstock MM-111, MM-106, M-9-T337, M9-Pajam, and M-26, have been taken for study. Among 5 rootstocks the rooting success percentage varied from 13.33% to 99.17% with maximum percentage in MM-106 and minimum in M9-T337. Maximum plant height (90.8cm), plant diameter (7.37cm), root length (11.5cm), root diameter (2.24mm), number of adventitious roots (6), root fresh weight (3.8g) was recorded in MM-106 and minimum plant height (47.4cm) and plant diameter (4.87cm) in MM-111, minimum root length (6.8cm) and root diameter (0.50mm) in M9-Pajam, minimum no. of adventitious roots (2) in M9-T337, minimum root fresh weight (1.4g) in MM-111. Maximum



MM-106



MM-111



MM-106



M-26



M9-T337



M9-Pajam

Air layering in open field conditions using soilless rooting medium (Cocopeat)

root dry weight (1.5g) was recorded in M-26 and minimum (0.1g) in M9-Pajam. Keeping in view the advantages, this technology can be directly replicated by the nursery growers as the increase in production in some rootstocks is almost double or can further be increased if one more tier is tied so that an additional 2-3, rootstocks can be harvested from the same piece on nursery area. This technology is suitable for the areas where there is sufficient growth of rooting outside the greenhouse/ greenhouse facilities are not available. This technology will suit the demand of all nursery growers of the country.

Air layering in apple rootstocks raised through cuttings in soil less beds in greenhouse conditions

This technology developed is encompassing the benefits of both cutting and air layering under greenhouse conditions. The cuttings of rootstocks were planted in soilless beds and these cuttings attain the growth of 3-4 feet particularly in the case of rootstocks MM-106 and cocopeat was used as the rooting medium. Sufficient growth has been recorded RS MM-106, Two additional plants were harvested in comparison to single rootstocks in the case of Rootstock MM-106. This



View of air layering in apple rootstocks raised through cuttings in soil less beds in greenhouse conditions

technology will be very useful in promoting the vertical expansion of the nursery in greenhouse conditions for rootstock propagated through cutting in soilless beds, so the number of plants per unit area can be increased manifold. This technology can be utilized for other all clonal rootstocks that are multiplying easily by cuttings. The technology will be further refined to harness the maximum benefits.

Impact of combined application of phosphorus and silicon on apple rootstock performance under various soil moisture regimes

A pot culture experiment was started to evaluate the apple rootstocks to different soil moisture regimes with combined application of the Phosphorous and Silica to improve the root proliferation. The aim of study is to develop the rootstock proliferation technology for climate resilient agriculture. The soil and plant samples were collected regularly and lab analysis is going on.

Development and evaluation of integrated nutrient management module for high-quality temperate vegetables production

In this study, treatments comprising of organics and inorganics combinations was under taken in temperate vegetables crops like Long day Onion, Garlic and Kale and completed the one

year of field experiments. Samples of plants and soil were obtained, prepared, and subjected to laboratory analysis.

Assessment of soil carbon dynamics and carbon sequestration potential of selected temperate fruit crops of Arunachal Pradesh

In this experiment, about 324 soil samples were collected from the apple, Kiwi and walnut orchards (108 samples/crop) of the Arunachal Pradesh from different layers (0 to 20, 21 to 40, 41 to 60 and 61 to 100 cm) in order to analyze the different soil C fractions to harness the potentiality of the these temperate fruit crops in carbon sequestration potential and C stock analysis. As the state already under organic cultivation practices, analysis of the nutrient status and soil fertility will help us to develop the organic practices for the state. The samples were under laboratory analysis along with the plants geo-referencing data.

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

For evaluation of integrated nutrient management of vegetables as intercrop in apple orchard, the technology were demonstrated among farmers under MGMG and SCSP scheme at Sunkiya, Nainital and Odlohar-Simsyari, Bageshwar villages during 2021&22 respectively



Field view of integrated nutrient management module for high-quality temperate vegetables production



Soil sample collections from different locations in Arunachal Pradesh

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.

Canopy management and canopy architectural engineering in temperate Fruits

In this experiment, two crops viz apple & pear were taken for experimentation at Srinagar. In canopy architectural engineering experiment in apple; six training systems (vertical axis, cordon, espalier, head & spread, spindle bush and modified central leader system) with two cultivars (Oregon Spur & Red Delicious) on four rootstocks (Seedling, MM 111, MM 106 & M 9) were evaluated for various fruit and yield traits. The fruit weight was highest (263.23 g) in Red Delicious on seedling rootstock in Spindle Bush system. As far as varieties is concerned, average yield in Oregon Spur cultivar was highest on MM 111 rootstock (43.03 t/ha) while in case of Red Delicious, it was more on MM 111 (33.83 t/ha). In case of training systems, highest average yield in Oregon Spur was recorded in Vertical Axis system (60.32 t/ha). While in case of Red Delicious, maximum average yield was recorded on vertical axis system (54.19 t/ha). Among all systems, varieties and rootstocks, maximum yield was recorded in Oregon Spur (70.85 t/ha) on MM 111 rootstock trained on vertical axis system followed by Oregon Spur (65.16 t/ha) on MM 106 rootstock trained on Vertical Axis, Red Delicious on MM 106 (60.13 t/ha), Oregon Spur on M 9 (59.93 t/ha) on vertical Axis, Oregon Spur on MM 111 (54.36 t/ha) in Spindle Bush and Red Delicious on MM 111 (54.19 t/ha) rootstock on Vertical axis system. However yield/ plant was recorded

highest in Oregon Spur on M-9 rootstock trained on modified central leader system followed by Oregon Spur on MM 111 trained on Espalier system, Red Delicious on MM 111 in espalier system. Among different systems average yield was higher in Espalier System in both varieties while among different rootstocks highest yield/ plant was recorded on M9 in Oregon Spur.

In canopy Architectural engineering in pear experiment, 4 varieties (Red Bartlett, Starkrimson, William Bartlett & Kashmiri Nakh), 2 rootstocks (BA 29 C & Q C) and 4 training systems (Vertical Axis, Espalier, Tatura Trellies and Modified Central Leader System) were used for experimentation. The fruit weight ranged from 61.93 g (in Kashmiri Nakh on Q C in Tatura Trellis) to 262 g (in William Bartlett on Q C in Vertical Axis System). Among the varieties on BA 29 C & QC rootsock, highest average fruit weight was recorded in Willam Bartlett. In case of training systems on BA 29 C it was maximum in Modified Central Leader System while on QC it was more in Vertical Axis System. The average productivity on BA 29C was recorded highest (13.75 t/ha) in Kashmiri Nakh while in case of Q C, highest productivity (15.68 t/ha) was recorded in William Bartlett. Similarly, among training systems highest productivity (28.22 t/ha) was recorded in Vertical Axis system on BA 29 C while on Q C highest average productivity was recorded again in Vertical Axis (21.60 t/ha). Among all varieties, rootstocks and training systems, highest productivity was recorded in William Bartlett trained on Vertical Axis on Q C rootstock followed by Red Bartlett (35.55 t/ha) on B A 29C rootstock. In overall, different varieties on BA 29 C rootstock gave more average productivity as compared to QC rootstock.

Development of almond based intercropping system involving saffron

In development of almond based intercropping system involving saffron, different type of varieties having varied growth habit viz. erect, semi erect and spreading were tried along with sole saffron crop and effect of various almond varieties was studied on saffron. The highest saffron yield was recorded under spreading type of almond varieties followed by sloe crop, semi erect almond varieties and erect. The highest almond yield (t/ha) was recorded in erect type (1.93 t/h) followed by spreading type (1.90t/ha) and semierect (1.66 t/h). The highest almond yield equivalent to saffron yield was recorded in erect type followed by spreading type & semierect type. The highest cumulative yield were recorded under spreading type followed by erect, semi erect type & sole. The saffron planting was very old and has witnessed many occurrence of many biotic & abiotic stresses which has resulted in gradual reduction in saffron yield. Hence, keeping of saffron for many years is not advisable and replacement/ planting after four five years with proper diseases management practices must be undertaken for better saffron yield. More over rodents attack has been noticed during last few years which have resulted to great loss. Non significant effect has been observed for most of plant and flower traits. Thus saffron-almond is the best combination

and there is less effect of almond varieties having different growing habit on economic traits of saffron. Thus the almond crop can give additional returns to growers and will be more beneficial to compensate losses during adverse biotic and abiotic conditions.

Off-season cultivation of onion in Kashmir valley

In Kashmir, onion is almost always cultivated in *Rabi* season that encompasses sowing in October, transplanting in December, sometimes in February, and harvesting in June. This leads to glut in onion supply during the months of June-August followed by scarcity leading to price hike starting from September/October. The valley is also forced to buy onion from other states.

To alleviate this problem, a study was conducted at the institute involving different day length responsive varieties collected from other states in combination with different dates of bulbset planting so as to identify a combination that may allow harvesting commercial bulbs during off-season (i. e. October to December) in the field. In the third year of testing, one more planting date was added to the technical program for evaluation of varietal performance for splitting percentage and marketable yield during offseason. Punjab White yielded the highest marketable bulbs for all the dates.

3. Crop Protection

The production of horticultural crops is associated with attack of a large number of insect, pest and diseases causing a huge loss to the growers. Institute is continuously doing need based research on plant protection aspect and the results of various studies carried out during 2022 are presented below:

Survey, collection, characterization and documentation of temperate horticultural crops

Screening of apple germplasm against major diseases using phenotypic and biochemical approaches

During 2021 & 2022, total 203 apple cultivars maintained in field gene bank at ICAR-CITH Srinagar, were screened under field conditions for powdery mildew of Apple incited by *Podosphaera leucotricha*. In spring when the terminal buds begin to grow, the fungus colonizes the young, green tissue as it emerges. These infected “flag shoots” have a silver-gray appearance and may exhibit defoliation, stunted growth, and die-back. The disease intensity was recorded using 0–5 severity scale. Five categories were made

and categorization of apple varieties on the basis of per cent disease intensity is as Immune (0%), Resistant (1-5%), Moderately susceptible (6-20%), Susceptible (21-50%) & Highly susceptible (51-100%). Out of 203 lines 88 were immune, ten were found resistant with disease intensity of 5 percent, 26 were moderately susceptible. Total 62 lines were found susceptible and 17 were found highly susceptible.

Diagnosis, transmission and management of virus/virus like diseases of temperate fruit crops

Exploring the virome of cherry and plum cultivars using RNA-Sequencing

The two cultivars of each, cherry (CITH Cherry 7 and 11) and plum (Santa Rosa & Stanley) were subjected to RNA-sequencing using Illumina platform for identification of viruses and viroids infecting both the crops. Two composite samples were formed from both the cultivars of cherry and plum respectively and were sent for high throughput sequencing using RNA-Seq. approach. The summary of mapping reads of the RNA-seq. data of cherry and plum along with viruses identified are shown in Table (15)

Transmission through budding and understanding the effect of clonal rootstocks x scions (virus infected) interface on mosaic disease of apple

During 2020-21, 8 and 3 rootstocks were selected for grafting (M.26, M.27, M.9, Pajam, T339, T337, MM.106, MM.111) and budding (M.9, MM.106, MM.111) respectively on same year. Scion wood for grafting was taken from ApMV and ApNMV infected designated apple plant as source plants for viral inocula. For cleft grafting, scions with 2-3 buds attached were

grafted on the stem of the recipient stock. A graft was determined to be successful if the scion bud retained its green color and had fused to the rootstock with visible callus tissue formed at the graft union edges. During the month of August 2020-21; T-budding was performed on 2.5 year-old rootstocks with axillary buds of size between 3mm to 5mm in width. The buds, taken from designated virus infected apple (cv. GD) plants. The development of graft union success was 60%- 100% on various rootstocks. From successful number of grafts the AMD viral pathogens (ApMV and ApNMV) graft success rate was found 50% to 80% on various rootstocks. The symptoms observed were mosaic or mosaic-necrosis on all the rootstocks. Symptoms of mosaic/ necrosis were first seen on two rootstocks MM.106 and MM.111 after 60 days of grafting. This pattern was apparent on most of the leaves emerged from buds on scion wood. Once the temperature rise took place in the month of July the symptoms were masked on leaves, however symptoms of mosaic were again retrieved in the month of September. The successful bud union was observed in the month of March-2021 and from successful number of buds the AMD viral pathogen (ApMV and ApNMV) success rate was found 0% on M9 followed by 25% on MM111 and 50% on MM106. The symptoms observed were small chlorotic spots spread over the entire lamina surface. Symptoms of mosaic/ necrosis were first seen on rootstock MM106 followed and MM111 nearly after 9 months (April) of budding, whereas on M.9 rootstock, no symptom was observed throughout the growing season. Mosaic or mosaic-necrosis symptoms ranging from small pale-yellow spots scattered across an entire leaf or part of a leaf to large contiguous chlorotic spots covering an entire leaf lamina along with

Table 15. Data on cherry and plum along with viruses identified

Statistics term	Cherry	Viruses identified	Statistics term	Plum	Viruses identified	Viroids identified
Total raw reads (Million)	38.70	Cherry necrotic rusty mottle virus (CNRMV) Cherry virus A (CVA)	Total raw reads (Million)	45.93	Prunus necrotic ring spot virus (PNRSV) Apple chlorotic leaf spot virus (ACLSV)	Hop stunt viroid (HSVd)
Total filtered reads (Million)	38.15		Total filtered reads (Million)	44.99		
Q30 (%)	93.50		Q30 (%)	93.99		

necrosis were observed. This pattern was apparent on most of the leaves emerged from buds on scion wood. The symptomatic leaf samples collected from grafted and budded plants were tested by conventional RT-PCR after symptom development. It was observed that the specific primers of coat protein gene amplified 252bp and 670bp corresponding to ApMV and ApNMV respectively in tested samples except healthy control both for budded and grafted plants.



Plate: Symptoms on grafted and budded plants a: Mosaic symptoms on grafted plants b: symptoms of mosaic along with necrosis on grafted plants, c: Symptoms of mosaic on budded plants

Spatial and temporal distribution of ApMV and ApNMV associated with mosaic disease in apple plants for tissue and time optimization

Apple is infected with almost 19 viruses and viroids, among them apple mosaic virus-ApMV

and apple necrotic mosaic virus-ApNMV are economically important viruses associated with mosaic disease. The present investigation was conducted to detect and quantify ApMV and ApNMV from different plant parts (spatial) in two cultivars (Oregon Spur and Golden Delicious) of apple plants during different seasons (temporal) for optimisation of tissue and time for their rapid and early detection. Detection and relative quantification using molecular diagnostic techniques viz., Reverse Transcription-PCR and RT-qPCR in various plant parts (leaf, whole flower, sepal, petal, anther, stigma with style, bark, fruit, seed and root) during different seasons was done (Fig 4). Depending upon the availability of tissues during different seasons, both ApMV and ApNMV were detected in all the plant parts except roots during spring season using RT-PCR. During the summer season both viruses were not detected in leaves, bark and fruits, however in autumn season both ApMV and ApNMV were detected in leaves but not in fruits and buds. The RT-qPCR analysis showed variation in expression of ApMV and ApNMV in different parts during different seasons. Results confirmed that during Spring season the ApMV and ApNMV expression was higher in leaves followed by whole flower. During all the three seasons, both ApMV and

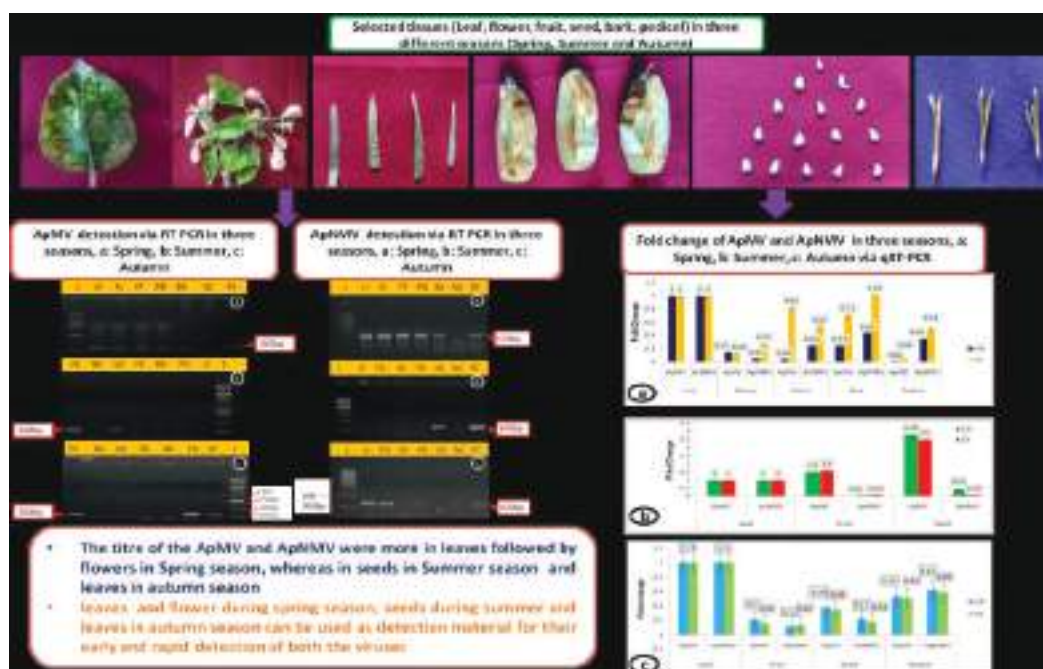


Fig 4. Diagrammatic representation of selection of tissue for ApMV/ApNMV indexing during different seasons of growing period

ApNMV were detected in leaves in measurable titre using RT-qPCR, however via RT-PCR, both the viruses remained undetected during summer season. Periodic detection of these viruses in different plant parts during all the three seasons revealed varied virus titer from one season to another in the same plant. Hence leaves during spring season can be directly used as detection material for their early and rapid detection of both the viruses.

Biochemical characterization of compatible plant-viral interaction- A case study with ApMV/ApNMV-Apple host-pathosystem

The symptoms of mosaic or necrosis occur due to alteration of various physiological, biochemical and metabolic processes within the infected plants. An investigation was conducted on eight cultivars of apple during summer 2022, for quantitative estimation of total chlorophyll, phenolic compounds, flavonoids, peroxidase (POX), catalase (CAT), superoxide dismutase (SOD), Malondialdehyde (MDA) activities etc to elucidate their role in mosaic infected apple plants. As the photosynthetic rate is directly related with chlorophyll content of the leaf and during mosaic the damage to chlorophyll is obvious which ultimately reduces the photosynthetic rate. During 2022, both symptomatic as well as asymptomatic leaf samples were taken from 8 cultivars of apple to quantify the chlorophyll content (Chl_a , Chl_b , total chlorophyll and carotenoids). Significant reduction in chlorophyll content was observed in mosaic infected cultivars as compared to asymptomatic ones. The total chlorophyll content ranged from 0.0028 to 0.0067mg/g in infected leaves as compared to 0.0106 to 0.0177 mg/g in asymptomatic leaves. The reduction in chlorophyll content may be either destruction or inhibition of development of chlorophyll formation by mosaic associated viruses. Flavonoids are a group of phenolic compounds that are known for their antioxidant and antimicrobial properties. In mosaic infected cultivars the flavonoid content was reduced as compared to asymptomatic cultivars. Minimum flavonoid activity was recorded in cultivar Spartan (diseased).

Catalase is an enzyme that plays a crucial role in the breakdown of hydrogen peroxide into water and oxygen. The activity of CAT was more in mosaic infected cultivars than in healthy cultivars. Mosaic-infected cultivars experienced more oxidative stress due to the virus, therefore produced more CAT and were having a higher initial rate of CAT activity compared to the healthy apple cultivars. However, over time, apple cultivars (both infected and healthy) experienced a decrease in CAT activity as the enzyme was used up. Studies have shown that mosaic-infected apple cultivars have lower SOD activity compared to healthy cultivars. This is likely due to the viral infections effect on the plant's metabolism and antioxidant defence system. Mosaic infection can induce oxidative stress in the plant, leading to reduced SOD activity, which in turn can lead to increased damage caused by reactive oxygen species (ROS). Decreased SOD activity contributes to the increased susceptibility of mosaic-infected apple cultivars to oxidative stress and damage. The activity of malondialdehyde (MDA) in mosaic infected apples and healthy apples were different, as MDA is a biomarker of oxidative stress and lipid peroxidation. When a plant is infected with a virus, it causes oxidative stress in the plant, which leads to the formation of MDA. Results have shown that the activity of MDA was higher in mosaic-infected apples compared to healthy apples. This indicates that viral infection causes oxidative stress and lipid peroxidation in apple plants, leading to increased MDA activity. Peroxidase results showed that in mosaic infected apple cultivars POX activity was increased in response to viral infection. This is because POX is involved in plant defence mechanisms against disease induced by pathogens.

Elucidating the diversity, species spectrum and management of *Alternaria* spp. infecting apple (*Malus domestica* Borkh)

Morphological and molecular characterization of *Alternaria* spp. associated with *Alternaria* Leaf Blotch disease of apple

In the year 2021-22, leaves having characteristic symptoms of *Alternaria* blotch were collected

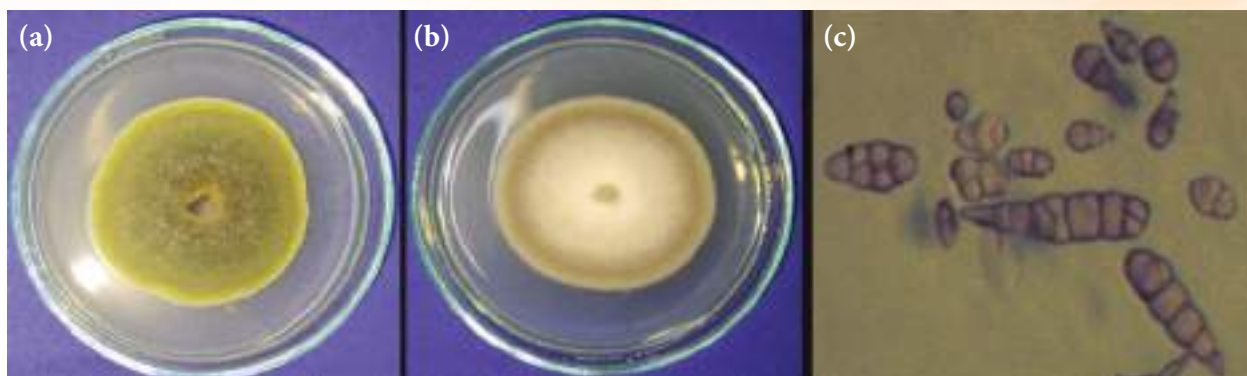


Plate: Seven days old culture of *Alternaria* spp., c- Conidia under microscope at 40X magnification

from plants of apple, almond, pear, walnut and quince from Jammu and Kashmir and apple from Himachal Pradesh. The morphological characters of the fungus *Alternaria* spp. causing leaf blotch of apple were studied both *invitro* and *invivo*. On potato dextrose agar medium, the fungus exhibited olive green to brown colony colour 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.

