Annual Report 2021-22

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

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Apple crop under High Density Plantation system

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Executive Summary

ICAR- Central Institute of Temperate Horticulture, Srinagar (J&K) has focused on generation of need based technologies in different temperate horticultural crops to boost the productivity of quality produce in horticultural crops. 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 emerged as a technological hub from last two decades 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. Presently farmers have adopted many technologies to boost the productivity of their farms. To cater the need of farmers associated with temperate horticultural crops, the research and extension work carried out by the Institute and its Regional Stations during 2021 are briefly summarized below:

Crop Improvement and Biotechnology

ICAR-CITH, Srinagar is National Active Germplasm Site for temperate fruit crops. The germplasm wealth is precious wealth to cater the present and future need of any country. To utilize the available diversity in temperate horticultural crops as well as its conservation for future use, ICAR- CITH , Srinagar along with its regional stations is continuously enriching germplasm wealth. Continuous efforts are going on for collection, evaluation, characterization and documentation of germplasm in temperate horticultural crops. During 2021, 53 germplasm of different fruit and vegetable 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, 90 germplam were planted in the field. The fruit germplasm was also added at ICAR-CITH RS, 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.

In evaluation of columnar apple cultivars viz. Sunlight, Moonlight, Redlane and Goldlane for fruit quality traits like TSS, acidity, pH, firmness, ascorbic acid, color parameters and for antioxidant potential through DPPH, FRAP, total phenols, flavonoids and flavonols assays. Sunlight showed maximum fruit weight (170g) and ascorbic acid (8.82%) in addition to its good antioxidant potential. During the year, commercially important cvs Gala Redlum, Super Chief, Red Velox, Golden Delicious Reindeers, Golden Delicious Clone B, Elstar, Jonaprince, Pinnova, and Red Chief were evaluated based on

fruit quality traits Gala Redlum, Red Chief, Super Chief and Red Velox are showing very good performance. Apple varieties like Pinnova, Elstar and Jonaprince have also the potential for commercialization owing to their desirable fruit quality traits. During the screening of apple germplasm against major diseases using phenotypic and biochemical approaches, total 203 apple cultivars were screened under field conditions for scab disease incited by *Venturia inaequalis*. On the basis of disease reaction (1-5 scale), 62 cultivars/lines were found resistant (1) as compared to susceptible check Oregon Spur (4). The biochemical profiling of various types of phenolic compounds (total phenol content-TPC, DPPH, flavonoids and flavanols) in all 62 lines along with susceptible (Oregon Spur) and resistant check (Prima) was carried out and higher phenol and flavonoids in addition to higher antioxidative and free radical scavenging potential observed in 63 resistant lines in comparison to scab susceptible check confirms our phenotypic studies under field condition.

In apricot, 65 varieties/ genotypes were evaluated for various fruit and colour traitsand 8 genotypes produced fruits having TSS more than 20^0 B. The highest yield efficiency was recorded as 0.3151 kg/cm ^{2} in CITH AP-1 while other genotypes with high yield efficiency were, CITH-AP-2, CITH-AP-6, CITH-AP-36, plumcot, PAS-2, Turkey, CITH-AP-7, Nari and Erani. In evaluation of 34 peach/ nectarine cultivars/ genotypes for initiation of flowering (first flower open); 7 were early (3rd week of March), 26 were mid (4th week of March) and 1 was late (2nd week of April). Among all germplasm, 21 were evaluated for various fruit, colour and stone traits and fruit weight ranged from 36.7 to 119.33g. In strawberry, 90 germplasm were evaluated for initiation of flowering and duration of flowering. Out of 90, 75 genotypes initiated flowering in 2nd week of April while 15 genotypes initiated in 3rd week of April. The peak flowering was in 2nd week of April in 4, 3rd week in 84 and 4th week in 2 genotypes. The end of flowering was in 3rd week of April in 10 and 4th week of April in 80 genotypes. The top highest yielding genotypes were Chandler, Katrian Sweet , Cammarosa, EC 22355, Sweet Heart, Heera, Douglas, Shasta and Majestic. In persimmon, two cultivars namely Hachiya andFuyu were evaluated and the fruit weight, length and diameter were 126.52 g, 63.11mm & 61.39mm in cv. Hachiya and 79.67g, 42.64 mm & 56.51 mm in cv Fuyu.

In almond, 10 cultivars and 20 Selections were evaluated and among almond cultivars the nut weight ranged from 1.96 (Pranyaj) to 3.06g (California Paper Shell). Similarly kernel percentage from 43.37 (Pranyaj) to 61.59 percent (Shalimar).Among the evaluated, almond selections the nut weight ranged from 1.62 (CITH A 22) to 4.29g (CITH A 15). In walnut 246 genotypes/ varieties were evaluated for various nut and kernel traits. Among all , 15 varieties/ genotypes

produced nuts having weight more than 20g while the 15 varieties/ genotypes which produced kernel weight more than 10g and 20 genotypes produced nuts having kernel percentage more than 55 per cent. The observation on female flowering was recorded for 225 genotypes and male flowering for 223 genotypes. About 23 walnut genotypes having more branching density (8 or more) were also identified. In Pistachio, there are 6 selections were evaluated and the heaviest nut and kernels (0.750g & 0.33 g) were produced by CITH Pistachio 1 while kernel percentage was maximum (51.2%) in CITH Pistachio 4. In hazelnut, nine cultivars were evaluated and nut weight ranged from 2.40g (Segorbe) to 3.23 g (Tonda Romana). In pecan, three seedling selections fruited and Selection 3 yielded biggest nuts followed by Selection 1 and Selection 2, respectively.

In vegetables, kale, pea, root vegetables and exotic vegetables were maintained and evaluated under field conditions. Fifty eight genotypes of kale were evaluated against 4 checks. Leaf yield of the germplasm ranged from 111.50 q/ha to 521.50 q/ha, leaf length from 13.88 cm to 27.04 cm and leaf width from 9.53 cm to 22.37 cm. NW-Saag-27 expressed highest leaf yield. SSR genotyping of kale germplasm comprising 62 lines was done with 46 markers. Among root crops, 3 genotypes of radish, namely, CITH-R-5, CITH-R-6 and Scarlet Globe were evaluated along with two checks Palam Hriday and Japanese White Long. Root yield of 205.70 q/ha to 378.16 q/ha was observed in Japanese White Long having statistically highest yield. In turnip, 18 lines including 3 checks Pusa Swarnima, Pusa Chandrima and Nigeen-1 were assessed for root yield (q/ha), root length (cm) and root diameter (cm). None of the lines performed statistically superior to best check Pusa Chandrima (357.78 q/ha). Among leafy, exotic and *Brassica* crops, Chinese cabbage line CITH-CC-1 expressed 413.00 q/ha of net head yield. Broccoli line CITH-Broccoli-1 gave net head yield of 198.06 q/ha and CITH-Cabbage Hybrid-1gave 346.65 q/ha yield.

At regional Station Mukeshwar, evaluation work was done in 17 apple cvs, 8 in peach, 6 in plum, 5 in kiwi fruit and 9 in strawberry for various physio-chemical traits under mid hill conditions of Uttarakhand and elite varieties were identified. Similarly , among vegetables, twelve germplasm of cherry tomato were evaluated under polyhouse at ICAR- CITH, Regional Station, Mukteshwar and highest yield was recorded in VL-4 (33.972 q/ha) followed by Manisha (31.792 q/ha), CT-2 Red (25.618 q/ha), CT-9 (22.931 q/ha) and CT-8 (22.208 q/ha) respectively.

In capsicum, total seven genotypes were evaluated and highest yield was recorded in VLSM-3 (310.30 q/ha) followed by CITH SEL-5 (235.00 q/ha), CITH SEL-7 (191.96 q/ha), CITH SEL-6 (186.17 q/ha) and CITH SEL-2 (159.39 q/ha),

respectively. In garlic, total six genotypes were evaluated and the highest yield was recorded in CITH-MG-1 (100.0 q/ha) followed by SEL-7 (65.7 q/ha), SEL-12 (60.0 q/ha), SEL-10 (57.5 q/ha) and SEL-6 (49.7 q/ha) respectively.