Molecular characterization

The molecular characterization was done for thirty isolates from all the crops. The isolated pathogens were grown in potato dextrose broth for DNA isolation. DNA of all thirty cultures was isolated and PCR amplification was done using ITS Primers and the product was sequenced. The BLASTn analysis revealed that our isolates showed sequence similarity with three *Alternaria* species viz, *Alternaria alternata*, *Alternaria angustivoides*, *Alternaria tenuissima* infecting these crops. The *Alternaria alternata* was infecting all the crops under study.

Bioprospecting of Rhizo-cum-endospheric Microbiota of temperate fruit rootstocks for management of soil and foliar diseases

Evaluation of microbiota against *Dematophora necatrix* isolated from apple rootstocks

Among fungal pathogens, *Dematophora necatrix* causing white root rot in apple is a destructive pathogen if left untreated and many a times may result in the death of plant. The

indiscriminate application of chemical fungicides results in chemical leakage into ground water, microbial imbalance in the soil-root ecosystem etc. So the focus has now been shifted to use of microorganisms as biocontrol agents which include both rhizospheric and endophytic microorganisms. Management by using microorganisms is most widely recognised and environmentally beneficial way for controlling any form of pest or disease, because it has no detrimental influence on the environment, animals and plants. The rhizospheric and endophytic microbial communities of two apple rootstocks (M27 and MM106) were evaluated against *Dematophora necatrix*. The rhizospheric soil and root samples of two root stocks i.e., M27 and MM106 were brought to laboratory for further processing. The microorganisms were isolated by serial dilution technique. A total of 475 microorganisms were isolated. Among them 203 were isolated from M27 and 272 from MM106. Out of 475 microorganisms 267 were bacterial isolates and 208 were fungal isolates. Both rhizospheric and endophytic microorganisms were isolated. In case M27, 57 bacterial and 40 fungal microorganisms were isolated from rhizosphere and 63 bacterial and 43 fungal endophytes from the roots of above rootstock. Similarly in case of MM106 75 bacterial and 75 fungal isolates were isolated from rhizosphere and 50 bacterial and 72 fungal endophytes were isolated from roots (Fig 5).

Dual culture and Volatile assays

All the microbiota was evaluated using dual culture technique and out of 475 only 18 was

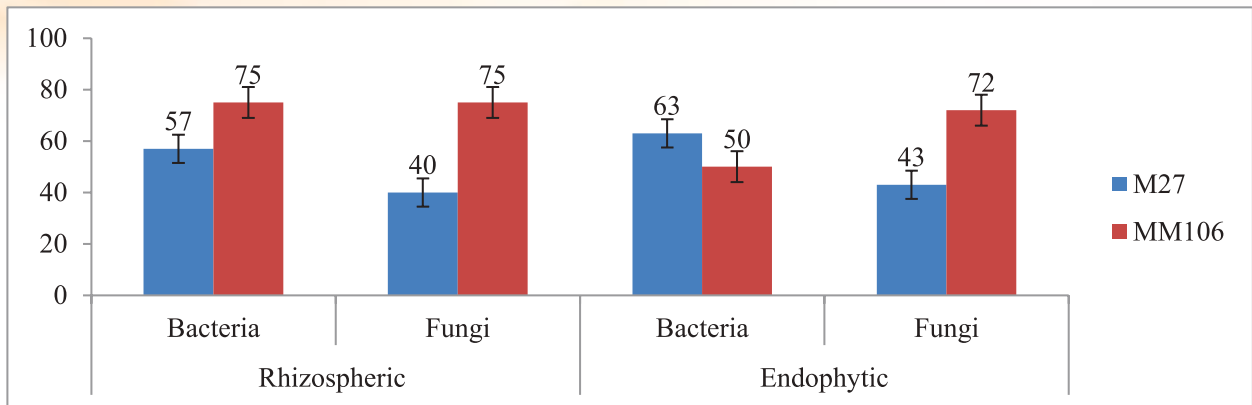


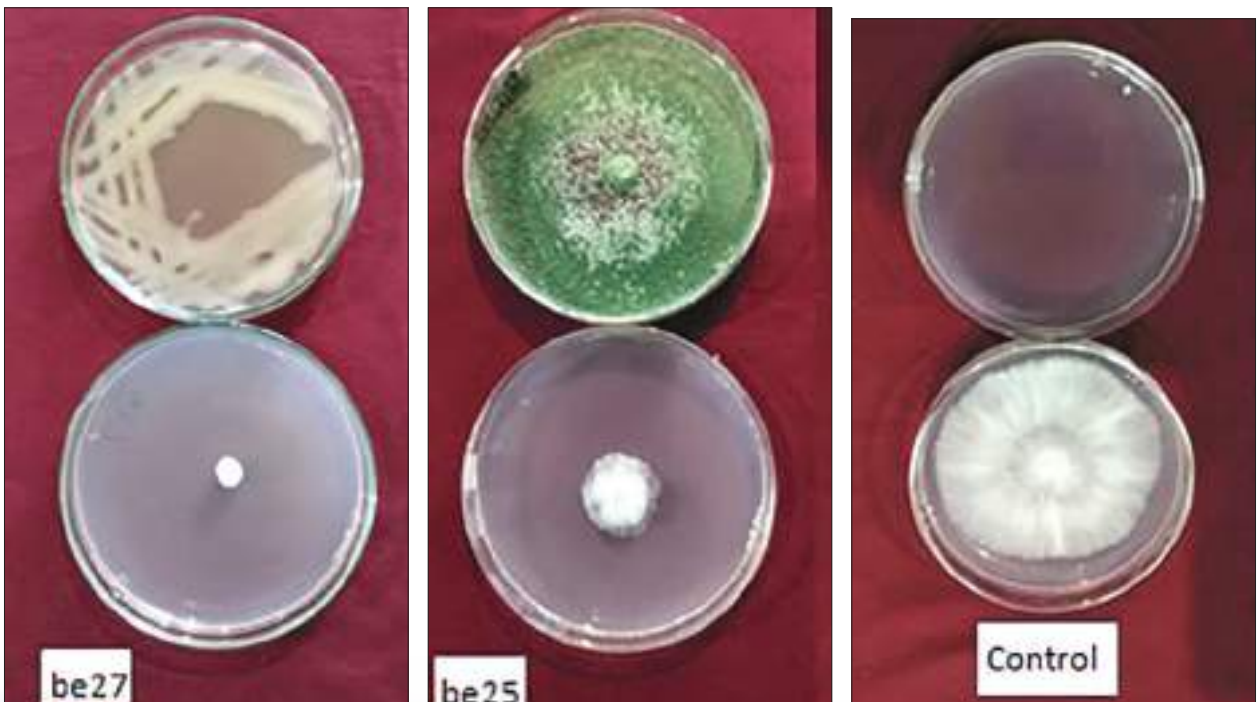
Fig 5. The Rhizo-endospheric statistics of fungi and bacteria in two rootstocks (M27 and MM106) of apple



Dual culture assay of bacterial isolates against *Dematophora necatrix*



Dual culture assay of fungal isolates against *Dematophora necatrix*



Volatile test of bacterial and fungal endophytes against *Dematophora necatrix*

showing inhibition of *Dematophora necatrix*. A total of 9 bacterial and 9 fungal endophytes that were showing percent inhibition of greater than 70 % were selected for further tests. Highest inhibition of 93 % was shown by fungal isolate while as among bacterial isolate highest inhibition of 83 % was observed. These best performing 18 isolates were subjected to test for production of volatile and non-volatile compounds. These microorganisms also performed better in volatile test with highest inhibition of 83 % and 76 % in case of bacterial and fungal isolates respectively.

Bionomics, modelling, and management of aphid-pest complex of temperate fruits

Population dynamics of green apple aphid, *Aphis pomi* De Geer (Hemiptera: Aphididae) in apple orchards

The seasonal population fluctuation of green apple aphid was studied in medium and high-density apple orchards throughout the year. The aphid populations were sampled from Coe Red Fuji and other standard varieties in high and medium-density orchards. The apple trees were 14 years old and grown on MM-106 rootstock. In addition, various varieties in non-bearing stage were also monitored to determine the effect of fruit load on the incidence of green apple aphids. The incidence of green apple started from the third week of March as occasional colonies, mostly on spots that did not receive delayed dormant horticultural mineral oil spray. The incidence continued as wingless viviparous females for two generations and by the 2nd week of April, the production of winged spring migrants started. The winged morphs spread to most of the apple plants and subsequently the aphid population reached very high numbers after 2-3 generations (Fig 6). The aphid population peaked during mid-June and subsequently decreased towards the third week of August. Thereafter, the population rebounded and maintained a steady state till the 1st week of October when the aphid populations entered the sexual phase, marked by the production of oviparae and males. Egg laying started from the 2nd week of October. The

aphid colonies are attended by the ants of genus *Formica* spp. The incidence of green apple aphids was consistently higher on the non-bearing apple trees, indicating a significant effect of fruit load on the vegetative growth rate and subsequently on the incidence of the aphids. The production of winged morphs peaked in the last week of May indicating a further higher propensity for population dispersal and infestation of the foliage of almost all the apple trees in the vicinity. Following this, an outbreak situation of the aphid population is reached needing immediate application of management practices.

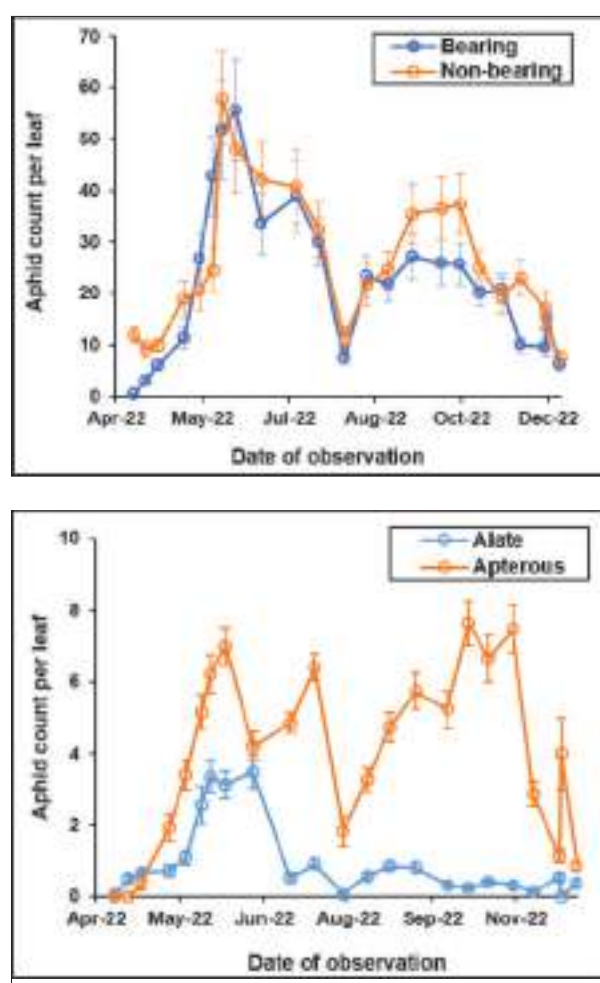


Fig.6: Seasonal population fluctuation of green apple aphid, *Aphis pomi* in bearing non-bearing apple orchards (left), and seasonal production of winged and wingless morphs (right).

Population dynamics of spiraea aphid, *Aphis spiraeicola* Patch infesting spiraea bushes

Population dynamics of spiraea aphid was monitored in Vanhouttespirea bushes (*Spiraea* ×

vanhouttei) throughout the year to explore the possibility of cross infestation of apple trees by the spiraea aphid. The spiraea aphid population reached a peak in the month of July and gradually declined afterwards (Fig.7). The per cent shoot incidence was 100% in the July and gradually decreased to less than 20% after October. The per cent leaf incidence was highest (60%) in the July and decreased to around 20 % after October. The production of winged viviparous morphs was highest from June -July and decreased significantly afterwards. The spiraea aphids remained in asexual mode though the year, including winter, and did not undergo sexual reproduction on the *Vanhouttespirea* bushes.

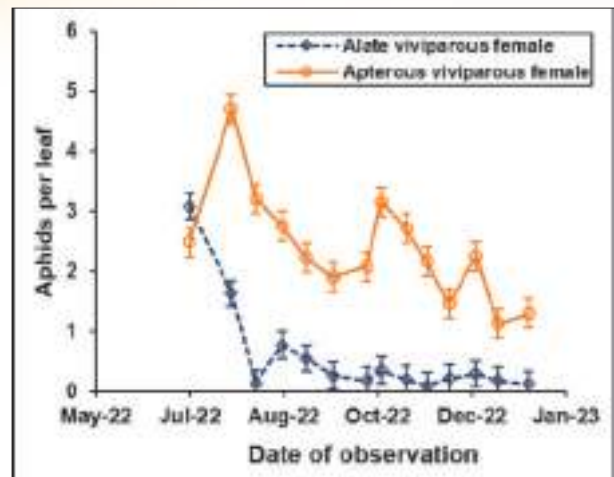
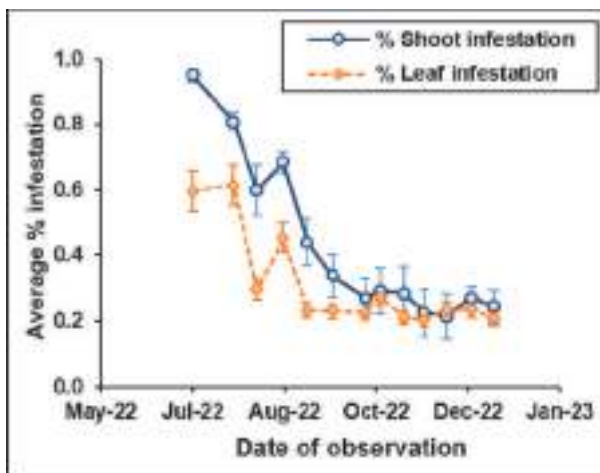
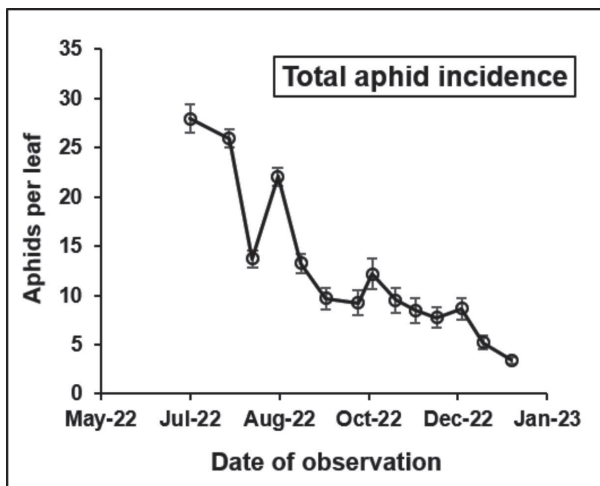


Fig. 7: Seasonal population dynamics of spiraea aphid, *Aphis spiraeicola* on *Vanhouttespirea* bushes- (clockwise from top to bottom) total aphid incidence, per cent shoot and leaf incidence, and seasonal production of winged and wingless morphs



Studies on oviposition of green apple aphid, *Aphis pomi* in apple orchards

The oviposition of green apple aphids was studied from October to December in early-bearing apple plants. The plants with significant infestation of the green apple aphid were selected for the study. After the appearance of oviparae and males in the 1st week of October, the first egg deposition was observed in the 2nd week of October. The freshly laid eggs were green in colour and turned shiny black within 3-5 days (Fig. 8). The number of green eggs per 20 cm of the shoot length starting 10 cm below the growing tip was counted every 4-5 days to determine oviposition schedule of the green apple aphid. The number of eggs laid increased gradually till the last week of October and remained very high till the middle of November. Afterwards, the oviposition rate decreased gradually and stopped altogether by the last week of December, the ovipositing females disappeared by mid-December. Almost all the eggs are laid on current year shoots. Several eggs remained green for longer time (7-10 days) and did not turn black and shrivelled after some time. Such eggs are laid by the unmated oviparae or are the result of unfertilized ova.

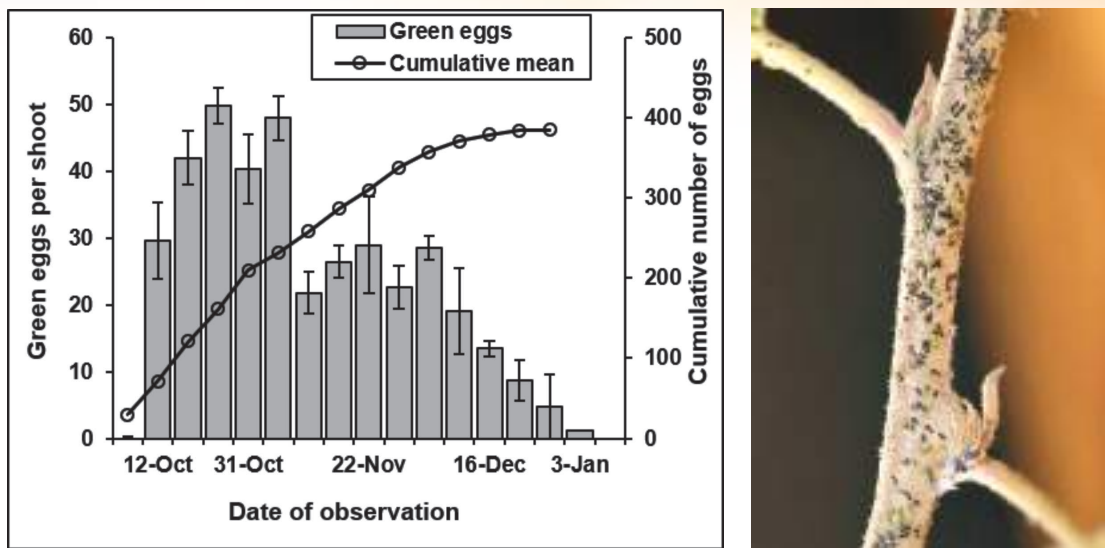


Fig. 8: Oviposition schedule of green apple aphid, *Aphis pomi* on apple trees- (clockwise from top to bottom): oviposition schedule, and green and black eggs on apple shoots.

Relative dispersion of the eggs of green apple aphid, *Aphis pomion* apple shoots

The dispersion of the eggs of green apple aphid was studied on current year shoots of apple when the oviposition was completed (last week of December). The current year shoots with eggs were cut from the tress and brought to laboratory and cut in to segments of 10 cm length. The total length of the shoots varied from 94 to 185 cm, giving rise to 9 to 18 segments for each shoot. the shoot segments were numbered, starting from top (apical meristem) to bottom, and the total number of eggs on each shoot segment was counted. The total number of eggs per segment varied from 0 to 355, averaging at 87.18 ± 3.29 (mean \pm SE). The highest number of eggs (Fig. 9) was found on the subterminal segments 2 – 5 (20 to 60 cm). The top most segment carried slightly lower number of

eggs. Similarly, the number of eggs per segment decreased gradually from 6th segment downwards. During early part of the oviposition, most of the eggs are laid on the upper segments of the shoots

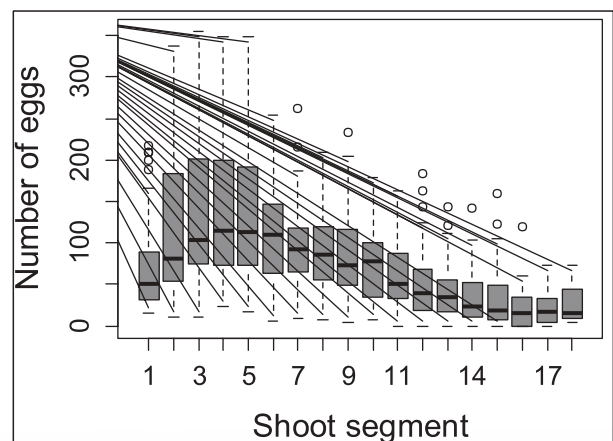


Fig.9: Eggs dispersion of green apple aphid, *Aphis pomi* on apple shoots

and the oviparae move gradually downwards as more and more eggs are laid.

Growers perception survey on the incidence and management of green apple aphids in apple orchards of Kashmir

An online survey program was conducted to understand the perception of apple orchardists of Kashmir valley about the incidence and management of green apple aphid, *Aphis pomi*. Growers from all 12 districts of the valley (n = 84) participated in the survey. While as 8.3% of the respondents reported that green apple aphid was not a problem in their apple orchards, the remaining 91.6% respondents reported that green apple aphid has been a problem for the last 1 to 3 years in their orchards. The 86.9% of the respondents observed sooty mould on leaves, 69% observed sooty mould on fruits, and 70.2% reported that additional cleaning or washing was required before packaging of such fruits. In 20.2% cases, one additional insecticide spray was needed for the management of green apple aphid, while as in 45.2%, 17.9% and 11.9%, two, three or more than three additional insecticide sprays, respectively were needed for the management of green apple aphids. Therefore, it is apparent that the incidence of green apple aphids in outbreak situation has led to significant increase in the cost of cultivation of apples in Kashmir valley.



Online survey program on growers' perception on the incidence and management of green apple aphids in apple orchards of Kashmir.

4. Post Harvest Technology

The some states especially hilly states of India are blessed with temperate climatic conditions suitable for growing a large number of horticultural crops. Among these states, Jammu & Kashmir has monopoly in area and production of some fruit crops in the country. But a large amount of these crops get wasted due to poor shelf life and poor post harvest handling leading to a great loss to the farmers. The stone fruits especially sweet cherry is most perishable fruit among temperate fruits. Institute is continuously doing research to address the problem of post harvest management. The salient findings of research programmes/ activities under taken during the year 2022 are briefly presented under different heads.

Development of edible coating with enriched anti-microbial bio-active compounds for various stone fruits

Under this project the microbial culture development on the storage of cherry in ambient conditions was done and found that the sweet cheery is prone to development of *Penicillium* during spoilage. The other preliminary research activities carried out during the year are effect of combined application of sonication and chemical treatment on shelf life in cherry at room temperature and cold storage and results are presented in different heads.

Effect of combined application of sonication and chemical treatment on shelf life in cherry at room temperature

In this study, Sweet cherry varieties viz. Lambert, Stella and Mishri were harvested and treated to extend their shelf-life and observe their qualitative attributes during storage. These cherry varieties were treated with varying concentration of oxalic acid (1, 3 & 5% solution; maintained at temperature of 4 °C) at constant sonication amplitude for 10, 20 and 30 minutes, whereas, controlled samples were sonicated in cold water. After giving treatment, the fruits were packed in punnet boxes and stored in ambient conditions [Tmax : 13.09 to 24.83 °C and Tmin : 5.36 to 12.76 °C, RH : 39.19 to 71.06] and qualitative attributes

were measured at interval of four days. From the observation, it was observed that maximum firmness was preserved in oxalic acid at 5% after storage of 20 days in Stella and firmness preserved was minimal in case of Lambert. The TSS of the cherries increased with storage period and observed that maximum increase in TSS after storage of 20 days was reported in 5% oxalic acid treated Lambert variety and least change in TSS was reported Mishri. The weight change was reported maximum in Mishri, whereas, the weight change in Stella and Lambert was nearly similar.

Effect of combined application of sonication and chemical treatment on shelf life in cherry under cold storage conditions

In second study, the Stella, De-Vignola, Sun Burst and DN -II varieties were treated with 1% oxalic acid maintained at ambient conditions and other at nearly 4 °C and both sonicated at 60 amplitudes for 10 min followed by evaluation study for storage in cold storage maintained at 4 ± 0.5 °C. The control sample was sonicated in cold water at 60 amplitudes for 10 min duration. It was found that, the Stella variety could only be stored for lesser duration while De-Vignola, Sun Burst and DN-II could be stored for more duration without any significant spoilage in



Sun Burst after end of study stored at 4±0.5 °C

terms of visible incidence of microbial strains or excessive shrinkage. It was observed that after end study, the DN-II recorded highest physiological weight loss and least was recorded in De-Vignola. In case of preservation of firmness, the controlled samples shown maximum preservation and least preservation was recorded in samples sonicated in oxalic acid at ambient condition. It can be concluded that the samples sonicated either in only cold water (control) or oxalic acid maintained at 4 °C resulted in retention of highest quality of fruits during the storage period.

Osmo-dehydration of Kiwi fruit

Osmo-dehydration of Kiwifruit (*Variety Allison*) was carried out with four independent variables *viz.* osmo-dehydration time (160, 180 & 200 minutes), concentration of osmo-dehydration sucrose solution (40, 50 & 60 °B), amplitude of sonication (30, 45 & 60) and sonication time (10, 20 & 30 minutes). From the results it was observed that the colour of slices faded due to loss of chlorophyll pigments in osmo-sonication treatment. The maximum loss of colour pigment was recorded in 7 mm thick slices treated with 60 amplitude for period of 20 minute in 50 °B followed by osmo-dehydration for 160 minutes and least colour change recorded in slices treated with 45 amplitude for period of 10 minutes in 50 °B solution osmo-dehydrated for 160 minutes.



DN-II after end of study stored at 4±0.5 °C



De-Vignola after end of study stored at 4±0.5 °C



Osmo-sonicated kiwi fruit slices (with maximum and least pigment losses)

5. Externally Funded /Network projects

Besides the in house projects, many externally funded projects are running at ICAR-CITH and salient outcome of various projects are presented below:

Production of quality planting material of elite walnut cultivars and demonstration of improved agro-technology for walnut orchards in Kashmir and Arunachal Pradesh

For promotion of CITH released walnut varieties in UT of Jammu & Kashmir and state of Arunachal Pradesh, 350 grafted plants of CITH released walnut varieties along with the bud wood (2600 sticks) were provided for establishment of mother blocks at SKUAST-K, Srinagar, farmer's field in Jammu & Kashmir and Arunachal Pradesh as well as research institutes in Arunachal Pradesh & Assam. Trainings on techniques in walnut propagation under protected conditions and open field conditions for attaining maximum success rate were organized at Institute of Horticulture Technology, Mandira, Hekra, Assam. Publications (English & Hindi) on propagation techniques in walnut was prepared and distributed among the farmers and other stakeholders at ITH, Assam. Demonstration on CITH released walnut varieties was also laid down at Institute of Horticulture Technology, Mandira, Hekra, Assam for their performance and further commercialization. Demonstration on imported varieties of walnut



Demonstration on walnut propagation at IHT, Assam



Training and distribution of publication on walnut propagation at IHT, Assam

(Chandler and Franquette) was laid down in farmer's field and different institutions.

Augmentation of plant genetic resources and capacity building of researchers in India and Uzbekistan (DST funded: Collaborator ICAR-NBPGR, New Delhi)

Exchange visit within Indian-Uzbekistan collaborative research project entitled, "Augmentation of plant genetic resources and capacity building of researchers in India and Uzbekistan" with the purpose to explore the temperate horticultural germplasm suitable for exchange and also to provide training as well as awareness about latest varieties and technologies developed in horticulture in India was made during 25th July to 31st, 2022. In addition visit included exchange the ideas through seminars organized during the visit to Uzbekistan for improvement of technical skills and know how about budding, grafting, rootstock multiplication, canopy management, nutrition management, breeding of horticultural crops, PEQ etc. Visit

was made to Institute of Horticulture, Viticulture and Winemaking named after Academician MakhmudMirzaev, 111116, Toshkent viloyati, Toshkent tumani, Guliston QFY, Chimkent yo'liko'chasi, UZBEKISTAN/ Exchange visit within Indian-Uzbekistan collaborative research project. During the visit, special lecture was given on "Role of ICAR in temperate horticulture development – Achievements and future plans". During the visit new varieties were identified for germplasm exchange in future under this project, improvement of grafting skill to the staff members of Uzbekistan research stations was done and possibilities for genetic improvement through breeding by introgression of specific traits (drought tolerance, temperature resistance etc) available in the germplasm of Uzbekistan was explored. Under this project germplasm imported during 2021-22 (48 germplasm of 12 crops) was released from PEQ after completing one year and was established in the field gene bank of ICAR-CITH, Srinagar. The germplasm supplied to Uzbekistan from ICAR-CITH, Srinagar during 2022-23 was 45 varieties of 8 crops.



Planting material packaging for Uzbekistan

DUS centre for temperate fruits and nuts

Characterization of apple, strawberry and pear, reference varieties was performed as per the DUS descriptor developed by ICAR-CITH, Srinagar. The characterized data was converted into different notes which can act as 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 germplasm block of apple has been further strengthened with total 238 varieties / hybrids of apple, making it a very good repository having such a huge number of varieties / hybrids of single crop at one place.

ICAR-Central Institute of Temperate Horticulture, Srinagar and PPV&FRA, New Delhi jointly organized two days International workshop on "DUS testing of apple and pear" from 7th to 8th September 2022 at ICAR-Central Institute of Temperate Horticulture, Srinagar (Hybrid Mode) under Indo-German Cooperation on Seed Sector Development. During the deliberations thorough discussions resolved many issues related to DUS testing of apple and pear under Indian conditions. Fine tuning of On-site DUS testing was planned after relevant and desired feedback obtained from German scientists. Workshop was attended by scientists from ICAR-CITH, Srinagar, ICAR-NBPGR, Srinagar, SKUAST-K, Srinagar, PPV&FRA, New Delhi, Dr YSPUH&F, Shimla, ICAR-CITH (RS), Mukteshwar etc. Field visit was also organized to provide on spot training on DUS testing to the participants. Farmers were made aware about protection of their varieties through PPV&FRA and the benefits of protection thereof.

Study visit, consultation meeting and training of Dr Javid Iqbal Mir (PI, DUS Centre) and Dr Wasim Hassan Raja (Co PI, Dus Centre) in Germany on DUS testing on Apple & Pear was convened from 25th July to 1st October, 2022. During the visit and discussion with German experts on DUS testing of apple & pear, breeding of fruit crops, germplasm management and protection etc, key areas having practical utility to be focussed were identified which include use

of molecular and biochemical markers in DUS testing for only those varieties which have specific gene for specific traits, DUS testing of apple rootstocks which need separate guidelines to be developed at the earliest, for speeding up breeding programmes in apple transgenic line PPMads-4 (source: Silver Birch) need to be used for inducing precocity, for maintaining scab resistance genes like Rvi-5, Rvi-11, Rvi-12 & Rvi-15 need to be introgressed in commercial cultivars etc. Also suitable genotypes of apple (SQ-159/Natula/Magic Star for scab resistance), Areko (Cherry for quality), PPMads-4 (Transgenic apple for speed breeding programme) etc were identified.

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

Identification, documentation, registration, release etc of technologies and varieties

During 2022, three applications have been submitted for registration of hybrids (Priame, Pritor and Golden Snow) through ICAR-NBPGR, New Delhi and for INGR number allotment. Technologies developed by the Institute were compiled and display boards are being prepared for their wide publication. Technology demonstrations were laid in farmer's field for evaluation of different technologies including apple hybrids, rootstock multiplication under controlled conditions etc. Organized training programmes for Horticulture Development Departments officials of Himachal Pradesh during 2022 to generate awareness about latest developments in temperate horticulture and to improve technical skill. MoUs were signed between ICAR-CITH, Srinagar and SKUAST-K, Srinagar, SKUAST-J, Jammu and private organizations. Process for transfer of five technologies (CITH walnut varieties) through Agrinnovate India limited has been initiated. One project through contract research for evaluation of product in apple crop has been initiated and is under progress. Awareness programme on protection of plant varieties through PPV&FRA was also held to generate awareness among the farmers for protection of their varieties.

Identification, documentation, registration, release etc of technologies and varieties

Online application for registration of apple hybrids namely "Ambrit" (Ambri x Top Red, Registration number R1137022293) "Pritor" (Prima x Top Red, Registration number R1137022291) and Golden snow (Golden delicious x snow drift, Registration number R1137022293) have been submitted to NBPGR for obtaining INGR number.

A comparative metabolomics approach for the analyses of scab-disease resistance in apple and development of a metabolite-based non-invasive sensor for early scab-disease diagnosis

Volatile organic compound profiling

Non invasive method of volatile organic compound collection was done and volatiles were collected at ICAR-CITH, Srinagar for scab resistant and susceptible varieties. The collected samples were transported to IIT, Roorkee for further profiling. Differential VOC profiling between scab resistant (Florina) and susceptible apple cultivars revealed that there are key VOCs which important form designing electronic nose for early detection of scab in apple. Apple samples and grafted plants of scab resistant (Prima, Firdous & Florina) and susceptible cultivars (Red Delicious & Golden Delicious) were processed and transported to IIT, Roorkee for VOC profiling. GC-MS chromatogram of VOC analyses from selected apple cultivars was done to identify specific molecules. (Fig 10 & 11).



Non-invasive collection of volatiles from apple leaf



SPME-GC-MS analyses of VOCs

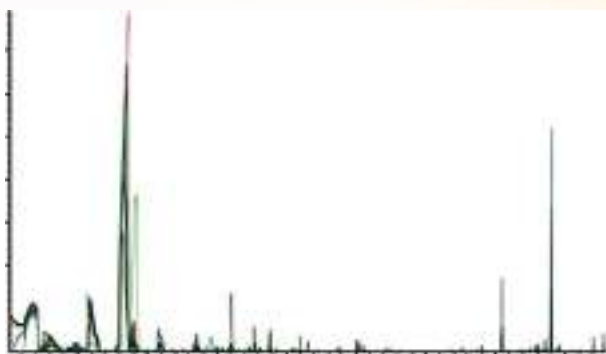


Fig 10. Representative GC-MS chromatogram of VOC analyses from selected apple cultivars

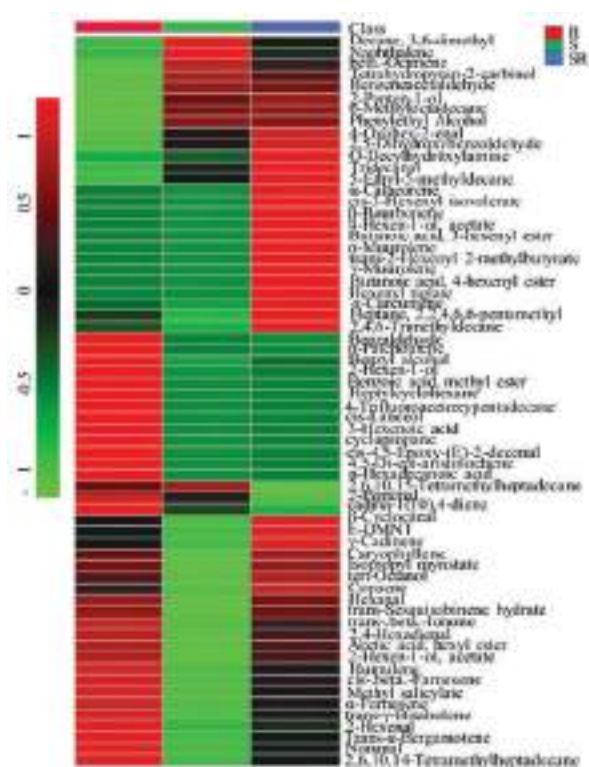


Fig 11: Identification of different volatile organic compounds (VOCs) from scab-susceptible (Granny Smith), semi-resistant (Golden Delicious) and resistant (Florina) cultivars of apple using SPME/GC-MS

Development of DUS test guidelines for vegetable kale (*Brassica oleracea* L. var. *Acephala*)

Sixty two genotypes of kale were evaluated and observations were recorded on five competitive plants marked at random in each plot over the replications on plant morphological parameters in the second year of evaluation and on reproductive stages for the first year. DUS test guidelines of UPOV and IBPGR were used for recording observations on 55 quantitative and qualitative traits.

Validation and development of DUS testing guidelines for olive

The results were compiled for various traits and 18 varieties were categorized and guidelines were prepared for further presentation in Task force meeting.

All India Network Research Project on Onion & Garlic (AINRPOG)

There are two centers (Srinagar & Mukteshwar) of All India Network Research Project on Onion & Garlic (AINRPOG). The brief findings of various experiments in this project are given below:

ICAR-CITH, Srinagar

Under sub-project 'Crop improvement', one new collection of onion CITH-O-110 was made and already existing onion germplasm comprising 102 accessions was evaluated during 2022 season. The marketable bulb yield of germplasm ranged from 184.97 to 694.92 q/ha and the average marketable yield of germplasm was estimated to be 393.76 q/ha. CITH-O-70 (694.92 q/ha) was the highest yielder followed by CITH-O-86 (645.83 q/ha), CITH-O-47 (608.79 q/ha) and CITH-O-2 (604.49 q/ha) showing performance at par with it. Under varietal and hybrid evaluation trials, 13 IET, 8 AVT-I and 9 AVT-II entries of onion varieties and 6 IET and 7 AVT-II entries of onion hybrids were tested. A new experiment on hybridization breeding in onion was also initiated in 2022 in which 9 single crosses were made between Brown Spanish and short day onion varieties. The seedlings of each of the crosses were transplanted to the field in November, 2022 to evaluate for bulb traits, yield and storage life during 2023

In garlic, no new collections were made and the yield of existing germplasm ranged from 77.23 to 398.75 q/ha. The average marketable yield of germplasm was 229.94 q/ha. CITH-G-65 (398.75 q/ha) was the highest yielder at par with CITH-G-30 (391.63 q/ha). In garlic, 7 IET, 6 AVT-I and 12 AVT-II varietal entries were tested..

Under sub-project 'Crop production', two experiments on 'Determination of optimum fertilizer regime for long day garlic cultivation

in Kashmir' and 'Determination of optimum fertilizer regime for long day onion cultivation in Kashmir' were concluded in 2022. Under sub-project 'Crop protection', survey of Kashmir valley was done for monitoring of major diseases and insect pests of onion and garlic. Percent incidence and PDI of *Stemphylium* blight, Downy mildew, Botrytis leaf spot and *Fusarium* rot were calculated from survey of districts Ganderbal, Srinagar and Anantnag. Under the experiment on 'Management of pests and diseases in garlic', Metiram 55% + Pyraclostrobin 5% resulted in lowest average intensity of *Stemphylium* blight (1.13) compared to all other treatments and check (8.52).

Total breeder seed production in onion was 3.5 kg (Brown Spanish and Yellow Globe) and total clove production in garlic was 110 kg (CITH-G-1 and CITH-G-3). New experiments to be reported in 2023 were also laid out in the field.

ICAR-CITH, RS Mukteshwar

In Long Day Red Onion, total nine genotypes were evaluated and highest yield was observed in RVA 21-23 (449.62 q/ha) followed by RVA 21-21 (175.02 q/ha), RVA 21-01 (118.49 q/ha), VL-3 (102.65 q/ha) and RVA 21-09 (65.54 q/ha yield), respectively. The highest TSS was recorded in RVA 21-21 (13.47 °B). In IET on long day white onion total six genotypes were evaluated and highest yield (202.30 q/ha) and TSS (13.25 °B) was observed in WVA 21-47. In IET on long day red hybrid onion total seven genotypes were evaluated and highest yield (229.16 q/ha) & TSS (12.73 °B) were observed in RHA 21-51. In AVT-I on long day red onion, total nine genotypes were evaluated and highest yield (357.80 q/ha) was recorded in RVB 21-17 & TSS in RVB 21-22 (14.67 °B). In AVT-II on long day red hybrid onion, total eight genotypes were evaluated and highest yield (217.73 q/ha) was recorded in RHC 21-63 and TSS (14.77 °B) in RHC 21-56. In AVT-II on long day red onion, total ten genotypes were evaluated and highest yield (170.58 q/ha) was observed in RVC 21-44 while the highest TSS was recorded in RVC 21-41 (14.43 °B). In HTSS-AVT-II on long day white onion, total eight genotypes were evaluated and highest yield

was recorded in WTC 21-82 (100.14 q/ha) while highest TSS was recorded in WTC 21-84 (16.47 °B). In AVT-II on long day white onion, total six genotypes were evaluated and maximum yield was observed in WVC 21-71 (155.52 q/ha) while maximum TSS was recorded in WVC 21-76 (17.10 °B).

In Long Day Garlic, total eight genotypes under IET long day garlic were evaluated and maximum marketable yield (88.33 q/ha) was recorded in GN 21-08 while maximum TSS (47.00 °B) was recorded in GN 21-25. In AVT-I, highest marketable yield was recorded in GN 21-38 (144.88 q/ha) while maximum TSS was recorded in GN 21-31 (42.63 °B). In AVT-II total thirteen genotypes under long day garlic were evaluated and maximum marketable yield were recorded in GN 21-75 (169.37 q/ha) while maximum TSS was recorded in GN 21-46 (46.17 °B).

All India Coordinated Research Project (Vegetable crops)

ICAR-CITH, Srinagar

Under AICRP (VC) sub-project, Collection, evaluation, conservation and utilization of Germplasm; 9 paprika, 4 chilli, 2 kale (Dinosaur kale and Improved Dwarf Siberian), 1 kohlrabi and 1 pakchoi collections were made. In varietal and hybrid trials, 8 IET, 9 AVT-I and 6 AVT-II hybrid chilli entries, 13 AVT and 7 AVT-II chilli entries; 6 IET, 7 AVT-I and 8 AVT-II determinate hybrid tomato entries, 6 IET and 9 AVT-II determinate tomato varietal entries; 7 IET capsicum varietal entries and 7 IET cabbage hybrid entries were tested.

ICAR-CITH, RS Mukteshwar

Total three genotypes of laipatta were evaluated during 2022 for their growth and yield parameters. Among the genotypes, 2021/MGVER-6 recorded highest leaf length (29.5 cm, and plant height (38.4 cm), however five leaves weight (111.0 g), leaf width (16.9 cm), five plant leaves weight (743.0 g), and total weight per plot (2.6 kg) were recorded in 2021/MGVER-3 as compared to other genotypes

State Varietal Trial of French bean (Volunteer Center)

Eleven genotypes of French bean were evaluated during 2022 for their growth and yield traits. The highest plant height (32.8 cm), pod length (16.3 cm), weight of ten pods (46.0 g), yield (43.2q/h) were recorded in genotype CITH-FB-1 as compared to other genotypes.

Walnut propagation for production of quality planting material for walnut promotion in Uttarakhand

The non-availability of quality planting is one of the major constraints which have led to slow increase in acreage with standard cultivars of walnut in India. To raise the socio economic status of farmers in Uttarakhand through promotion of walnut cultivation, the project aimed production of quality planting material of walnut and its planting in Uttarakhand to enhance farmer's income in future. The project was executed at Srinagar and Mukteshwar. Different trials were conducted on various propagation methods and varieties. In comparative studies on success of various propagation methods (4 methods) performed on different dates in CITH W 1, cleft grafting gave better success. Among different varieties, maximum success was recorded in CITH W 3 followed by CITH W 1, 5, 8 & 9. As far as time span for grafting of different Institute

released varieties are concerned, CITH W 3 & 4 offered large span for grafting from 2nd Week of February to 3rd Week of March followed by CITH W 1 from 3rd Week of Feb to 2nd Week of March. The role of rootstock and its condition also played an important role in grafting success. Hence *in situ* grafting (last year planted well established rootstock) or a fresh rootstock with minimum time gap between uprooting and planting should be assured and planting of rootstock should be done well in advance (ending November to early December in Kashmir conditions) so that it can get well established before grafting for better success. In November, 2022, 3000 grafted plants of walnut were provided to UFRMP-JICA, Dehradun for further planting at different locations of Uttarakhand. About 1179 grafted plants were raised in different nurseries of Deptt of Forest, Uttarakhand mainly at Sony and Magra. Regional Station, Mukteshwar also produced about 400 plants. During 2022, five training programmes of one day duration on walnut propagation & mother orchard management were organized in various forest nurseries in Uttarakhand *viz.* Maldevta (17th February), Magra (18th February), Sony (20th February), Ladiyakata (21st February) and Silalekh (22nd February) were organized in which total 130 participants (Forest staff & some farmers) participated. The programme were attended by Dr O C Sharma, Dr Arun Kishore, Sh Bashir Ahmad Ganai, Dr N C Nainwal from



Maldevta



Magra



Sony



Ladiyakata



Silalekh



Glimpses of training programmes at various forest nurseries on walnut propagation

UFRMP-JICA, Sh S K Singh from UFRMP-JICA, Range Officer, and DFO etc. Very good impact of previously organized programmes was witnessed as these nurseries started production of planting material.