At ICAR- CITH,RS Dirang exploration and collection of wild species temperate fruit crops in West Kameng Districts of Arunachal Pradesh was carried out and 7 accessions were collected from different locations at Shergoan, Dirang and adjoining areas West Kameng District, Arunachal Pradesh. The evaluation work was done in four kiwi fruit cultivars and it it was found that cultivar Bruno matures early in the season followed by Allison, Monty and Hayward. The highest fruit weight (89.65g) was recorded in Monty and lowest (65.58g) in Allison. Two cultivars of persimmon Hachiya (astringent) and Fuyu (non-astringent) were also evaluated.

In characterization and diversity analysis of flowering related gene/ genes in almond, transcriptomic analysis was performed in almond cultivars to identify the genes associated with blooming. RNA seq data of Almond cultivars Waris and Ferralise was processed using FASTQ, Trimmomatic, HISAT2, Stringtie, Stringtie merge and DESeq2 pipeline. Results revealed the differentially expressed genes. The prominent genes with significant up-regulation in local cultivar Waris included Ethylene Insensitive 3 while BADH acyltransferase and accelerated cell death were down-regulated

In development of superior cultivars/hybrids in temperate fruits through conventional and non-conventional methods, hybridization work was carried out in almond and walnut. evaluation of apple hybrids obtained from previous crosses was done to identify the superior hybrids with respect to traits like scab resistance, fruit quality, pollinizer ability etc. Six identified apple hybrids were again evaluated for fruit quality traits *viz* antioxidative and free radical scavenging potential. Studies revealed that superior quality parameters with respect to TSS, acidity, ascorbic acid content, fruit weight and bioassays were obtained in hybrids with respect to their parents. Hybrid and mutant populations (Pre-breeding/breeding populations) developed have been grafted on precocious M9 clonal rootstocks for inducing precocity are being maintained and evaluated for different traits. Improvement of Ambri apple cultivar through mutation (gamma radiation and EMS) has been taken up with the objective for improvement of colour. About 4000 buds each were treated with different doses of EMS and Gamma radiation for generating the mutant population. These treated buds were budded on M-9-Pajam-I clonal rootstocks. Feathering has been induced in these plants by applying BAP during May, 2021 to induce precocity for early evaluation of mutant population. In almond, the crosses were made between Tardy Non Pariel × Pranyaj ,Ferralise × Waris,Ferralise ×

California Paper Shell and Ferragnese × Waris. In walnut, the crosses were made between CITH-W 4 X CITH-W 121, CITH-W 1 X CITH-W 121, CITH-W 121 X CITH-W 4, Opex Caultuary X CITH-W 121 , Opex Caultuary X CITH-W 4 , Serr X CITH W 121, Serr X CITH 4, Franquette X CITH W 12, and Franquette X CITH W 4.

In development of CMS lines in onion (*Allium cepa* L), no morphologically scorable male sterile plants were observed in the flowers of F1 generation grown from crossings between male sterile lines from PAU and promising varieties/ lines at the institute. In a separate crossing programme, bulbs of F2 generation were evaluated for storability before planting them in December, 2021. Brown Spanish when crossed with either MS-1 line or MS-2 line resulted in highest storability in F2 generation.

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 doing this, 13 new lines were constituted.

Crop Production

During 2021, institute has supplied about 24000 plants of different temperate fruit crops besides the supply of 23900 scionwood, 267 runners, 6174 plants/ seedlings of flowers, 86.34 kg vegetable seeds, 23000 vegetable seedlings and 13.5 kg onion seedlings to different stakeholders, vegetable growers & research organization etc. During the year 2021 about 3000 from Srinagar and 1000 grafted plants of walnut from Mukteshwar 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).