Characterizing diversity, genome profile and development of robust diagnostics for *Diplodia* spp. associated with canker disease of apple (*Malus x domestica* Borkh.) in North Western Himalayan Region of India (SERB-DST)

Survey and status of apple canker disease in North Western Himalayan region of India

During the course of survey, it was revealed that canker disease was prevalent in all the areas surveyed in all three states of North Western Himalayan region of India. Highest disease incidence was found in apple orchards of Jammu and Kashmir with percent disease incidence of 32 percent followed by Himachal Pradesh and Uttarakhand with percent disease incidence of 23 percent and 19 percent, respectively. In J&K highest disease incidence was found in Shopian (31%) and minimum in Ganderbal 19.43 percent. In Uttarakhand the incidence was found highest in Mukteshwar Region, however in Himachal Pradesh highest incidence of disease was found in Lahul Spiti and Kinnaur area. The symptoms were observed in all the three locations were as small sunken, reddish brown spots with clearly defined elliptical shape on the outside of tree trunks and limbs. These regions displayed a sequence of concentric or alternating rings before turning smoky and completely encircling the affected trunks and limbs.

Morpho-cultural and molecular characterization

The pathogen was isolated and purified via

hyphal tip culture and total 50 isolates (35 from J&K, 10 from HP and 5 from UK) were maintained and studied further. The cultural characteristics of isolates collected from different regions of various States (J&K, HP and UK) showed that most of the culture colonies were white and some were creamy white. After 15 days of incubation, the reverse colony color changed from creamish white to dark gray in color. The margins of the colony vary from round to wavy. The mycelium of all isolates was septate, smooth, thick-walled and hyaline. After 25–30 days, all of the isolates generated pycnidia, which were partially embedded in the culture medium. The conidiophores were absent and conidiogenous cells were hyaline, smooth, cylindrical, somewhat swollen at the base, producing a single apical conidium. The conidia were aseptate to single celled measuring 20.0–28.0 x 9.0–14.5 μm , initially hyaline but later on becomes brown in color. On the basis of cultural and morphological characteristics most of the isolates were found to belong to probable genus *Diplodia* from all the three apple growing regions of North Western Himalayan region of India. However the identification was not confirmed via morpho-cultural characteristics. Molecular identification using multi genes was done to confirm the genus and species of the pathogens isolated from cankerous samples from three states using primers of ITS gene. Out of fifty isolates three species causing apple canker were found abundant namely *Diplodia bulgarica* (97–100% sequence similarity), *Botryosphaeria dothidea* (94–98 % similarity) and *Diplodia seriata* (97 % sequence similarity). In J&K most prominent species was *Diplodia bulgarica*, while as in Himachal Pradesh *Botryosphaeria dothidea* was found most abundant and in Uttarakhand *Diplodia seriata* was predominant.

MEETINGS AND EVENTS



Institute is continuously organizing various meetings and events for benefit of stakeholders. During 2022, institute organized majority of meetings and events on physical mode. Institute has organized number of programmes and participated in the programmes organized by other agencies as resource persons. The events and meetings organized by ICAR- CITH, Srinagar and its Regional Stations viz. Mukteshwar & Dirang are presented below and summarized in the Table 16.

Famers, Kisan Board Members, Development Department Officials and Scientists/Experts Interface meeting

ICAR-Central Institute of Temperate Horticulture, Srinagar and J & K Advisory Board for Development of Kisans jointly organized Famers, Kisan Board Members, Development Department Officials and Scientists/Experts Interface meeting on 18th May, 2022 at ICAR-CITH, Srinagar. During the meeting vision and progress of ICAR-CITH, Srinagar and future plans for collaborative work with development departments and SKUAST-K, Srinagar were presented and discussed. Additional Chief Secretary, Agriculture Production Department (APD), Atal Dulloo was the Chief Guest who during his address reaffirmed the government's commitment with a single focus objective to increase farmers' income manifold through better technological interventions in farming and urged the participating farmers, scientists and officers of agriculture and allied sectors, in particular to horticulture, to work beyond production and productivity to focus mainly on value addition, branding, marketing, packaging etc in collaboration for increasing the farmers income. Vice Chancellor Sher-e-Kashmir University of Agriculture Sciences & Technology of Kashmir

(SKUAST-Kashmir), Prof (Dr) Nazir Ahmad Ganai, while addressing the interaction meet said there is enormous support system from the government in Agriculture and allied sectors especially for Horticulture sector due to which production has increased manifold. He also spoke about the rejuvenating orchards and in the research field to increase production with high density plantations. New Vision document of University was discussed with special emphasis for doubling farmers' income through collaborative work with ICAR, Development departments and SKUAST-K, Srinagar. Director ICAR-CITH, Dr Om Chand Sharma talked about the role of the institute for carrying out basic, strategic and applied research on major temperate horticultural crops. He added that the Institute is involved in generation of basic information identification and development of high yielding varieties and hybrids, efficient cropping systems and appropriate production and protection technologies, post-harvest management, production of quality seeds and planting material, demonstration and transfer of technologies. Director Horticulture Kashmir, Shri Ghulam Rasool Mir and Secretary J&K Advisory Board for Development of Kisans, Abdul Hamid Wani complemented ICAR-CITH for the programme and hoped that such programmes would help farmers to connect with scientists for the use of latest technologies in farming. During the programme, several progressive farmers put forth various issues, problems and queries, to which the speakers assured resolution of their issues. Director Horticulture Panning & Marketing, Director Agriculture Kashmir, Director Agriculture Jammu, Managing Director Agro Industries Development Corporation Ltd., Managing Director Jammu and Kashmir Horticultural Produce Marketing and Processing Corporation (JKHPMC) Limited, Director Sheep

Husbandry Kashmir, Director Animal Husbandry & Fisheries, Director Floriculture Kashmir, Director Sericulture, Heads of the Departments of APD and other concerned were also present during the programme. More than 300 officers, kisan board members and farmers participated in the programme.



Glimpses of Famers, Kisan Board Members, Development Department Officials and Scientists/Experts Interface meeting

ICAR-CITH and SKUAST-Kashmir & SKUAST- Jammu Entered Into MOU For Mutual Cooperation

ICAR-Central Institute of Temperate Horticulture and SKUAST-Kashmir entered into a MoU for mutual cooperation between the two leading institutes of the region. The Memorandum of understanding was signed by Prof. Nazir Ahmad Ganai, Vice Chancellor, SKUAST-Kashmir and Dr. O.C.Sharma, Director ICAR-CITH on 18th April, 2022. All the Directors, Deans and representatives from ICAR- CITH were present during the MOU signing ceremony. Prof. Nazir Ahmad Ganai, Hon'ble Vice-Chancellor SKUAST-Kashmir and Dr Om Chand Sharma, Director, ICAR-CITH, Srinagar highlighted the importance of an alliance between the two Institutions to serve the farming community. They said that signing of such MoUs will ensure quality education and research that can make a difference to the society. Both Institutions will work in areas like submission of collaborative research

projects, exchange of expertise, holding of joint conferences, workshops, publications, faculty and curriculum development. Similarly, ICAR-Central Institute of Temperate Horticulture and SKUAST-Jammu entered into a MoU for mutual cooperation between the two organizations. Memorandum of Understanding was signed by O C Sharma, Director (Act) and Prof J P Sharma, Vice Chancellor SKUAST-J for research and other areas of mutual interest.



Signing of MOU between ICAR-CITH Srinagar & SKUAST-K, Srinagar

International workshop on DUS testing of apple and pear

ICAR-Central Institute of Temperate Horticulture, Srinagar and PPV&FRA, New Delhi jointly organized two days International workshop on “DUS testing of apple and pear” from 7th to 8th September 2022 at ICAR-Central Institute of Temperate Horticulture, Srinagar (Hybrid Mode) under Indo-German Cooperation on Seed Sector Development. During the event speeches on DUS testing of apple and pear in India were made by Dr. K. V. Prabhu, Chairperson, PPV&FRA, Dr.T.K.Nagarathna, Former Registrar, PPVFRA, Dr Ravi Prakash, Ex-Registrar, PPV&FRA and Dr Javid Iqbal Mir, PI, DUS Centre on temperate fruits & nuts project and from Germany detailed presentation was made by Dr. Erik Schulte, Head of regional DUS testing Station with Focus on Fruits



Glimpses of International workshop on DUS testing of apple and pear in Wurzen, Germany. During the deliberations thorough discussions resolved many issues related to DUS testing of apple and pear under Indian conditions. Fine tuning of On-site DUS testing was planned after relevant and desired feedback

obtained from German scientists. Workshop was attended by scientists from ICAR-CITH, Srinagar, ICAR-NBPGR, Srinagar, SKUAST-K, Srinagar, PPV&FRA, New Delhi, Dr YSPUH&F, Solan, ICAR-CITH (RS), Mukteshwar etc. Field visit was also organized to provide on spot training on DUS testing to the participants. Farmers were made aware about protection of their varieties through PPV&FRA and the benefits of protection thereof. Dr Om Chand Sharma, Director, ICAR-CITH, Srinagar shared the achievements made by the Institute and specified the areas of collaboration with Germany for further cooperation.

Apple Day/show cum workshop

ICAR-CITH, RS Mukteshwar organized Apple Day/show cum workshop on Harvest maturity standards of apple cultivars for quality yield in collaboration with Department of Horticulture, Vikas Bhawan, Bhimtal, Nainital on 26th August, 2022 at Mukteshwar. A large number of farmers and line department personnel participated in the programme. An exhibition of different apple varieties was also displayed during the occasion.



Table 16. List of various events organized during the year 2022

S. No	Event	Date	Organizers/ Coordinators
1	Famers, Kisan Board Members, Development Department Officials and Scientists/Experts Interface meeting	18 th May, 2022	All Staff
2	International workshop on DUS testing of Apple	7 th & 8 th Sep, 2022	Ji Mir & O C Sharma
3	18 th IRC Meeting	6 th to 7 th June, 2022	Md Abas Shah
4	18 th RAC Meeting	28 th Dec, 2022	J I Mir

S. No	Event	Date	Organizers/ Coordinators
5	3 rd Bimonthly Structured Meeting of DDM's of NABARD (Srinagar Cell)	17 th October, 2022	J I Mir, W H Raja, S U Nabi, Geetika Malik, Md Abas & O C Sharma
6	International Women Day	8 th March 2022	Dr Geetika Malik, Sh Vishal Dinkar & Mrs Mubeena
7	Antiterrorism Day	21 st May, 2022	Sh Puneet Kumar, J I Mir & O C Sharma
8	International Yoga Day	21 st June, 2022	Sh Puneet Kumar & Vishal Dinkar (Srinagar); Arun Kishore (R S Mukteshwar), Khushi Ram (R S Dirang) & Manoj Kumar (KVK Baramulla)
9	Hindi Diwas & Hindi Week	14 th to 21 st September, 2022	Geetika Malik & Puneet Kumar (Srinagar) and Arun Kishore (Mukteshwar)
10	Rastriya Ekta Diwas	31 st October, 2022	Dr Geetika Malik & O C Sharma
11	Vigilance Week	31 st October to 6 th November 2022	Dr Geetika Malik O C Sharma & Puneet Kumar (Srinagar) and Arun Kishore (Mukteshwar)
12	Inaugural function of PM Kisan Sammelan	17 th Oct,2022	Md Abas, Sh Eshan & Smt Mubeena
13	Gandhi Jayanti & Special campaign 2.0	2 nd October & 2 nd October to 31 st October, 2022	Puneet Kumar, Vishal Dinkar, O C Sharma & Showkat Ahmad Mir (Srinagar) & Arun Kishore (Mukteshwar)
14	Constitution day	26 th Nov, 2022	O C Sharma, Eshan Ahad & Diwan Chandra (Srinagar) & Arun Kishore (Mukteshwar)
15	Har Ghar Tiranga Campaign	13 th to 15 th August, 2022	O C Sharma, J I Mir (Srinagar), Arun Kishore (Mukteshwar), Manoj Kumar (KVK Baramulla) & Kuishi Ram (Dirang)
16	World Soil day	5 th December, 2022	Sudhakara N R
17	Kisan Samman Diwas	23 rd December, 2022	S U Nabi, W H Raja & Puneet Kumar (Srinagar); Arun Kishore (R S Mukteshwar); Vishal Mhetre (R S Dirang)
18	Swachhata Pakhwara	16 th Dec to 31 st December, 2022	Sh Puneet Kumar & O C Sharma
19	Apple Day/show cum workshop	26 th August, 2022	Arun Kishore
20	Interaction meeting with NABARD officers of Uttarakahnd	19 th September, 2022	Arun Kishore

18th Institute Research Council Meeting

The 18th Institute Research Council Meeting was held from 6th to 7th June, 2022 under the chairmanship of Dr O C Sharma, Director, ICAR-CITH, and Srinagar. All the scientists of ICAR-CITH, Srinagar, Regional stations and KVK attended the meeting in physical and virtual mode. 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 details. The presentation on Research Projects from Regional Station, Mukteshwar and KVK Baramulla was discussed on virtual mode. The Chairman gave critical inputs on experimentation for obtaining realistic and reproducible results.



Discussion and presentation during 18th IRC meeting

18th Research Advisory Committee Meeting

The 18th RAC meeting of ICAR-CITH, Srinagar was held on 28th December, 2022 in hybrid mode under the Chairmanship of Dr. T A More, Former -Vice Chancellor, MPKV, Rahuri. The RAC members who attended the meeting were Dr. R K Avasthe, Dr. A T Sadashiva, Dr. R K Pal, Dr. V K Baranwal, Dr. V B Patel, Sh. Abdul Jabbar Parrey, Dr. O. C. Sharma and Dr J I Mir. Besides, the Scientists of ICAR- CITH, Srinagar; Dr Geetika Malik, Dr. W H Raja, Dr. Mohd Abas Shah, Dr. Sajad Un Nabi, Sh Punnet

Kumar, Sh Vishal Dinkar & Dr Sudhakara N R, Dr. Manoj Kumar (P C & Head, KVK Baramulla) and Dr. Arun Kishore (I/C RS Mukteshwar) also attended the meeting. The meeting started with welcome address by Dr. O. C. Sharma, Director ICAR-CITH, Srinagar which was followed by presentation of Action Taken report of 17th RAC. The research achievements made during last year were presented by Dr J I Mir (Member Secretary). After the presentations there was a detailed discussion on various research aspects and chairman & committee members appreciated the work done by the Institute. The various committee members gave important inputs and suggestions for ongoing research projects and future line of work. After detailed discussion various recommendations were made for future line of action for further submission to council.



Glimpses and discussion during RAC meeting

3rd Bimonthly Structured Meeting of DDM's of NABARD (Srinagar Cell) held at ICAR-CITH, Srinagar

The 3rd Bimonthly Structured Meeting of DDM's of NABARD (Srinagar Cell) was held at ICAR-CITH, Srinagar on 17th October, 2022. The CGMNABARD was the chiefguest on the occasion and 20 officers from J&K and Ladakh participated in the programme. During the programme, Dr O C Sharma (Director) highlighted various technologies which can be helpful for the farmers

for boosting their production and income and can be funded by the bank. During the programme various scientist from ICAR-CITH, Srinagar gave detailed presentations on various technologies. The CGM lastly made a meeting with the staff and thanks ICAR-CITH, Srinagar for organizing the programme at the Institute. A field visit was also organized for the bank staff.



3rd Bimonthly Structured Meeting of DDM's of NABARD

Kisan Bhagidari, Prathmikta Hamari campaign

ICAR-Central Institute of Temperate Horticulture, Srinagar organized the 'Kisan Bhagidari, Prathmikta Hamari' campaign on 28th April, 2022 at ICAR-CITH, Srinagar. The campaign was organized under 'Azadi Ka Amrit Mahotsav' in which 85 farmers from Jammu and Kashmir and development department officials from Jammu and Kashmir & Himachal Pradesh participated. One lecture on "Use of Pheromone Technology for Insect Management – An Important Component of Natural Farming" by Dr Barkat Hussain, Associate Professor, Entomology, SKUAST-K, Srinagar was organized. Programme was focused on "Crop Diversification" and "Natural Farming". Similar programme was

also organized at ICAR-CITH-RS, Mukteshwar in which 49 farmers and other stakeholders participated.



Glimpses of programme on Kisan Bhagidari, Prathmikta Hamari campaign

Innugural of PM Kisan Samman Sammellan

ICAR-CITH Srinagar organized the Innugural of PM Kisan Samman Sammellan on 17th October,



Innugural of PM Kisan Samman Sammellan

2022. In this programme all staff of ICAR-CITH and farmers participated and listen the views of various dignitaries and address by Hon'ble Prime Minister of India.

Anti terrorism Day

ICAR-CITH, Srinagar observed Antiterrorism Day on 21st May, 2022 in which all staff members participated. The objective behind observance of this day is to wean away the youth from terrorism and the cult of violence by highlighting the suffering of common people and showing as to how it is prejudicial to the national interest. During the programme various participants along with Director shared their views and pledge was taken by all the staff to fight against terrorism.

International Women's Day

International Women's Day was celebrated 8th March 2022 in which 40 women participated. During the programme the role of women in various fields were highlighted by various speakers like Dr. O. C. Sharma, Director, Dr. J. I. Mir, Senior Scientist, Dr. Geetika Malik, Scientist,



International Women Day at ICAR-CITH, Srinagar

Sh.Vishal Dinkar, Smt. Mubeena, Dr. Danish Bashir, Dr. Salwee Yasmeen, Dr. Saima Farooq (YP-II) & Smt. Iqra Qurashi. In the programme, training programme for women of adjoining areas related to vegetable kitchen garden, field visit of participants & distribution of vegetable seed was done.

International Yoga Day

ICAR-Central Institute of Temperate Horticulture celebrated 8th International Yoga Day on 21st June, 2022 at ICAR-CITH, Srinagar, Regional Station Mukteshwar (Uttarakhand), Dirang (Arunachal Pradesh) and KVK Baramulla. The theme of the day was *Yoga For Humanity*. All the permanent as well as contractual staff at all places took part in the programme and showed extra zeal and enthusiasm while performing and participating this great event. In the programme organized at ICAR-CITH main campus, Dr O C Sharma, Director highlighted the importance and need of yoga invigorating overall mental and physical status of a person and Sh Puneet Kumar (scientist) gave remarks on the celebration of the day including its history and role of different *Asanas* followed by demonstration of various yoga practices by Sh Vishal Dinkar and all staff performed various *asanas*. All scientific, administrative, technical and supporting staff of ICAR-CITH, Srinagar and scientific staff of ICAR-NBPGR-RS, Srinagar participated in the programme. Dr Arun Kishore gave the importance of Yoga Day at Regional station, Mukeshwar followed by demonstration of yoga practices and its practice by the staff. Yoga Day was also celebrated at ICAR-CITH RS Dirang (Arunachal Pradesh) in which Mr K R Vasisth and Young Professional performed various yoga practices at the station. At KVK Baramulla two programmes were organized at KVK campus (for men farmers) as well as in Kunzer village (for women farmers) in which many farmers participated and Dr. Manoj Kumar told the importance of Yoga in human life followed by demonstration of various *asana*. Farmers also performed various yoga practices during the programmes.

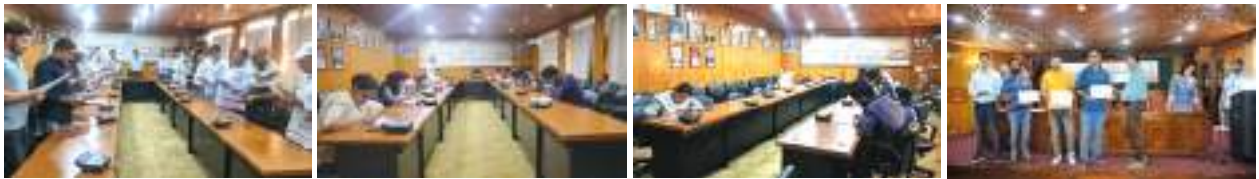


8th International Yoga day Celebration at ICAR-CITH, Srinagar,

Hindi Diwas and Hindi Week-2022

The *Hindi Diwas* and *Hindi Saptah-2022* were observed from 14th to 21st September, 2022 at ICAR-CITH, Srinagar. On 14th September, 2022, *Hindi Diwas* was celebrated and official language pledge was taken by the staff. The importance of language was discussed in detail by Director who stressed for improving work in Hindi. From 15th to 21st September various programs and competitions were conducted such as extempore competition, poetry, *dohe* & *shayari* competition, essay writing

and importance of vigilance week by Vigilance Officer on 31st October, 2022 followed Director's address to adopt various practices for achieving transparency, accountability and corruption free governance. A Pledge ceremony was held in which all staff members took pledge. All the staff of the institute took part in observance of vigilance awareness week with enthusiasm and zeal. At inaugural function, the participants shared their views on vigilance awareness and how we, as common man, can contribute to making India



Glimpses of various programmes during Hindi week at ICAR-CITH, Srinagar

competition, translation competition, poster presentation and *Antakshri*. The permanent staff, contractual lab and field worker and other research staff actively participated in different programmes. The valedictory function and distribution of monetary award & certificate to the winners of various competitions of the Hindi week-2022 was held on 21st September, 2022. Hindi Week was also celebrated at ICAR-CITH, R S Mukteshwar and permanent and contractual staff participated in different programmes.

Vigilance Awareness Week

ICAR-Central Institute of Temperate Horticulture, Srinagar observed Vigilance Awareness Week from 31st October to 6th November, 2022. The theme of the Vigilance Week was Corruption-free India for Developed Nation ("भ्रष्टाचार मुक्त भारत – विकसित भारत"). The programme was started with welcome address



Inaugural of Vigilance Awareness Week-2022 at ICAR-CITH, Srinagar

a corruption free nation. Some information on functions and powers of CVC was also sought by the participants, which was answered on the spot by the Director and Vigilance Officer. A debate on 'Can common man contribute to eradication of corruption' was also held on 2nd November, 2022. A lecture on CVC Act, 2003 was delivered by the Finance and Accounts Officer of the institute for the benefit of participants on 4th November, 2022 in a one day workshop. The closing ceremony ended with valedictory address by the Director on 7th November, 2022. The vigilance awareness week was also celebrated at ICAR-RS Mukteshwar.

National Unity Day/ Rashtriya Ekta Diwas

The National Unity Day/ Rashtriya Ekta Diwas was celebrated at ICAR-CITH, Srinagar on 31st October, 2022 and all staff of ICAR-CITH attended the programme. During the programme Dr O C Sharma highlighted the commitment of the Sardar Vallabhbhai Patel towards work and about his life. He 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 Vallabhbhai Patel and importance of unity day. Pledge was also taken by the staff for their dedication to preserve the unity, integrity and security of Nation. He also told that 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 Balhbhai Patel will always be remembered. The major reforms made in his life were also discussed. Lastly, Director urged the staff



Integrity Pledge Ceremony during National Unity Day

to work for integration and development of the Nation.

World Soil Day

ICAR-CITH, Srinagar celebrated World Soil Day on 5th December, 2022 with theme as "Soils where food begins". Participants from different categories viz. Scientists, staff, research scholars and farmers participated in the program. The program started with the importance of the soil for future by address by Director, ICAR-CITH, Srinagar followed by video film. Further, Dr. Sudhakara N. R., Scientist (Soil Sciences),



Glimpses of World Soil Day organized at ICAR-CITH, Srinagar

ICAR-CITH, Srinagar, gave a lecture on “Importance of soil in Agriculture and Human Life” during which he emphasized the significance of soil for ecosystem services, nutrients and their impact on plant and human health as well as the most pressing global issues relating to food security and sustainability everywhere in the world. Following the presentation, a field trip was organized to demonstrate the process and procedure of collecting soil samples. By addressing the growing issues with soil management, raising soil awareness, and enticing societies to improve soil health, this field trip helped to raise awareness of the value of soil in preserving healthy ecosystems and promoting human well-being. A total of 67 participants participated in this programme.

Constitution Day

ICAR-Central Institute of Temperate Horticulture, Srinagar along with Regional Station Mukteshwar & Dirang celebrated Constitution Day on 26th November, 2022. At 11 am, physical & online programme was organized in which all staff from main and Regional Stations participated. Director, ICAR-CITH, Srinagar highlighted the history of the Day and discussed importance of Constitution and contribution of Dr Bhimrao Ambedkar for equality. After that Preamble was read in Hindi and all staff took the



Preamble/ pledge ceremony for permanent staff



Preamble/ pledge ceremony for contractual staff

pledge in Hindi. After that programme was also organized physically to the contractual staff and they were made aware of Constitution Day and importance of Constitution to the people of India. The Pledge was also taken by 45 contractual staff. All the permanent also read the preamble online on Govt of India, parliamentary Affairs Site and certificates were taken.

Har Ghar Tiranga Campaign

On the occasion of celebration of 75 year of Independence, ICAR-CITH, Srinagar, ICAR-CITH, RS Mukteshwar, ICAR-CITH, RS Dirang and KVK Baramulla celebrated the week from 13th to 15th August, 2022. For celebration of week, meeting was organized on 2nd August, 2022 in which staff of ICAR-CITH Srinagar and representatives from two regional stations and KVK Baramulla participated on physical/ virtual mode. Detailed discussions were held regarding importance of week and procurement of National Flags should be done immediately so that they can be provided to staff well in time. Discussions were also held regarding creating awareness among public by organization of various programmes. The National Flags were provided to all staff of



Glimpses of Har Ghar Tiranga Campaign

ICAR- CITH, main campus, Regional Stations and KVK Baramulla which were hoisted by the staff at their homes from 13th to 15th August. Besides this National flags were also provided to NBPGR RS Srinagar, IGFRS Srinagar and DARS SKUST K, KD Farm Rangreth. Pinning of flag with /without selfie were also done by majority of staff. During the week all staff displayed National Flag as DP in different personnel as well as official social media accounts. The flag Hoisting was done in all the units on 15th August in which staff participated and some programmes like Tiranga Rally and competitions were organized by KVK Baramulla in which villagers and students participated in a great zeal.

Kisan Samman Diwas

The Kisan Samman Diwas was observed on 23rd December, 2022 at ICAR-CITH, Srinagar and its Regional Stations (Mukteshwar, Uttarakhand and Dirang, Arunchal Pradesh). During this, the farmers were invited to visit institute or else farm visit was organized. At main station, twenty farmers were invited from Pulwama and Kulgam district of Jammu & Kashmir. The Director

ICAR-CITH, Srinagar inaugurated the program with formal welcome address of farmers. During this program the farmers expressed their view on current scenario of horticulture in Kashmir and also shared their problem, and our experts (scientists) gave their valuable suggestion to resolve the farmers problems. The plantation drive for farmers was also organized followed by the planting material distribution. In Regional Station Mukteshwar (Uttarakhand), Dr. Arun Kishore (Scientist) along with team visited the farmers field in Nainital to observe Kisan Samman Diwas. They organised scientist-farmers interaction in which total fifteen farmers participated. They also organised Farmer awareness program (FAP) on management and maintenance of high-density apple orchards. At Regional Station Dirang (Arunchal Pradesh), Dr. Vishal Mhetre (STO) and his team organised program for farmers. Total twenty-two farmers were invited and input material such as water pipe, secateurs, spades and pruning saws were distributed to honour and appreciate their contribution to nation building.



Scientist-Farmer Interaction at IACR-CITH, Srinagar



Plantation drive by farmers in orchard at ICAR-CITH, Srinagar



Briefing about rootstock plantation



Plantation drive by farmers in orchard at ICAR-CITH, Srinagar



Farmer awareness program at RS-Mukteshwar (Uttarakhand)



Farmers facilitation at RS-Dirang (A.P.)

Gandhi Jayanti & Special Campaign 2.0

Under the Special Campaign 2.0, from 2nd October to 31st October, 2022 various activities were conducted in the institute to make the institute cleaner and greener. The campaign started with celebration of “Gandhi Jayanti” to commemorate the birth anniversary of respected Mahatma Gandhi ji. The Director ICAR-CITH, Srinagar offered flower garland to the portrait of Gandhi ji and briefed about the messages taught by him about moral and values to incorporate in our life. On this occasion, a program regarding



Paying homage to Mahatma Gandhi Ji



Cleaning and arrangement of stationary



Program organized for AFWWA, Srinagar



Dusting of lab wares and equipment

importance of cleanliness was organized for Air Force Family Welfare Association (AFWWA), Srinagar in which 78 participants participated. During Special campaign 2.0, cleaning and sweeping drives were organized in various locations of institute such as main building, biotechnology building, residential area, guest house, central library, vehicle garage etc. The proper waste management methods were discussed with the lab workers to enhance the safety and workability insides the labs. Also, cleaning drive and efficient space utilization activities were performed in central store facility. The programme was also organized at Regional station Mukteshwar.

Swachhta Pakhwada

ICAR-CITH Srinagar along with its Regional Station Mukteshwar observed Swachhta Pakhwada to strengthen cleaning drive operations, with a particular focus on issues and practices associated with swachhta abhiyan, by participation of all institute employees. Swachhta pakhwada events included a Swachhta pledge ceremony, cleaning of various locations such as the main building, biotechnology building, campus roadways, inside laboratories, guest house, orchards and so on. All of the employees eagerly participated and dedicated themselves to swachhta drives. “Kisan Samman Diwas” was also observed at the institute during pakhwada. Farmers were invited to various locations and were facilitated at the institute, including a plantation drive by farmers and the provision of planting material to them.



Swachhta Pledge taking ceremony



Cleaning drive inside labs



Roadside sweeping and cleaning drive



Cleaning drive inside labs

EXTENSION AND OTHER PROGRAMS



Extension Activities

The main aim of any research programme in agricultural sciences is to improve the production of quality produce with minimum/judicious use of farm inputs, thus reducing the cost of cultivation and improving the net returns. This is possible only by generating farm friendly technologies by research organizations and their dissemination/ popularization among farmers/ stakeholders. ICAR-CITH has emerged as a hub for generating farmer-friendly technologies which in turn are boosting the productivity of quality produce and benefits the farmers with higher returns. These technologies were generated after need based quality research on different aspects in different horticultural crop. There is a lot of scope for the increasing productivity of quality produce of temperate horticultural crops in different regions of the country having temperate climatic conditions. 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 through various extension means. Institute and its Regional stations are actively organizing various training programmes, demonstrations, participating in kisan melas/ goshies, TV & radio programmes, print media, advisories through various social media etc for the benefit of farmers. Several programmes were organized during the year for officers, farmers & students and details of various

programmes organized by ICAR-CITH during 2022 are presented under various heads.

ICAR-CITH, Srinagar

Training programmes for officers

Five days programme organized for Horticulture Officer

A five days training programme was organized on Modern interventions for enhancing productivity and quality of temperate fruit crops under high density plantation for officers from Deptt of Horticulture, Govt of Himachal Pradesh from 18th to 22th April, 2022 at ICAR-CITH, Srinagar. Total 19 Subject Matter Specialist (SMS), Horticulture Development Officers (HDO), Horticulture Extension Officers (HEO) etc participated in the programme. During the programme, various lectures were delivered on various technologies for enhancing productivity followed by practical demonstrations in temperate fruits. All aspects like research and development needs in temperate fruits, planting material production, high and medium density plantation in different temperate fruits, pollination management, training & pruning, orchard floor management practices, diseases & pest management, soil & water management, postharvest management etc were covered. Some visits to different organizations/ orchards were also organized during the trainings. The participants were highly satisfied with the training and assured to implement in their state to boost the productivity of temperate fruits in future. The course Director for the programme was Dr O C Sharma and co coordinators were W H Raja, S U Nabi & Puneet Kumar.



Glimpses of five days training held at ICAR-CITH, Srinagar from 18th to 22nd April, 2022 for Horticulture officers

Table 17: List of training programmes organized for officers/ staff of line department by ICAR-CITH, Srinagar

S. N.	Name of Programme	Venue	Duration (Days)	Date	No. of Participants	Organizers/ coordinators
1.	Modern interventions for enhancing productivity and quality of temperate fruit crops under high density plantation	ICAR-CITH, Srinagar	5	18 th to 22 th April, 2022	19	W H Raja, S U Nabi, and Puneet Kumar
2.	Technological advances in temperate fruit production for enhancing productivity of quality produce	ICAR-CITH, Srinagar	5	25 th to 29 th April, 2022	20	Md Abas Shah, Vihal Dinkar and Sudhakara N R
3	Hydroponics in temperate horticultural crops	ICAR-CITH, Srinagar	1	23th March 2022	13	O C Sharma

Five days programme for Horticulture Officer

ICAR-CITH, Srinagar organized a five days training programme on Technological advances in temperate fruit production for enhancing productivity of quality produce for Officers from Deptt of Horticulture, Govt of Himachal Pradesh from 25th to 29th April, 2022. Total 20 Subject Matter Specialist (SMS), Horticulture Development Officers (HDO), AHDO & Horticulture Extension Officers(HEO) etc participated in the programme. The programme was a good blend of lectures and practical demonstrations. During the programme, various lectures delivered on various technologies for enhancing productivity in temperate fruits

followed by practical demonstrations. Different aspects of temperate like temperate fruit scenario in India, quality planting material production, high and medium density plantation, polinizer & pollinator management, canopy architectural engineering, importance of knowledge of bearing habit in pruning, orchard management practices, diseases and pest management, soil & water management, postharvest management etc were covered. Some visits to different organizations/ orchards were also organized during the trainings. The participants were highly satisfied with the training and assured to implement in their state to boost the productivity of temperate fruits in



Glimpses of five days training from held at ICAR-CITH, Srinagar from 25th to 29th April.,2022 for Horticulture officers from Himachal Pradesh

future. Dr Md Abas Sha, Dr Vishal Dinkar & Dr Sudhakar Nr coordinated the programme and Dr O C Sharma was course director for the programme. The researchable issues of farmers as well as the problems faced by the officers in the field were also discussed in detail, so that institute can plan future research work accordingly.

One Day training cum visit organized for scientists

One day training cum exposure visit was organized to the participants of Short Course on Hydroponics : The future of food without soil, organized by Division of Basic Sciences & Humanities, Faculty of Horticulture, SKUAST K on 23th March 2022. Total 13 participants were present and exposed to various research activities going on at the Institute followed by farm visit and exposure to various experimental fields

Five training programmes of one day duration organized for staff of UFRMP & Department of Forest, Uttarakhand

During 2022, five training programmes of one day duration were organized in different nurseries of Deptt of Forest, Uttarakhand. Total 130 participants from Deptt of Forest, Staff of UFRMP, Self help group & some farmers participated in the programmes. These programmes were organized on mother orchard management and walnut propagation techniques. The location of the programmes was at Maldevta, Magra, Sony, Ladiyakata, and Silalekh in Uttrakhand. In these training programmes demonstrations were provided on various aspects for promotion of walnut in Uttarakhand. The brief of these programmes is presented in Table 18.



Farm Visit of participants (scientist) of short course on Hydroponics at ICAR-CITH Srinagar

Table 18: One Day training programmes organized for Staff of UFRMP & Department of Forest, Uttarakhand

Date	Topic	Venue	No. of Participants	Type of participants	Coordinators
17 th Feb, 2022	Walnut propagation	Maldevta-Dehradun	23	Forest staff and Self Help group	O C Sharma & B A Ganai
18 th February, 2022	Walnut propagation & mother orchard management	Magra	20	Forest staff	O C Sharma & B A Ganai
20 th February, 2022	Walnut propagation & mother orchard management	Sony	28	Forest staff & Farmers	O C Sharma & B A Ganai
21 st February, 2022	Walnut propagation	Ladiyakata	24	Forest staff	O C Sharma, Arun Kishore & B A Ganai
22 nd February, 2022	Walnut propagation & mother orchard management	Silalekh	35	Forest staff & Farmers	Arun Kishore & B A Ganai
Total	5		130		



Maldevta, Magra & Sony



Silalekh

Ladiyakata

Training programme on walnut propagation in different nurseries in Uttarakhand

Training programmes/ visits for students

ICAR- CTH, Srinagar is well equipped with labs as well as experimental orchards/ ermplasm blocks of many temperate horticultural crops. These facilities makes it as centre of attraction for the students and researchers. During the year, 7 visits/ training were organized for students. The details of students visit/ training from different organizations are presented in Table 19.

Two Days training programme on Use of molecular biology techniques in Horticulture under DST- SERB, Scientific Social Responsibility (SSR) initiative

Two Days training programme on “Use of molecular biology techniques in Horticulture “under DST- SERB, Scientific Social Responsibility (SSR) initiative was organized at ICAR-CITH Srinagar from 10th to 11th May, 2023.

During this training programme the trainees were acquainted with different techniques like PCR, RT-PCR, Gel electrophoresis, UV Transilluminator, bioinformatics tools etc. Total 20 student trainees participated from various disciplines like Fruit Science, Biotechnology, Entomology, Plant Pathology, Genetics and Plant Breeding, Floriculture and Microbiology. Five lectures were also delivered on recent advances in molecular biology techniques, Recent advances in pathogen detection, CRISPR-CAS a genome

editing technique, importance of Real time PCR, applications of proteomics, and recent advances in Molecular markers and bioinformatics tools. Also hands on training were given PCR and qRT-PCR. The training programme was coordinated by Dr Sajad Un Nabi, PI, CRG/2021/003401 project funded by DST-SERB. At last Director ICAR-CITH, Dr O.C.Sharma distributed the certificates among the participants in valedictory function on 11th May 2022.



Glimpses of Two Days training programme on “Use of molecular biology techniques in Horticulture

Table 19: List of schools/colleges/ institutes who visited the ICAR-CITH during the year 2022

Date	Name of School/ University/ Training	No. of Students/ participants	Organized By
10 th to 11 th May, 2022	Use of molecular biology techniques in Horticulture “under DST- SERB, Scientific Social Responsibility (SSR) initiative	20 (Students /scholars/ SRF/RA’s)	S U Nabi
26 th March, 2022	Students of BSc (2 nd & 3 rd year) from Govt Degree Pampore	39 (36 students +3 Teachers)	Md Abas Shah, J I Mir & O C Sharma
17 th May, 2022	Students of B Sc 3 rd Year from Wayanad Campus, Kerala Agriculture University	64 (60 students + 4 teachers	O C Sharma, W H Raja & J I Mir
23 rd July, 2022	Trainees of DST sponsored training programme (students from SKUAST K)	22	Geetika Malik, S U Nabi & Dr W H Raja

Date	Name of School/ University/ Training	No. of Students/ participants	Organized By
19 th October, 2022	Students of Biotechnology & Biochemistry (BSc. VI Semester) from Govt College Shopian	30	Md Abas, Geetika Malik, O C Sharma & M A Sheikh
10 th October, 22	Students of BSc Horticulture, SKUAST K (RAWE)	11	M A Sheikh
26 th September 2022	Aspire Heritage School Kursoo Mehjoor Nagar, Srinagar	60	Vishal Dinkar, Sudhakara N & Eshan Ahad



Glimpses of various students visits

Training Programmes/ visits for Farmers

Training programme/ Farm visit organized for Farmers of Jammu and Kashmir. The farmers are the final user of any technology generated by any agricultural organization. During the year, 14 farmer groups sponsored by various agencies visited the Institute for one day training/ farm visit. The farmers were made aware of various technologies generated at ICAR-CITH in various horticultural crops. The details of various programmes are presented in Table 20.

One Day training-cum- awareness programme on “Importance of training pruning and pest disease management in apple” at Hijama Baramulla

One Day training-cum- awareness programme on “Importance of training pruning and pest disease management in apple” was organized at Hijama Baramulla on 2nd of June 2022 under Kissan Biotech Hub, Department of Biotechnology, GOI. During the training programme 41 farmers participated from various areas of district Baramulla. The farmers were acquainted with different methods of training pruning especially in medium and high density apple orchards, pollination management as well as real time pest and disease management in these orchards. The programme was conducted by Dr Wasim H Raja and Dr Sajad Un Nabi.

Table 20: List of visits/ trainings organized for farmers at ICAR-Central Institute of Temperate Horticulture during the year 2021

S. No.	Date	Training/ visit/Topic	Department/ Organization	Zone/ Area/ District	No of participants	Facilitator/ Coordinator
1	11 th January, 2022	Training and pruning in temperate fruits	KVK Baramulla	Distt Baramulla	12	W H Raja & J I Mir
2	25 th February, 2022	Nursery production in temperate fruits	KVK Baramulla	Tangmarg area of Distt Baramulla	12	O C Sharma, W H Raja, S U Nabi & MA Sheikh

S. No.	Date	Training/ visit/Topic	Department/ Organization	Zone/ Area/ District	No of participants	Facilitator/ Coordinator
3	4 th March, 2022	Fertilizers in temperate horticultural (under Training programme for fertilizer dealers)	Directorate of Extension, SKUAST -K	Kashmir Division	150	O C Sharma & GS Madhu
4	11 th March, 2022	Training cum exposure visit on Soil moisture management orientation to farmers (NAFCC 21-22)	Deptt of Agriculture, Budgam	District Budgam	208	J I Mir, O C Sharma, Sudhakar N R
5	12 th March, 2022	Training cum exposure visit on Soil moisture management orientation to farmers (NAFCC 21-22)	Deptt of Agriculture, Budgam	District Budgam	208	J I Mir, O C Sharma, Sudhakar N R
6	19 th March, 2022	Temperate fruit and vegetable production	SKUAST- K	Srinagar	18	Getika Malik, Md Abas Shah & Puneet Kumar
7	2 nd June, 2022	Training pruning and pest disease management in apple	Kissan Biotech Hub	Hijama Distt Baramulla	41	W H Raja & S U Nabi
8	29 th March, 2022	One ay training cum exposure visit on production of quality planting material of fruit crops	KVK Budgam	Distt Budgam	22	Md Abas Shah, J I Mir & O C Sharma
9	26 th April, 2022	Quality planting material production in Temperate fruit crops.	Under Campaign <i>Kisan Bhagidari Prathmika Hamari</i>	ICAR CITH, Srinagar	20	O C Sharma
10	28 th April, 2022	Diversification and Natural Farming	Under Campaign <i>Kisan Bhagidari Prathmika Hamari</i>	ICAR CITH, Srinagar	70	J I Mir & O C Sharma
11	27 th September, 2022	Training cum visit of Farmers on technologies on temperate horticultural crops	Aspirational block of Pakherpora & Susasya	ICAR CITH, Srinagar	28	S U Nabi & Md Abas Shah
12	29 th November, 2022	Training cum field visit on Technologies for boosting temperate horticulture Production	ZAZNA Farmers Producer Company Ltd	Ganderbal	19	J I Mir, O C Sharma, Geetika Malik & Muneer Ah sheikh
13	2 nd October, 2022	Home gardening of temperate horticultural crops	AFWWA, Srinagar	Old airfield, Srinagar	78	O C Sharma, Vishal Dinkar & Puneet Kumar

S. No.	Date	Training/ visit/Topic	Department/ Organization	Zone/ Area/ District	No of participants	Facilitator/ Coordinator
14	13 th December, 22	New practices and techniques for production of temperate horticultural crops	Kirmaniya Fed Fruit Producer Company Limited, Batwina-Ganderbal	Batwina-Ganderbal	28	J I Mir, Geetika Malik, Md Abas, M A Sheikh & O C Sharma



Participation as Resource person in Programmes of other organizations

Being the premier Institute in temperate horticulture, the demand for resource persons by various agencies is increasing day by day. The scientists of ICAR-CITH, Srinagar actively participates in the programmes organized by various agencies and delivers their scientific inputs on various aspects for the benefit of growers/farmers and for boosting the productivity of quality produce. During the year, Scientists participated in various programmes are presented in Table 21 and details are given below:

Table 21. Participation as resource person in different programmes

Sr No.	Date	Programme	Organized By	Resource persons
1	30 th June, 2022	Horticulture Cluster Development awareness programme	JKHPMC and NHB	W H Raja & S U Nabi
2	22 nd to 23 rd June 2022	National Apple Growers workshop	All India Kisan Sabha P Sundaraya Memorial Trust New Delhi	W H Raja & S U Nabi

Horticulture Cluster Development awareness programme

ICAR-CITH participated in, “Horticulture Cluster Development awareness programme” organised at DIET Shopian by JKHPMC and NHB on 30th June, 2022. District Development Commissioner, Shopian, Sachin Kumar Vaishya, Chief Guest on the occasion said that the programme will address all major issues related to the horticulture sector in the District including pre-production, production, post-harvest management, logistics, marketing and branding. He also said that the programme is designed to leverage geographical specialization and promote integrated and market-led development of horticulture clusters. He further said that district Shopian known as Apple Town, now has been declared as Apple Cluster under the scheme of MOA&FW emphasizing upon farmers of the district to come forward and use latest technologies and best practices to grow high yielding varieties and crops under high density



Dr S U Nabi & Dr W H Raja delivering their lectures during Cluster Development awareness programme

plantaion. He said that this would lead to better production and profits among the farmers of the district. Scientists from our institute stressed upon the production and supplying of quality planting material vis-à-vis production of quality produce of apple from such clusters should be given preference to increase the income of farmers.

National Apple Growers workshop

ICAR-CITH participated in, “National Apple Growers workshop” on 22nd to 23rd June 2022 organized by All India Kisan Sabha P Sundaraya Memorial Trust New Delhi. Our scientists participated in the programme as technical experts on various issues of apple production and protection practices. During the programme Dr Wasim H Raja spoke on various matters like apple varieties, importance of rootstocks, development of nurseries etc where as Dr Sajad Un Nabi spoke on disease of apple, their diagnostics and real



Dr W H Raja & Dr S U Nabi delivering their lectures during National Apple Growers workshop

time management. Several farmers, department officials, university officials participated in the two days programme and deliberated on various issues of apple production.

ICAR-CITH, Regional Station Mukteshwar

ICAR-CITH, Regional Station Mukteshwar is continuously working for the upliftment of hilly farmers of Uttarkhand through temperate horticultural crops. This station is disseminating the generated technologies through various means and continuously organizing various programmes for the benefits of the farmers and students. The programmes/ activities organized during 2022 for students and farmers are briefly presented in Table 22&23.

Table.22: Training / visits organized for students at ICAR-CITH, RS Mukteshwar

Date	Department/ Organization	Region	Number	Facilitator/ Coordinator
12 th April,2022	Exposure visit of M Sc students from department of Botany, Hindu College, Delhi University	Delhi	09	Dr Arun Kishor
3 rd June,2022	Exposure visit of M Sc students from department of Botany, SSV College, Hapur, UP	Hapur, UP	25	Dr Arun Kishor
19 th June, 2022	Exposure visit of B Sc students from Institute of Agricultural Sciences, BHU, Vanarasi, UP brought by ICAR-VPKAS Almora	Vanarasi, UP	30	Dr Arun Kishor
26 th June,2022	Exposure visit of B Sc students from Institute of Agricultural Sciences, BHU, Vanarasi, UP brought by ICAR-VPKAS Almora	Vanarasi, UP	30	Dr Arun Kishor
29 th June, 2022	Exposure visit of M Sc students from Acharya Narendra Dev College, Delhi University	Delhi	37	Dr Arun Kishor

Table 23: Training, demonstration & awareness programmes, lectures organized by CITH RS, Mukteshwar

Sr No	Date	Training/Demonstration/Day/activity etc.	Venue	No of participants	Scientist/Coordinator
1	19 th January,2022	Awareness on field demonstration in onion	Odlohar-Simsyari, Bageswar	54	Dr Arun Kishor
2	28 th January,2022	Awareness and field demonstration on temperate fruits	Odlohar-Simsyari, Bageshwar	51	Dr Arun Kishor
3	29 th January, 2022	Awareness and field demonstration on onion	Naveen Sunkiya	29	Dr Arun Kishor
4	15 th February, 2022	Training and pruning in kiwifruit and other temperate fruits	Karna Almora	11	Dr Arun Kishor
5	16 th March, 2022	Training on walnut propagation for production of quality planting materials	Selalekh	10	Dr Arun Kishor
6	26 th March, 2022	Awareness cum workshop on prospect and scope of growing horticultural crops in Bageshwar District and distribution of farm tools	Odlohar-Simsyari, Bageshwar	100	Dr Arun Kishor
7	29 th March,2023	Exposure visit cum awareness on management and maintenance of horticultural crops	CITH RS Mukteshwar	50	Dr Arun Kishor
8	21 st April, 2022	Field demonstration & awareness on management and maintenance of walnut plantation	Dwarhat Almora	05	Dr Arun Kishor
9	23 rd April, 2022	Campaign cum awareness on cultivation of kiwifruit and walnut under <i>Anna data devo bhava</i> and AKAM in collaboration DFMD	Sunkiya/Darima	64	Dr Arun Kishor and Dr C Jana
10	27 th April, 2022	Awareness on management and maintenance temperate horticultural crops. (<i>Kisan Bhagidari Prathimikta Hamari</i> under AKAM)	CITH RS Mukteshwar	20	Dr Arun Kishor
11	28 th April,2022	Awareness cum exposure visit (<i>Kisan Bhagidari Prathimikta Hamari</i> under AKAM)	CITH RS Mukteshwar	15	Dr Arun Kishor
12	29 th April, 2022	Campaign and workshop on advanced production techniques of horticultural crops and livestock production for higher income in collaboration IVRI Mukteshwar (<i>Kisan Bhagidari Prathimikta Hamari</i> under AKAM)	Odlohar-Simsyari, Bageshwar	100	Dr Arun Kishor and Dr Nitesh Kharayat
13	30 th April, 2022	Campaign cum distribution of saplings for demonstrations on tomato	Sunkiya	18	Dr Arun Kishor and Dr Dr C Jana

Sr No	Date	Training/Demonstration/Day/activity etc.	Venue	No of participants	Scientist/Coordinator
14	25 th May, 2022	Nutrient management in temperate fruit crops	Dutkanedhar	06	Dr Arun Kishor
15	5 th June,2022	Field day on the occasion of World Environment Day	CITH RS, Mukteshwar	10	Dr Arun Kishor
16	16 th July, 2022	Tree plantation on the occasion of ICAR foundation day	CITH RS, Mukteshwar	11	Dr Arun Kishor
17	3 rd September, 2022	Field demonstration & distribution of garlic & pea seeds	Odlohar-Simsyari, Bageshwar	100	Dr Arun Kishor
18	9 th November,2022	Orchard management practice	Dutkanedhar	10	Dr Arun Kishor
19	16 th December,2022	Swachhata campaign cum waste decomposition awareness programme	CITH RS Mukteshwar	11	Dr Arun Kishor
20	3 rd October, 2022	Awareness on Swachhta cum distribution of garlic, pea seeds for field demonstration	Sunkiya	16	Dr Arun Kishor
21	23 rd December, 2022	Awareness on management and maintenance of high density apple orchard during winter on the occasion of farmers day and <i>swachhta campaign</i>	Gajar	11	Dr Arun Kishor
22	1 st January, 2022	Delivered invited lecture in kisan gosthi on advanced production techniques of kiwifruit	Dalkanya	20	Dr Arun Kishor
23	28 th Sepember, 2022	Delivered invited lecture in Farmer fair/kisan gosthi on management and maintenance of temperate horticultural crops	VPKAS Almora	100-150	Dr Arun Kishor
24	12 th December,2022	Exposure visit cum awareness on management and maintenance of temperate horticultural crops for farmers of Lamgara block Almora	CITH RS Mukteshwar	90	Dr Arun Kishor
25	26 th August, 2022	Apple Day/show cum workshop on Harvest maturity standards of apple cultivars for quality yield in collaboration with department of Horticulture, Vikas Bhawan, Bhimtal, Nainital	CITH RS Mukteshwar	150	Dr Arun Kishor and Dr Narendra Kumar
26	26 th to 28 th April, 2022	Three days training cum workshop on advanced production techniques of horticultural crops and livestock production for higher income in collaboration IVRI Mukteshwar	CITH RS Mukteshwar	45	Dr Arun Kishor and Dr A K Mohanti

ICAR-CITH, Regional Station, Dirang

The NEH region has diverse climatic conditions suitable for growing a number of horticultural crops and offers a great scope for increase in area and production of temperate horticultural crops in some regions. Keeping in view the scope of temperate horticulture in NEH region, ICAR-CITH, Regional Station was started few year back. The Institute is working continuously working for the benefit of farmers of the NEH Region through the need based research, dissemination of technologies, human resource development and supply of quality planting material for increasing the area, production and productivity of temperate fruit crops in the region. The Institute has started doing research on various horticultural crops with respect to Germplasm collection, production of quality planting material and establishment of mother blocks of elite germplasm. The infrastructure development is going on and recently one PEQ facility for NEH region was sanctioned and work for its creation is going on. During the year 2022, Institute has organized many programmes in different areas of different states for the benefit of farmers. Total 25 programmes were organized for the benefit of farmers. The details of training programs along with the planting material/ tool kits distribution among the beneficiaries of NEH region are briefly presented in Table 24.

Training cum distribution programme under NEH scheme in North eastern Region of India

During the month of March 2022, several Training cum distribution programme were held in various states of north eastern region of India viz., Arunachal Pradesh, Meghalaya, Mizoram and Assam under NEH scheme of ICAR, Govt. of India. On 17th of March 2022, the training

programme of farmers of Dirang region was conducted in which they were acquainted with modern aspects of temperate fruit production and their cultivation practices. At the end of the programme apple, walnut and almond plants were distributed among the beneficiaries. Total 40 farmers participated in the said programme held at ICAR-CITH, RS Dirang. On 19th of March three training cum distribution programmes were conducted in Meghalaya state and aim of the programmes were to acquaint the farmers about the cultivation of vegetables through organic practices. In this connection, the first programme was conducted at ICAR-CPRI RS-Shillong in which 64 farmers participated. The seeds of hybrids of tomato and chilli were distributed along with organic manure among the farmers. Similarly two more programmes were conducted in villages Tynring and Keshpyndeng, East Khasi district of Meghalaya in which 110 and 78 farmers respectively participated. At both the places seeds of tomato and chilli along with organic manure were distributed. On 21st of March, training cum distribution programme was conducted at ICAR-Research complex NEH Umiam in which 107 farmers participated. The seeds of tomato and chilli along with organic manure were again distributed among the farmers. On 24th of March training cum distribution programme was conducted at KVK Sonitpur Assam in which 150 farmers participated and were acquainted with litchi cultivation practices. At the end of the programme litchi plants were distributed among the beneficiaries. Total six thousand Litchi plants were sent to Department of Horticulture Mizoram for distribution among the beneficiaries. During all the programmes, farmers actively participated in discussion and showed great interest in learning the basic aspects of temperate fruit production and organic farming.



Table 24. Training / farm input distribution programmes organized during 2022 in NEH region

Date	Programme	Venue	Participants	Inputs supplied	Co ordinators
Meghalaya					
19 th March, 2022	Production of horticultural crops and their management	CPRI ,RS Station Shillong (Meghalaya)	64	Vegetable Seed & Organic Fertilizers	O C Sharma, J I Mir, W H Raja & S U Nabi
19 th March, 2022	Organic production of horticultural crops and their management	Tynring, East Khasi Distt (Meghalaya)	110	Vegetable Seed & Organic Fertilizers	Madhu GS & Sudhakara N R
19 th March, 2022	Organic vegetable production	Keshpyndeng, East Khasi Distt (Meghalaya)	78	Vegetable Seed & Organic Fertilizers	Madhu GS & Sudhakara N R
21 st March, 2022	Fruit and vegetable production in Meghalaya	ICAR-Research Complex for NEH Umiam (Meghalaya)	107	Vegetable Seed & Organic Fertilizers	O C Sharma, J I Mir, W H Raja & S U Nabi , Madhu G S & Sudhakara NR

Date	Programme	Venue	Partici- pants	Inputs supplied	Co ordinators
Arunachal Pradesh					
7 th March, 2022	Organic farming in horticultural crops	RS Dirang	50	Vermicompost	W H Raja & S U Nabi
8 th March, 2022	Organic farming in horticultural crops	RS Dirang	70	Vermicompost	S U Nabi & WH Raja
17 th March, 2022	Temperate fruit production in Arunachal Pradesh	RS Dirang	40	Temperate fruit plats	W H Raja & S U Nabi
1 st April, 2022	Cultivation of high yielding vegetable varieties	Jyotinagar, Dirang	100	Vegetable seeds	Khishi Ram & YP's of RS Dirang
8 th April, 2022	Cultivation of high yielding vegetable varieties	Chug village West Kameng Distt.	100	Vegetable seeds	Khishi Ram & YP's of RS Dirang
9 th April, 2022	Cultivation of high yielding vegetable varieties	Yuang village, West Keming distt AP	100	Vegetable seeds	Khishi Ram & YP's of RS Dirang
24 th November, 2022	Training pruning and post-harvest management in stone fruits.	Namshu, West Kameng	60	Water pipe, Spade, pruning saw and pruning secateur	Wasim H. Raja, Puneet Kumar, Vishal Dinkar and Vishal Mhetre
25 th November, 2022	Scope and prospects of value addition and post-harvest management of kiwifruit	Thembang, West Kameng	63	Water pipe, Spade, pruning saw and pruning secateur	Wasim H. Raja, Puneet Kumar, Vishal Dinkar and Vishal Mhetre
Asam					
29 th November, 2022	Awareness programme cum input distribution	Paramaighul, Paruwa, Assam	42	Banana sucker, Assam lemon plants, Arecanut plants and coconut plants	Wasim Hassan Raja, Puneet Kumar and Vishal Dinkar
30 th November, 2022	Awareness programme cum input distribution	Jamuguri, Assam	50	Coconut plants	Wasim Hassan Raja, Puneet Kumar and Vishal Dinkar
1 st December, 2022	Awareness programme cum input distribution	Behali, Assam	23	Banana sucker, Assam lemon plants, Arecanut plants and coconut plants	Wasim Hassan Raja, Puneet Kumar and Vishal Dinkar
2 nd December, 2022	Awareness programme cum input distribution	Soteea, Assam	20	Banana sucker, Assam lemon plants, Arecanut plants and coconut plants	Wasim Hassan Raja, Puneet Kumar and Vishal Dinkar
3 rd December, 2022	Awareness programme cum input distribution	Gohpur, Assam	31	Banana sucker, Assam lemon plants, Arecanut plants and coconut plants	Wasim Hassan Raja, Puneet Kumar and Vishal Dinkar

Date	Programme	Venue	Partici- pants	Inputs supplied	Co ordinators
4 th December, 2022	Awareness programme cum input distribution	Bihaguri, Assam	37	Banana sucker, Arecanut plants and coconut plants	Wasim Hassan Raja, Puneet Kumar and Vishal Dinkar
5 th December, 2022	Awareness programme cum input distribution	Rangamuri, Disiri, Assam	22	Banana sucker, Assam lemon plants, Arecanut plants and coconut plants	Wasim Hassan Raja, Puneet Kumar and Vishal Dinkar
6 th December, 2022	Awareness programme cum input distribution	Balipara, Assam	12	Coconut plants	Wasim Hassan Raja, Puneet Kumar and Vishal Dinkar
7 th December, 2022	Awareness programme cum input distribution	Rangapara, Assam	83	Banana sucker, Assam lemon plants and coconut plants	Wasim Hassan Raja, Puneet Kumar and Vishal Dinkar
8 th December, 2022	Awareness programme cum input distribution	Missamari, Jamugurihat, Assam etc.	33	Banana sucker, Assam lemon plants and coconut plants	Wasim Hassan Raja, Puneet Kumar and Vishal Dinkar
9 th December, 2022	Use of Bio pesticides in Horti crops in co- ordination with DBT-Unit/ NECAB, Jorhat, Assam	AAU, Jorhat, Assam	50	Biopesticide	Wasim Hassan Raja, Puneet Kumar and





Glimpses of trainings and agricultural input material, planting material and Bio-pesticide distribution among the beneficiaries under NEH Scheme from during 2022.

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

The tribal sub plan was executed by ICAR-CITH for the benefit of tribal farmers in notified districts and areas under execution in early years. Three programmes like trainings, interaction, demonstrations and planting material distribution for enhancing their farm income were organized during 2022. The programmes carried out are summarized in Table 25 and detail is presented below:

Quality planting material and agriculture kits distributed to 100 tribal farmers

The ICAR-Central Institute of Temperate Horticulture, Srinagar, Jammu & Kashmir in collaboration with the Krishi Vigyan Kendra, Poonch of SKUAST, Jammu distributed the planting material and kits to 100 Tribal Farmers of Poonch District on 11th February, 2022. Dr. S.K. Gupta, Director (Extension), Sher-e-Kashmir University of Agricultural Sciences & Technology, Jammu stressed on the need for working in collaboration with the Institutes of repute like ICAR-CITH for improving the tribal families' economic status. Dr. Javed Iqbal Mir, Nodal Officer, TSP & Head, Fruit Science Division, ICAR-CITH, Srinagar underlined the main objectives of the programme. He also discussed about the production techniques of temperate horticultural crops, especially, fruits and vegetable crops. The need for quality planting material and timely management, viz., pruning in fruit crops for maximum production and returns was also stressed by Dr. Mir. The Institute distributed the free planting materials of Apple, Almond, Peach Apricot and Cherry along with the tool kit consisting of Pruning Saw, Scateur and Tarpaulin to 100 tribal farmers of the District from

Villages - Nangali, Degwar, Chella, Gali Pindi and others Panchayats.

One day training and planting material distribution programme for tribal farmer at FTEC Ganderbal

On 15th of December, one day training and planting material distribution programme for tribal farmers was organized for tribal farmers of District Ganderbal and Srinagar "under Tribal sub plan (TSP) at Farmers training and education centre (FTEC) Ganderbal, in collaboration with Department of Agriculture, Govt. of J&K. Total 59 tribal farmers/beneficiaries participated in the programme from tribal areas of Fakir Gujri (Srinagar), Chonth Wali War and Andarwan (Ganderbal). The coordinator of the programme Dr Sajad Un Nabi highlighted the importance of the programme conducted under Tribal sub Plan by ICAR-CITH Srinagar. The chief guest of the function was Additional Deputy commissioner (ADC) Ganderbal Shri Mehraj Ahmad who stressed the farming community to learn the scientific ways of cultivation for enhancing the productivity of their crops. Farmers were made acquainted with important cultivation practices of important temperate fruit crops especially apple, peach, almond and apricot by Dr Javid Iqbal Mir (Senior scientist-SS) of ICAR-CITH Srinagar. The Deputy Director of the FTEC also stressed the tribal farming community to adopt the modern practices of cultivation of fruit and vegetable crops. The farmers participated with zeal and were highly satisfied with the training programme. Finally at the end of the programme plants (Apple, almond, peach and apricot) along with pruning tool (Secateur) were distributed among 50 beneficiaries.



One day training programme organized for tribal farmers of Babanagri, Ganderbal

To improve the livelihood of the Tribal population in Kashmir region, ICAR-Central Institute of Temperate Horticulture, Srinagar organized Planting material Distribution

Programmes on 26th March, 2022. One day programme was organized in the Babanagri, Ganderbal tribe dominated areas of Jammu & Kashmir under TSP Scheme. Apple planting material and tomato seeds were distributed among 41 tribal farmers in the Babanagri village.



Glimpses of training programme and planting material distribution at Babanagari

Table 25: List of training programmes/ agricultural farm input distribution under TSP during 2022

Sr No.	Name of Programme	Venue	Date	No. of Participants	Organizers/ coordinators
1.	Production techniques of temperate horticultural crops & farm input distribution for demonstrations	KVK Poonch	11 th February, 2022	100	J I Mir & G. Nabi
2	Production techniques of temperate horticultural crops & farm input distribution for demonstrations	Ganderbal	15 th of December	59	J I Mir & S U Nabi
3	Fruit and production and vegetable production cum planting material distribution	Babanagari, Ganderbal	26 th March, 2022	41	Vishal Dinkar & Ishtiyahq Ahmad
4.	One day exposure visit cum training programme on production practices of important temperate fruit crops	ICAR-CITH, Srinagar	20 th September, 2022	85	S U Nabi & O C Sharma

Schedule Caste Sub Plan (SCSP)

The ICAR-Central Institute of Temperate Horticulture, Srinagar, Jammu & Kashmir executed the Schedule Caste Sub Plan (SCSP) during 2022. A series of programs were organized in SC-dominated areas of Jammu and Kashmir and Uttarakhand under the SCSP Scheme and detail of programmes organized are briefly presented in Table 26 & 27 and text below.

Training-cum-Farm Input Distribution Programmes under SCSP Scheme organized

The ICAR-Central Institute of Temperate Horticulture, Srinagar, Jammu & Kashmir organized a series of programs in March 2022 in SC-dominated areas of Jammu and Kashmir and Uttarakhand under the SCSP Scheme.

On 05th March, 2022, two training programmes were organized for the beneficiaries of Bishnah region of the Jammu district at Chak Avtara Panchayat and Naugram Panchyat. The beneficiaries were appraised about the nutritional and economic value of horticultural crops and how vegetable cultivation can generate self-employment opportunities for rural youth. Farm inputs like tarpaulins, watering hoses, shovels, sickles, and spades were distributed among the participants. More than 200 beneficiaries were benefitted from the two programs.

In another program, a demonstration was held for the popularisation of low-chill apples in warmer areas of J&K in the Bishnah tehsil. Quality planting material of low and medium chill apples

was distributed among 15 progressive farmers from SC community.

On 26th March, 2022, ICAR-CITH-Regional Station Mukteshwar, Nainital (UK) organized a training-cum-farm input distribution program at Odalohar and Simsyari villages of district Bageshwar (UK). The participating SC farmers were made aware of the prospects and scope of growing horticultural crops. Farm tools like tarpaulins, shovels, sickles, spades, and bags were distributed among the 100 participating farmers.

On 28th March, 2022, the Institute organized two more training-cum-farm input distribution programs at Suchet Garh and Kutub Nizam villages of R.S. Pura area of Jammu district. The farmers were appraised about eco-friendly measures of plant protection in agriculture and pre-and post-harvest management of crop produce. Inputs like manual knapsack sprayers, SS grain bins, shovels, and bags were distributed among the 200 participating farmers.

On 29th March 2022, an exposure visit for 50 progressive SC farmers of Bageshwar district to ICAR-CITH- Regional Station, Mukteshwar was organized wherein the farmers were appraised about the management and maintenance of horticultural crops. Relevant literature published by the institute was also made available to the participants.

On 02 August 2022 in SC-dominated areas of Samba district under SCSP Scheme, in collaboration with KVK, Samba. In the first

program, 75 beneficiaries from panchayat halqas Sarna, Mandi Kehli, Tapyal, Sarhti Kalan and Abtal were appraised about sustainable cultivation of fruit crops. Quality planting material of Litchi (375), Guava (235) and Lime (375) were provided to the beneficiaries along with one each of manual knapsack sprayer and spade. In second program, 75 beneficiaries from panchayat halqas Druee, Papar Avtara, Taloor and Naran were appraised about economic benefits of fruit cultivation. Quality

planting material of Litchi (425), Guava (225) and Lime (375) were provided to the beneficiaries along with one each of manual knapsack sprayer and spade. In the third program, 50 beneficiaries from panchayat halqas Harsath, Samlah and Sangwali appraised about modern techniques of fruit cultivation. Quality planting material of Litchi (500), Guava (150) and Lime (250) were provided to the beneficiaries along with one each of manual knapsack sprayer and spade.

Table 26: Training Programmes organized for SC farmers under SCSP Scheme

Date	Programme	Venue	Participants	Co ordinators
05 th March, 2022	Nutritional and economic value of horticultural crops	Chak Avtara Panchayat of Bishnah, Jammu	100	Md Abas Shah & Puneet Kumar
05 th March, 2022	Nutritional and economic value of horticultural crops	Naugram Panchyat of Bishnah, Jammu	100	Md Abas Shah & Puneet Kumar
05 th March, 2022	popularisation of low-chill apples	Bishnah Panchayat Jammu	15	Md Abas Shah & Puneet Kumar
26 th March, 2022	Prospects and scope of growing horticultural crops	Odalohar and Simsyari villages of district Bageshwar (UK).	100	Arun Kishore, Diwan Chandra
28 th March, 2022	Eco-friendly measures of plant protection in agriculture and pre-and post-harvest management of crop produce	Suchet Garh and Kutub Nizam villages of R.S. Pura area of Jammu	200	Puneet Kumar, Madhu G.S.
29 th March, 2022	Management and maintenance of horticultural crops	Exposure visit to ICAR-RS Mukteshwar	50 from Bageshwar district of UK	Arun Kishore,
2 nd August, 2022	Sustainable production of fruit crops	Mandi Kehli, Tapyal, Sarhti Kalan and Abtal of Distt Sambha, Jammu	75	Md Abas Shah & Puneet Kumar
2 nd August, 2022	Sustainable production of fruit crops	Panchayat halqas Druee, Papar Avtara, Taloor and Naran of Distt Sambha, Jammu	75	Md Abas Shah & Puneet Kumar
2 nd August, 2022	Sustainable production of fruit crops	Panchayat halqas Harsath, Samlah and Sangwali of Distt Sambha, Jammu	50	Md Abas Shah & Puneet Kumar

Table 27: Farm input distribution Programmes organized for SC farmers under SCSP Scheme

Date	Venue	Participants	Inputs supplied	Co ordinators
05 th March, 2022	Chak Avtara Panchayat of Bishnah, Jammu	100	Tarpaulins, watering hoses, shovels, sickles and spades	Md Abas Shah & Puneet Kumar
05 th March, 2022	Naugram Panchyat of Bishnah, Jammu	100	Tarpaulins, watering hoses, shovels, sickles and spades	Md Abas Shah & Puneet Kumar

Date	Venue	Participants	Inputs supplied	Co ordinators
05 th March, 2022	Bishnah Panchayat Jammu	15	Planting material of low chill appl	Md Abas Shah & Puneet Kumar
26 th March, 2022	Odalohar and Simsyari villages of district Bageshwar (UK).	100	Tarpaulins, shovels, sickles, spades, and bags	Arun Kishore, Diwan Chandra
28 th March, 2022	Suchet Garh and Kutub Nizam villages of R.S. Pura area of Jammu	200	Manual knapsack sprayers, SS grain bins, shovels, and bags	Madhu G.S. & Puneet Kumar
2 nd August, 2022	Panchayat halqas Sarna, Mandi Kehli, Tapyal, Sarhti Kalan and Abtal of Distt Sambha, Jammu	75	Planting material of Litchi, Guava, Lime , manual knapsack sprayer and spade.	Md Abas Shah & Puneet Kumar
2 nd August, 2022	Panchayat halqas Druee, Papar Avtara, Taloor and Naran of Distt Sambha, Jammu	75	Planting material of Litchi, Guava, Lime , manual knapsack sprayer and spade.	Md Abas Shah & Puneet Kumar
2 nd August, 2022	Panchayat halqas Harsath, Samlah and Sangwali of Distt Sambha, Jammu	50	Planting material of Litchi, Guava, Lime , manual knapsack sprayer and spade.	Md Abas Shah & Puneet Kumar





Glimpses of different programmes organized under SCSP in Jammu Division of J&K



Glimpses of different programmes organized under SCSP by ICAR-CITH, Rs Mukteshwar in Uttarakhand

Mera Gaon Mera Gaurau Programme

ICAR- CITH RS, Mukteshwar has adopted Sunkiya village under Mera Gaon Mera Gaurav. The village is situated at 1750 meter above mean sea level (29° North latitude and 79° East longitudes) in Dhari block of Nainital district. Eight trainings, 2 diagnostic/field visits three demonstrations in which total more than 75 farmers participated. The farmers of the village were also supported with different technological literatures on temperate fruits and vegetables. Further, three Swachhata Campaign and waste decomposition awareness programme were conducted. Also provided technical support to the farmers of the village as and when approached.

Exhibition (s)

ICAR-CITH, RS, Mukteshwar organized two exhibitions during Kisan Mela at ICAR-VPKAS and Apple Day/ show cum workshop at ICAR-CITH, R S Mukteshwar on 28th September, 2022 and 26th August, 2022. Dr Arun Kishore coordinated the programmes,

Radio/ TV Talks

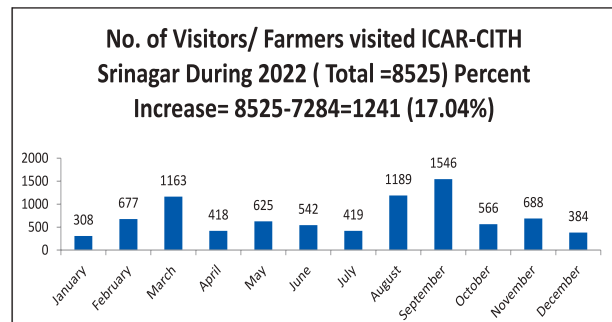
To disseminate the technologies through mass media for their adoption on a larger scale, scientists of ICAR-CITH, Srinagar continuously delivered need-based talks on various topics beneficial for farmers and line departments. A total 22 TV/Radio talks were delivered by various scientists during the year is presented in Table 28.

Table 28: Radio/ TV talks delivered by scientist of ICAR-CITH during 2022

Sr No	Name of Scientist	No. of talks
1.	Dr J I Mir	2
2.	Dr Geetika Malik	1
3.	Dr Abass	1
4.	Dr W H Raja	11
5.	Sh Sajad Un Nabi	7
Total		22

Farmers/ visitors visit to ICAR-CITH, Srinagar

The well managed orchards and technologies generated by Institute in different crops has become the center of attraction for visitors / farmers. During 2022, total 8525 farmers/ visitors visited ICAR-CITH, Srinagar and month wise detail is presented below:



TRAININGS AND CAPACITY BUILDING



ICAR-CITH, Srinagar is deputing its staff regularly for various need based training programmes organized time to time by various organizations for up gradation of knowledge and skill of the staff. During 2022, following officers were deputed for below mentioned trainings (online/offline) and have successfully completed the trainings.

Trainings attended by Scientific Staff

Dr Om Chand Sharma (Director-Act.)

- Attended one day training programme on Post Entry Quarantine (PEQ) for imported planting material of horticultural crops on 17th September, 2022 organized by ICAR-NBPGR, New Delhi (virtual mode)

Dr J I Mir, Sr Scientist (Agricultural Biotechnology)

- Attended one day training programme on Post Entry Quarantine (PEQ) for imported planting material of horticultural crops on 17th September, 2022 organized by ICAR-NBPGR, New Delhi(virtual mode)

Dr Arun Kishore, Scientist Sr Scale (Fruit Science)

- Attended one day training programme on Post Entry Quarantine (PEQ) for imported planting material of horticultural crops on 17th September, 2022 organized by ICAR-NBPGR, New Delhi (virtual mode)

Dr Geetika Malik, Scientist Sr Scale (Vegetable Science)

- Attended one day training programme on Post Entry Quarantine (PEQ) for imported planting material of horticultural crops on 17th September, 2022 organized by ICAR-NBPGR, New Delhi (virtual mode)

Dr W H Raja, Scientist Sr Scale (Fruit Science)

- Attended one day training programme on Post Entry Quarantine (PEQ) for imported planting material of horticultural crops on 17th September, 2022 organized by ICAR-NBPGR, New Delhi (virtual mode)

Dr Mohd Abas Shah, Scientist Sr Scale (Entomology)

- Attended one day training programme on Post Entry Quarantine (PEQ) for imported planting material of horticultural crops on 17th September, 2022 organized by ICAR-NBPGR, New Delhi (virtual mode)

Dr Sajad Un Nabi, Scientist (Plant Pathology)

- Attended one day training programme on Post Entry Quarantine (PEQ) for imported planting material of horticultural crops on 17th September, 2022 organized by ICAR-NBPGR, New Delhi (virtual mode)

Sh Vishal Dinkar, Scientist (Plant Breeding and Genetics)

- Attended ten days ICAR-sponsored short course on Opportunities of naturally occurring nutraceuticals as potent alternate medicines of future” organized by Division of Basic Sciences and Humanities, Faculty of Horticulture, SKUAST Kashmir , Srinagar from 5th to 14 March, 2022.
- Attended three days Hindi workshop/ training on Basic statistical techniques and its application in Genetics held at ICAR-IASRI, New Delhi from 3rd to 5th August, 2022.

Dr Sudhakara N R, Scientist (Soil Science)

- Attended 21 Days Winter School on Geospatial science and technology under

National Geospatial Programme, DST, Govt of India held at ICAR-Central Arid Zone Research Institute, Jodhpur from 1st to 21st November, 2022

- Attended one day training programme on Post Entry Quarantine (PEQ) for imported planting material of horticultural crops on 17th September, 2022 organized by ICAR-NBPGR, New Delhi (virtual mode)

Sh Puneet Kumar Scientist (ASP&E)

- Attended one day training programme on Post Entry Quarantine (PEQ) for imported planting material of horticultural crops on 17th September, 2022 organized by ICAR-NBPGR, New Delhi (virtual mode)

Trainings attended by Technical Staff

Sh Vinod Chandra, Sr Technical Officer (T-6)

- Attended one day training programme on Post Entry Quarantine (PEQ) for imported planting material of horticultural crops on 17th September, 2022 organized by ICAR-NBPGR, New Delhi (virtual mode)

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

- Attended one day training programme on Post Entry Quarantine (PEQ) for imported planting material of horticultural crops on 17th September, 2022 organized by ICAR-NBPGR, New Delhi (virtual mode)

Trainings attended by Administrative Staff

Sh Diwan Chandra, AAO

- Attended six days training on MDP on public procurement (basic/advanced) from 5th to 10th September, 2022 organized by AJNIFM, Faridabad, Haryana.

Sh Showkat Ahmad Mir, AAO

- Attended two days training programme on Advanced course on public procurement through portal from 26th to 27th May, 2022 organized by National Productivity Council, Deptt of Promotion, Industry and Internal

Trade, Ministry of Commerce and Industry, Govt of India.

Trainings attended by Skilled supporting Staff

Shabir Ahmad Mir, SSS

- Attended one day training programme on Post Entry Quarantine (PEQ) for imported planting material of horticultural crops on 17th September, 2022 organized by ICAR-NBPGR, New Delhi (virtual mode)

Abroad Visits

Exchange visit of ICAR-CITH, Srinagar scientists within Indian-Uzbekistan collaborative research project entitled Augmentation of plant genetic resources and capacity building of researchers in India and Uzbekistan to Uzbekistan

Exchange visit within Indian-Uzbekistan collaborative research project entitled Augmentation of plant genetic resources and capacity building of researchers in India and Uzbekistan with the purpose to explore the temperate horticultural germplasm suitable for exchange and also to provide training and awareness about latest varieties and technologies developed in horticulture in India was done by Dr Javid Iqbal Mir, Senior Scientist, ICAR-CITH, Srinagar from 25th to 31st July, 2022. In addition visit included exchange the ideas through seminars organized during the visit to Uzbekistan for improvement of technical skills and know how about budding, grafting, rootstock multiplication, canopy management, nutrition management, breeding of horticultural crops & PEQ etc. The visit was coordinated by the collaborating organization, Institute of Horticulture, Viticulture and Winemaking named after Academician Makhmud Mirzaev, 111116, Toshkent viloyati, Toshkent tumani, Guliston QFY, Chimkent yo'li ko'chasi, UZBEKISTAN/ Exchange visit within Indian-Uzbekistan.



Visit to Andijon Ilimiy, Tajriba research station and interaction with staff and farmers

Study visit, consultation meeting and training in Germany on DUS testing in Apple & Pear.

Dr Javid Iqbal Mir, Senior Scientist and Dr Wasim Hassan Raja, Scientist, ICAR-CITH, Srinagar visited Germany in the frame of the Indo-German Cooperation on Seed Sector Development. A visit, consultation meeting and training on the most recent technologies used in DUS testing according to the UPOV /German system was attended in Germany from 25th September to 1st October, 2022 at the German Federal Plant Variety Office (Bundessortenamt) to facilitate understanding and exchanging of experience and information about DUS testing

procedures. The exchange of practical experience and information helped us to harmonize procedures. There was a mutual exchange of ideas between scientists and experts from Germany with strong deliberations and discussions on topics like DUS testing of mutant varieties, DUS testing of Essentially derived varieties, use of molecular markers in DUS testing, need for VCU testing for national listing, *on-site* DUS testing, DUS testing of rootstocks and guidelines to be followed thereof etc. Future of line of action and areas for cooperation were also discussed and finalized.



Visit to Federal Plant variety office Bundessortenamt Headquarters Hanover on 26th September, 2022



Visit to JKI, Dresden-Pillnitz-Institute of breeding research on fruit crops on 30th September, 2022

AWARDS/ REWARDS/ RECOGNITION



Dr Geetika Malik, Scientist SS (Vegetable Science)

- Received 2nd best paper (poster) presentation award in International conference on Advances in agricultural, veterinary and allied sciences for improving livelihood and environmental security organized by ICAR-IFGRI, RS, Srinagar from 28th to 30th September, 2022 held at Gandhi Bhawan, University of Kashmir, Srinagar (J&K).
- Received best oral presentation award in International conference on Existing climate change scenario and its arising risks organized by SKUAST-J, Chatha, Jammu from 21st to 22nd Oct, 2022.

Dr. Sajad Un Nabi, Scientist (Plant Pathology)

- Received Best oral presentation award for paper entitled Spatial and temporal distribution of Ilarviruses ApMV and ApNMV associated with mosaic disease of apple for optimization of tissue and time for real time detection during IPSCONF 2022 held at SKNAU, Jobner Rajasthan from 23rd to 26th March, 2022.
- Received Young Scientist Award in International conference on Advances



Dr S U Nabi Receiving Young Scientist Award in 3 Days International Conference

in agricultural, veterinary and allied sciences for improving livelihood and environmental security (AAVASILES-2022), held at Gandhi Bhawan, University of Kashmir Srinagar (J&K) from 28th to 30th September, 2022.

- Received Best oral presentation award for paper presentation on recent advances for Detection and Diagnosis of Plant Viruses Affecting Temperate Fruit Crops: a case study of Apple (*Malus domestica*) in National symposium on, Impact of climate change on emerging plant diseases organized by Indian Psychopathological Society, North Zone at SKUAST-K Shalimar Srinagar from 28th to 29th of October 2022.

Dr. Arun Kishor, Scientist-SS (Fruit Science)

- Received Best article award for article entitled Hill farming in Uttarakhand region of Himalaya (In References to Fruit & Vegetables) authored by Arun Kishore & Y Kumar published in Agriculture & Food -e Newsletter, ISSN 2581-8317, 2022, 4(7); pp. 631-635

Sh Puneet Kumar, Scientist (AS&PE)

- Received second best poster award in poster presentation on Electro hydrodynamic: applications in food processing during International conference on sustainable approaches in food engineering and technology (SAFETY-2022) organized by Department of Food Engineering & Technology, Tezpur, University Assam and Department of Soils, Water & Agricultural Engineering, Sultan Qaboos University, Oman in association with AFST(I) Tezpur from 18th to 19th October, 2022.



Research Papers (International/ National)

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- Indrabi S A, Malik A A, Hussain K, Malik G, Narayan S, Akhter A, Sultan A, Javeed I and Rashid M 2022. Evaluation of Chilli (*Capsicum annuum* L.) Genotypes for Growth and Yield Attributing Traits. *Journal of Community Mobilization and Sustainable Development* 17(2) : 1-8.
- Jan R, Ara T and Mir J I 2022. Quality Profiling and Estimation of Total Phenols, Flavonoids, Flavonols and Antioxidative Potential of Walnut Kernel (*Juglans regia*) from Kashmir Valley. *Journal of Nuts*. DOI: 10.22034/JON.2022.1952204.1152
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- Malik A A, Malik G, Hussain K, Narayan S, Mufti S, Kumar A, Nazir G, Masoodi U and Magray M 2022. Characterization of bioactive compounds and antioxidant activity among genetically different genotypes of chilli (*Capsicum annuum*. L.). *International Journal of Plant and Soil Science* 34(20):384-393.
- Malik G, Shabir Alima, Shah R A, Farooq S, Jabeen A, Mir J I and Sharma O C 2022. Identification of alternatives to landraces of Kale (*Brassica oleracea* Group Acephala) for off-season cultivation and seed-to-seed production in Kashmir valley. *International Journal of Plant & Soil Science* 34(20): 547-557, 2022; Article no.IJPSS.88709 ISSN: 2320-7035
- Masoodi K Z , Ahmed N , Mir M A , Bhat B, Shafi A , Mansoor S, Rovidha S. Rasool M Y, Dar Z A , Mir J I, Andrabi S M and Ganai N A 2022. Comparative transcriptomics unravels new genes imparting scab resistance in apple (*Malus x domestica* Borkh.). *Functional & Integrative Genomics* <https://doi.org/10.1007/s10142-022-00889-x>
- Mhatre PH, Thube SH, Navik O, Venkatasalam E P, Sharma S, Patil J, Subhash S, Divya K L, Watpade S, Pandian T P, Shah MA and Kumar M 2022. Outbreak and management of serpentine leaf miner, *Liriomyzahuidobrensis* (Blanchard) (Diptera: Agromyzidae), on potato (*Solanum tuberosum* L.) crop in India. *Potato Research* (Online first), <https://doi.org/10.1007/s11540-022-09549-w>
- Mir A H, Bhat M A, Fayaz H, Wani A A, Dar S A, Maqbool S, Yasin M , Mir J I , Khan M A , Sofi P A , Ahmed H. ElSappah, Thudi M, Varshney R K & Mir R R 2022. SSR markers in revealing extent of genetic diversity and phylogenetic relationships among chickpea core collection accessions for Western Himalayas. *Molecular Biology Reports* <https://doi.org/10.1007/s11033-022-07858-4>
- Nabi SU, Baranwal V K, Rao G P, Mansoor S, Vladulescu C, Raja W H, Jan B L, Alansi S 2022. High-Throughput RNA Sequencing

- of Mosaic Infected and Non-Infected Apple (*Malus × domestica* Borkh.) Cultivars: From Detection to the Reconstruction of Whole Genome of Viruses and Viroid. *Plants* 11, 675. <https://doi.org/10.3390/plants11050675>
- Narayan R, Kishor A, Narayan S. and Kumar A 2022. Performance of Cherry Tomato (*Solanum lycopersicum* var. *cerasiforme* (Dunal) A. Gray) Genotypes for Physico-chemical Attributes under Naturally Ventilated Protected Structure. *Biological Forum – An International Journal*, 14(3): 395-403.
 - Shah M.A, Kumar R, Sharma S and Dua V K. 2022. Thermal requirement and temperature thresholds for development of peach-potato aphid, *Myzuspersicae* (Sulzer) on potato in the subtropical plains of India. *Int J Trop Insect Sci* 42: 2513–2520. <https://doi.org/10.1007/s42690-022-00779-6>
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 - Sridhar J, Venkateswarlu V, Shah M.A, Kumari N, Raigond B, Bhatnagar A, Choudhary J S, Sharma S, Nagesh M and Chakrabarti S K 2022. Species composition and distribution of the vector aphids of PVY and PLRV in India. *Potato Research* 65: 601-617. <https://doi.org/10.1007/s11540-022-09540-5>
 - Sridhar J, Venkateswarlu V, Shah M A, Kumari N, Bhatnagar A, Raigond B and Chakrabarti S K 2022. Incidence of the cabbage aphid, *Brevicorynebrassicae* L. in potato crops in India and its efficiency for transmission of potato virus Y^o. *Int. J. Trop. Insect Sci.* 42: 285–291. <https://doi.org/10.1007/s42690-021-00544-1>
- ### Review Papers
- Chandra A K, Joshi A, Tripathi A, Kumar A, Pandey S, Singh A, Lal D, Bharati A, Adhikari S and Dinkar V 2022. Climate-Resilience Maize: Heat stress, Signalling, and Molecular interventions. *Journal of Plant Growth Regulation*, pp.1-18.
 - Lalita and Kumar P 2022. Robotics Intervention in Food Processing Industries: A Mini Review. *Current Journal of Applied Science and Technology*, 41(40), 1-9.
 - Nabi S U, Parveen S, Raja Wasim H, Mir J I, Yasmin Salwee, Sheikh Muneer Ahmad, Sharma O C 2022 Diseases of apple (*Malus domestica*) and their management. *Agrica*, (11) 32-40.
- ### Book
- Chakrabarti, SK, Sharma, S, Shah, MA (eds). 2022. Sustainable Management of Potato Pests and Diseases, 540p. Springer, Singapore <https://doi.org/10.1007/978-981-16-7695-6>
- ### Book chapters
- Ahmad S, Malik A R, Kirmani S, Nabi S U and Shah M A 2022. Orchard planning, establishment and soil management. In: Apples: Preharvest and Postharvest Technology edited by Mushtaq R, Nayak GA and Malik AR, CRC Press, London pp. 9-21.
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 - Chakrabarti S K, Sharma S and Shah M A 2022. Potato pests and diseases: a global perspective. In: Sustainable Management of Potato Pests and edited by Chakrabarti S K, Sharma S & Shah M.A. Springer, Singapore.

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 - Shah M A, Subhash S, Ellango R, Asokan R, Sharma S and Chakrabarti S K 2022. Biology and Management of Whiteflies in Potato Crops. In :Sustainable Management of Potato Pests and Disease edited by Chakrabarti S K, Sharma S & Shah M.A. Springer, Singapore. https://doi.org/10.1007/978-981-16-7695-6_10, pp. 247-279
 - Shah M A, Subhash S, Naga K.C, Sharma S 2022. Biology and Management of Aphids Infesting Potato. In: Sustainable Management of Potato Pests and Diseases . edited by Chakrabarti S K, Sharma S & Shah M.A. Springer, Singapore. https://doi.org/10.1007/978-981-16-7695-6_9, pp. 213-245

Technical bulletins/ Popular articles/ pamphlet/folders

- Debnath S, Kishor A, Kumar A, Purakayastha T J and Bhowmik A 2022. Orchards in Uttarakhand: Soil nutrient status. Current Science, 123 (5): 629-630.
- Kishor A and Kumar Y 2022. Hill Farming in Uttarakhand Region of Himalaya (In References to Fruit & Vegetables). Agriculture & Food -e Newsletter, ISSN 2581-8317, 4(7); pp. 631-635.
- Kumawat K L, Sharma A, Raja W H, Sharma O C and Mir J I 2022. Untimely snowfalls – An emerging concern for temperate fruit growers in Kashmir valley. Indian Horticulture. 21-26.
- Malik A A, Hussain K, Narayan S, Kumar A, Nazir G, Masoodi U, Lone Sameena and Malik G 2022. Breeding techniques in vegetable crops- A practical manual. Published by Dean, Faculty of Horticulture, SKUAST-K, Shalimar
- Mir J I, Sharma O C, Raja W H, Sami-Ullah S and Raja R H S 2022. High density plantation in apple – A highly remunerative enterprise. Indian Horticulture. 24-26
- अरुण किशोर और योगेश कुमार 2022. किचन गार्डन फल एवं सब्जी उत्पादन के लिए उत्तम विकल्प— मध्य भारत कृषक भारती पत्रिका: E-ISSN 2582–5976, pp- 75.
- यासीन मो, सिंह के एन, लामा ए, गुरुंग बि, पॉल आर के, कुमार पी, पॉल अ कु, रॉय एच यस और दिनकर वि। फसल उपज के पूर्वानुमान के लिए उन्नत मौसम सूचकांक आधारित बेसि अनसमा श्रयण मॉडल। सांख्यिकी–विमर्श 2021, भारतीय सांख्यिकी अनुसंधान संस्थान, नई दिल्ली।

PARTICIPATION IN WORKSHOPS/ CONFERENCE/ MEETING



O C Sharma, Director (Act.)

- Attended XXVII meeting of ICAR Regional Committee No 1 on 22nd April, 2022 on virtual mode under the chairmanship of Dr T Mohapatra, Secretary DARE & DG ICAR.
- Attended Director's Conference on 13th April, 2022 at NASC complex, New Delhi
- Attended 93rd Annual General Meeting of the ICAR Society on 26th March, 2021
- Attended International Indo-German workshop on DUS testing in apple and pear under seed sector cooperation organized by ICAR-CITH, Srinagar (Hybrid mode) on 7th to 8th, September, 2022.
- Attended Review meeting on progress of Indo Dutch & Indo Israel Center of Excellence (virtual mode) on 22nd Sep, 2022 chaired by Dr Abhilaksh Likhi, Additional Secretary (Hort) at ICAR-IVRI Jakhini (UP)
- Attended XXVII Regional Committee meeting of West Bengal, Orisa, Telangana and Andaman Nicobar on 14th Oct, 2022 organized by NRRI, Chaired by Secretary DARE & DG ICAR..

Dr J I Mir, Sr Scientist (Plant Biotechnology)

- Participated in International Indo-German workshop on DUS testing in apple and pear under seed sector cooperation organized by ICAR-CITH, Srinagar (Hybrid mode) from 7th to 8th September, 2022.
- Attended National symposium on renaissance of hill agriculture through advanced genetics and crop breeding interventions for attaining food and nutrition security under climate change scenario organized by SKUAST-K, Srinagar from 10th to 12th September, 2022
- Attended National symposium on impact of climate change on emerging plant diseases

organized by SKUAST-K, Srinagar on 29th October, 2022.

- Attended 64th Research Council Meeting of SKUAST-K, Srinagar at SKUAST-K, Srinagar on 16th December 2022.

Dr Geetika Malik, Scientist SS (Vegetable Science)

- Attended one day workshop on revival of fish production, scope of nadru (Nelumbo nucifera) cultivation, value addition to chestnut and its viability and entrepreneurship in Wular and Manasbal lake organized by J&K Advisory board for development of kisans on 21st June, 2022 at Tagore Hall, Srinagar
- Attended international conference on Advances in agricultural, veterinary and allied sciences for improving livelihood and environmental security organized by ICAR-IFGRI, RS, Srinagar from 28th to 30th September, 2022
- Attended International conference on Existing climate change scenario and its arising risks' organized by SKUAST-J, Chatha, Jammu from 21st to 22nd October, 2022

Dr Arun Kishore, Scientist SS (Fruit Science)

- Attended ITMC meeting of ICAR-VPKAS, Almora, Uttarakhand on 20th June, 2022, 5th July 2022 and 17th November 2022 as Member of ITMC Committee.
- Attended SAC meeting of KVK, Jeolikit on 12th January, 2022 through virtual mode organized by KVK, Jeolikit.
- Attended AINRPOG Group Meeting of All India Network Research Project on Onion and garlic held at UAS Dharwad Karnataka from 5th to 7th August, 2022

- Attended RAC meeting of GBPUAT Pantnagar on 21st October, 2022 organized by Director Resaerch GBPUAT Pantnagar.
- Attended SLEC meeting as Member of SLEC committee of HMNEH and DOHFP, Directorate of Horticulture & Food Processing, Uttarakhand on 24th March, 19 November and 21st October, 2022

Dr W H Raja, Scientist SS (Fruit Science)

- Participated in International Indo-German workshop on DUS testing in apple and pear under seed sector cooperation organized by ICAR-CITH, Srinagar (Hybrid mode) from 7th to 8th September, 2022.

Dr Sajad Un Nabi, Scientist (Plant Pathology)

- Participated in 8th International conference (Hybrid Mode) on Plant pathology: retrospect and prospects held at SKNAU, Jobner-Jaipur, Rajasthan from 23rd to 26th March, 2022.
- Participated in National conference of IVS VIROCON 2021 via virtual mode from 26th to 28th March, 2022
- Participated and delivered oral presentation in International Conference on advances in agricultural, veterinary and allied sciences for improving livelihood and environmental security (AAVASILES-2022) held at Gandhi Bhawan, University of Kashmir, Srinagar from 28th to 30th September, 2022.
- Participated and delivered oral presentation in 2 days National symposium on Impact of climate change on emerging plant diseases organised by Indian Phytopathological society, North Zone at SKUAST-K Shalimar Srinagar from 28th to 29th October, 2022.
- Participated in VIROCON-2022 an international conference on emerging and re-

emerging viral infections impacting human, animals, plants, fish and environment, held at SKUAST-K, Srinagar from 5th to 6th November, 2022.

- Attended National workshop on Apple for apple growers, organised by the All India Kisan Sabha and P Sundarayya Memorial Trust held at Srinagar (J&K) from 22nd to 23rd June 2022.
- Attended in International workshop on DUS testing of apple and pear held at ICAR-Central Institute of Temperate Horticulture, Srinagar from 7th to 10th September 2022, under Indo-German Cooperation on Seed Sector Development.

Dr Md Abas Shah, Scientist SS (Agricultural Entomology)

- Participated in International conference on Advances in agriculture, veterinary and allied sciences for improved livelihood and environmental security (AAVASILES-2022), held at University of Kashmir, UT of J & K (hybrid mode), from 28th to 30th September, 2022.

Sh Puneet Kumar, Scientist (AS&PE)

- Attended one day Indo-German virtual workshop on waste to wealth and sustainable packaging on 27th January, 2022 organized by Indo-German Science & Technology Centre, Gurgaon.
- Attended one day National conference on promotion of kisan drones: issue, challenges and way forward held at A.P. Shinde Hall, NASC Complex, New Delhi on 2nd May, 2022.
- Attended two days international workshop on DUS testing of Apple and Pear on 7th to 8th September, 2022 at ICAR-CITH, Srinagar.

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 [<i>Allium cepa</i> L]
6.	Breeding of nutraceutical varieties or hybrids in root vegetable crops.
7.	Rootstock breeding in apple (<i>Malus domestica</i>)
B. Project: Crop Production and Propagation	
Sub projects	
1.	Management of pre harvest fruit drop in apple by fruit load management
2.	Development of different techniques for enhancing the multiplication rate of temperate fruits under protected/open conditions
3.	Standardization of integrated nutrient management of vegetables as intercrop in apple orchard
4.	Development of almond based saffron inter cropping system
5.	Challenge programme on canopy management and plant architectural engineering in temperate fruits
6.	Development and Evaluation of Integrated Nutrient Management Module for High-Quality Temperate Vegetable Production
7.	Impact of combined application of phosphorous and silicon on apple rootstock performance under various soil moisture regimes
8.	Assessment of Soil Carbon Dynamics and Carbon Sequestration Potential of Selected Temperate Fruit Crops of Arunachal Pradesh
C. Project: Crop Protection	
Sub projects	
1.	Diagnosis and prognosis of apple viral diseases – Spatial and temporal variation in virus infection in apple
2.	Diagnosis, transmission and management of virus/virus like diseases of temperate fruit crops

3.	Characterization of pathogens associated with apple canker disease and evaluation of botanicals against most prevalent canker in Kashmir valley
4.	Elucidating the diversity, species spectrum and screening of germplasm against <i>Alternaria</i> spp. infecting temperate fruits
5.	Bionomics, modeling and management of sucking pest complex of temperate fruits
6.	Bioprospecting of Rhizo-cum-endospheric Microbiome/Microbiota of temperate fruit Rootstocks for management of soil and foliar diseases
D. Project: Post Harvest Management	
Sub projects:	
1.	Development of edible coating with enriched antimicrobial bioactive compounds for various stone fruits
II. 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.	DUS testing centre for temperate fruits
5.	Development of an electronic nose sensor to determine the optimum harvesting time for apple and papaya
6.	Walnut propagation for development of quality plating material in Uttarakhand
7.	Validation and development of DUS testing guidelines for olive
8.	Development and validation of DUS guidelines in Kale under Indian conditions
9.	Augmentation of plant genetic resources and capacity building of researchers in India and Uzbekistan
10.	Production of quality planting material of elite walnut cultivars and demonstration of improved agro technology for walnut orchards in Kashmir and Arunachal Pradesh
11.	Characterizing diversity, genome profile and development of robust diagnostics for <i>Diplodia</i> spp. associated with Canker disease of Apple (<i>Malus domestica</i> Borkh.) in North Western Himalayan Region of India
12.	Development of DUS guidelines for Pran (<i>Allium proliferum</i>)
13.	A comparative metabolomics approach for the analyses of scab-disease resistance in apple and develop
14.	Capacity building for improving skill and efficiency in transfer of technologies in farmers field under J & K State

RESEARCH REVIEW AND MANAGEMENT COMMITTEES



Research Advisory Committee of ICAR-CITH, Srinagar (9th Jan, 2021 to 8th Jan, 2024)

1.	Dr T A More Ex -Vice Chancellor, MPKV, Rahuri	Chairman
2.	Dr R K Avasthe Joint Director, ICAR Research Complex, Sikkim	Member
3.	Dr A T Sadashiva Ex-Head, ICAR-IIHR, Bangalore	Member
4.	Dr Bhardendu Vatsya Cofounder farmogo Exotica Private Limited Plot No 22/1 Telegaon Floriculture MIDC, Maval, Pune, Maharashtra 410507	Member
5.	Dr R K Pal Ex Director, NRC Pomegranate, Solapur	Member
5.	Dr V K Baranwal National Professor, ICAR-IARI, New Delhi	Member
6.	Shri Abdul Jabbar.Parey S/O Sh Mohd Jamal Parrey, R/O Yorekhoshpora, Qazigund, Distt. Kulgam (J&K)	Non Official Member
7	Shri ChheringAngchok 34 Tyapa, Sakara, Leh, Ladakh, 194101	Non Official Member
8.	Dr V B Patel , Assistant Director General (HS-II), ICAR, New Delhi	Ex – Officio Member
9	Dr. O. C. Sharma , Director (Act), ICAR-CITH, Srinagar	Ex – Officio Member
10	Dr.Javid Iqbal Mir , Senior Scientist and Head Fruit Science (I/C)	Member Secretary

Institute Management Committee (IMC)

1.	Director ICAR-CITH, Srinagar	Chairman
2.	Director Horticulture Govt. of J&K, Raj Bagh, Srinagar	Member
3.	Director Horticulture & Food Processing, Deharadun, Uttarakhand	Member
4.	Shri Abdul Jabbar.Parey S/O Sh Mohd Jamal Parrey, R/O Yorekhoshpora, Qazigund, Distt. Kulgam (J&K)	Member / Progressive Farmer
5.	Shri ChheringAngchok 34 Tyapa, Sakara, Leh, Ladakh,	Member / Progressive Farmer

6.	Dr. S K Singh Head, Division of Fruit and Horticulture Technology, ICAR- IARI, New Delhi.	Member
7.	Dr. Subhash Chander Professor, Division of Entomology ICAR-IARI, New Delhi	Member
8.	Dr. Sheikh Mohd Sultan I/C Scientist ICAR-NBPGR, RS, Srinagar (J&K)	Member
9.	Dr. Javid Iqbal Mir Senior Scientist (Biotechnology), ICAR-CITH, Srinagar	Member
10.	Asstt. Director General (HS II) ICAR, KAB-II, Pusa, New Delhi-110012	Member/Council representative
11.	Member Finance Sh Fayaz Ahmad Dar , AF&AO	Co opted Member
12.	Administrative Officer ICAR-CITH, Srinagar (J&K)	Member Secretary

DISTINGUISHED VISITORS



- Sh Atal Dulloo, Additional Chief Secretary, Agriculture Production Department (APD), Govt of Jammu & Kashmir visited ICAR-CITH Srinagar on the occasion of Famers, Kisan Board Members, Development Department Officials and Scientists/Experts Interface meeting on 18th May, 2022. He was made aware of various research activities and technologies generated by the Institute.



Glimpses of Visit of Sh Atal Dulloo, Additional Chief Secretary, Agriculture Production Department at ICAR-CITH Srinagar

- Prof(Dr) Nazir Ahmad Ganai, Vice Chancellor Sher-e-Kashmir University of Agriculture Sciences & Technology of Kashmir (SKUAST-Kashmir) visited the Institute on 18th May, 2022. He was made aware of various research activities carried out at ICAR-CITH, Srinagar



Glimpses of Visit of Prof (Dr) Nazir Ahmad Ganai, Vice Chancellor Sher-e-Kashmir University of Agriculture Sciences & Technology of Kashmir (SKUAST-Kashmir) at ICAR-CITH Srinagar

- Dr J. P. Sharma, Vice Chancellor Sher-e-Kashmir University of Agriculture Sciences & Technology of Jammu (SKUAST-J) visited ICAR-CITH, Srinagar on 13th June, 2022. The research programme going on various temperate horticultural crops were sown in the field.



Glimpses of Visit of Dr J P Sharma, Vice Chancellor Sher-e-Kashmir University of Agriculture Sciences & Technology of Jammu (SKUAST-Jammu) at ICAR-CITH Srinagar

- Dr A. K. Singh , DDG (Hort Science) visited the Institute on 3rd& 4th September and 6th October, 2022 and was apprised with various research activities going on at ICAR CITH, Srinagar. He was also apprised with various problems faced by the Institute and issues were discussed in detail.



Dr A. K. Singh, DDG (Hort Science), visiting apple high density plantation at ICAR-CITH, Srinagar

- Dr V. K. Pandey , ADG (Hort Science I) visited the Institute on 9th October, 2022 and was apprised with various research activities going on at ICAR CITH, Srinagar. He was also apprised with various problems faced by the Institute and issues were discussed in detail.
- Dr B. K. Pandey, ADG(HSII) visited ICAR-CITH on 19th May, 2022 and apprised various research activities of the Institute.
- Sh Binod Kumar, Chief Comptroller of Accounts (CCA), Ministry of Agriculture and Farmers Welfare visited ICAR-CITH, Srinagar on 9th April, 2022
- Shri Ghulam Rasool Mir, Director Horticulture, Deptt of Horticulture Kashmir visited the Institute on 18th May, 2022
- Dr R. K. Singh, ADG (Food and Fodder Crops) visited ICAR-CITH, Srinagar on 14th June, 2022 and discussion was held on various temperate horticultural crops.
- Dr Amrish Chandra, Director IGFRI, Jhansi visited ICAR-CITH, Srinagar on 14th June, 2022 and stressed IGFRI RS Srinagar to work on collaborated mode with ICAR-CITH.
- Dr Sardar Singh, Director Central Sericulture and Training Centre, Srinagar visited ICAR-CITH, Srinagar on 14th June, 2022 regarding post quarantine facility for import of mulberry cuttings.
- Dr Ashok Kumar, Director ICAR-NBPGR visited ICAR-CITH, Srinagar on 4th June, 2022
- Dr T. K. Nagarathana, Registrar PPV&FRA, New Delhi visited ICAR-CITH on 8th July, 2022
- Dr Jivasha Joshi MD, JKDFC, Deputy Secretary, Ministry of Commerce and Industry, GOI visited ICAR-CITH, Srinagar on 13th August, 2022
- Dr Joykrushna Jena, DDG (Fisheries Sciences) visited ICAR-CITH, Srinagar on 10th June, 2022
- Dr BNS Murthy, Director IIHR, Bengaluru visited ICAR-CITH, Srinagar on 27th April, 2022
- Sh M. K. Jain, Joint Secretary (Personnel), ICAR visited ICAR-CITH, RS Dirang on 15th May, 2022
- Sh G P Sharma, Director Finance ICAR visited ICAR-CITH, RS Dirang on 18th May, 2022
- Dr Rajbir Singh, Director ATARI Zone 1 visited KVK Baramulla on 22nd April, 2022.
- Prof. A. K. Mishra, Ex Chairman ASRB , New Delhi visited ICAR-CITH, Regional Station Mukteshwar on 10th June, 2022.
- Dr Lakshmi Kant, Director ICAR-VPKAS, Almora visited ICAR-CITH, Regional Station Mukteshwar on 24th June, 2022.

PERSONNEL



ICAR-CITH Head Quarter, Srinagar

RMP

- Dr. Om Chand Sharma, Director (Acting)

Scientific

- Dr. J.I. Mir, Senior Scientist (Agricultural Biotechnology)
- Dr. Geetika Malik, Scientist SS (Vegetable Science)
- Dr. Wasim Hassan Raja, Scientist SS (Fruit Science)
- Dr. Mohd. Abas Shah, Scientist SS (Agriculture Entomology)
- Dr. Sajad Un Nabi Naingroo, Scientist (Plant Pathology)
- Dr. Sudhakara N R, Scientist (Soil Science)
- Sh. Vishal Dinkar, Scientist (Plant Breeding and Genetics)
- Sh. Puneet Kumar, Scientist (AS&PE)

Administrative

- Sh. Fayaz Ahmad Dar, F&AO
- Smt. Shahida Rafiq, P S to Director
- Sh. Showkat Ahmad Mir, AAO
- Sh. Reyaz Ahmad Mir, AAO
- Sh. Tariq Ahmad Mir, P A to Director
- Sh. Mehraj-ud-Din Meer, Assistant
- Sh. Mohd. Muzafer Lone, LDC
- Sh. Rouf Ahmad Sheikh, LDC

Technical

- Sh. Eshan Ahad, Sr. Technical Officer (T-6)
- Dr. Muneer Ahmad Sheikh, Senior Technical Officer (T-6)
- Sh. Mehraj-ud-Din Bhat, Sr. Technical Assistant (T-4)/Driver
- Sh. Farman Ali, Technical Officer (T-5)/Driver

- Smt. Mubeena, Technical Assistant (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 SS (Fruit Science)

Administrative

- Sh. Diwan Chandra, AAO
- Sh. Pushpendra Kumar, (UDC)

Technical Staff

- Sh. Vinod Chandra, Sr. Technical Officer (T-6)
- Sh. Puran Chandra, Technical Assistant (T-1-3)

Skilled Supporting Staff

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

ICAR-CITH-RS, Dirang (Arunachal Pradesh)

Technical

- Sh. Vishal Balasaheb Mhetre, Sr. Technical Officer (T-6)

Administrative

- Sh. Khushi Ram, LDC

NEW JOINING/ TRANSFERS/ PROMOTIONS/ PROBATIONS



New Joining

- Sh Vishal Balasaheb Mhetre appointed as Senior Technical Officer at ICAR-CITH, Regional Station Dirang (Arunachal Pradesh) on 21st November, 2022

Transfers

- Sh Madhu G S, Scientist (Plant Pathology) transferred from ICAR-CITH, Srinagar to ICAR-IIHR Bengaluru on 7th April, 2022(A/N)
- Sh J L Kaul, Assistant (on deputation) was relieved from ICAR-CITH Srinagar to join back ICAR-IVRI, Bareilly on 31st August, 2022.

Promotions

- Dr Muneer Ahmad Sheikh is promoted from

Technical Officer (T-5) to Sr. Technical Officer (T-6 -Field/ Farm) w.e.f.28th Dec, 2021

- Sh Mehraj Ud Din Meer was promoted from UDC to Assistant at ICAR-CITH, Srinagar w.e.f. 12th May, 2022.
- Sh Pushpendra Kumar was promoted from LDC to UDC at ICAR-CITH, RS Mukteshwar w.e.f. 13th May, 2022

Probation

- Probation of Sh Mdhu G, Scientist (Plant Pathology) was confirmed w.e.f.27th January, 2022.
- Probation of Sh K R Vashisht, LDC was confirmed w.e.f.20th December 2021.



ICAR-Central Institute of Temperate Horticulture

**K.D. Farm, Old Air Field, Rangreth,
Srinagar-191132 (J&K), India**