In nutrient requirement and irrigation scheduling for apple under high density planting system, Nutrient requirement and irrigation scheduling for apple under high density planting system, the data related to apple yield control was collected which will be suit as basic data on yield parameters of apple. Initial soil samples were collected according to treatment and analysed for basic soil quality parameters. In nutrient profiling of Nursery Blocks of the fruits crops of ICAR-CITH, Srinagar, samples were analyzed for pH, Electrical Conductivity, Organic Carbon, Nitrogen, Phosphorous, Potassium and

micronutrients such as Iron, Zinc, Manganese and **Cupper**. The nutrient profiling studies showed that major nutrients such as Nitrogen and Phosphorous was found deficit in apple, plum and walnut nursery blocks whereas micronutrients like Iron and **Cupper** levels were below average in the apple and walnut blocks. A survey was done in Arunachala Pradesh for identification of potential areas suiting for promotion of Temperate fruit crops. The soil samples of these locations were analyzed for its nutrient quality and analysis is in progress

In standardization of integrated nutrient management of vegetables as intercrop in apple orchard , technology was demonstrated among farmer under MGMG and SCSP scheme at Sunkiya, Nainital and Odlohar-Simsyari, Bageshwar villages during the year 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 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 was recorded in erect type followed by semi erect and spreading without any significant effect on flower traits of saffron. Thus saffron-almond is the best combination and the almond crop can give additional returns to growers and will be more beneficial to compensate losses during adverse biotic and abiotic stresses. In comparison of various planting systems ,highest saffron yield was recorded in raised bed system.

In off-season cultivation of onion in Kashmir valley (New Technology), Punjab White was found superior for offseason cultivation of onion in Kashmir valley conditions with marketable bulb yields of 27.89 to 28.81 t/ha and marketable bulb weight of 57.92 to 64.83 g obtained with end July to mid August planting of bulbsets and harvesting in second fortnight of October to first week of November.

The effect of different concentrations of IBA on rooting of cutting using in soil under naturally ventilated green house at ICAR-CITH RS Dirang, it was observed that the kiwi cv Allison treated with IBA 4000 ppm has a higher rooting success rate of 54%, whereas the lowest has been recorded case of Hayward 4000 ppm with a success rate of 27.5% rooting. Hence higher conc. of IBA (4000) has been found to produce the highest rooting success rate

Plant Protection

Crop Protection

In diagnosis and prognosis of apple viruses, detection and quantification of ApMV and ApNMV from different plant parts (spatial) in two cultivars (Oregon Spur and Golden Delicious) of apple trees during different seasons (temporal) for optimisation of tissue and time for their rapid and early detection was conducted.

Results confirmed that during spring season the ApMV and ApNMV expression was higher in leaves followed by pedicel. During these seasons, both ApMV and ApNMV were detected in leaves in measurable titre using RT-qPCR. Periodic detection of these viruses in different plant parts during all the seasons revealed varied virus titer from one season to another in the same plant. Hence leaves during spring season and fruits/seeds during summer can be directly used as detection material for their early and rapid detection of both the viruses. In diagnosis, transmission and management of virus/virus like diseases of temperate fruit crops, survey was conducted in apple germplasm bank of ICAR-CITH Srinagar and among the 203 germplasm, various cultivars viz., Golden Delicious, Oregon Spur, Ambri, June Eating, Welson Red June, Sharp Earliest and Gala Mast were found infected with mosaic and necrosis mosaic disease.. Survey was also conducted in stone fruit germplasm and suspected viral symptoms like leaf roll, necrosis, ring spots, shot holes, leaf crinkling, small leaves, chlorosis and yellowing was observed. Studies were also carried out for transmission through budding and understanding the effect of clonal rootstocks x scions (Virus infected) interface on mosaic disease of apple. Comparative Transcriptomal studies in mosaic infected apple cultivars comparison to asymptomatic cultivar transcriptome analysis was used to identify the gene expression profiles in ApMV and ApNMV infected apple cultivars (Oregon Spur-AIN and Golden Delicious-AP) in comparison to healthy cultivar Red Fuji. Identification of DEGs in ApNMV/APMV infected apple in comparison to healthy. Based on GO and KEGG pathway analyses, the difference in response to ApMV/ApNMV between infected and healthy mainly involved transport, photosynthesis, plant–pathogen interaction, protein synthesis, defence against pathogen, cell division, oxidative stress in all three comparisons.

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.

In characterization of virus like pathogens, the suspected phytoplasmas symptoms of flat branch, little leaves and witches' broom were observed and PCR based amplification using multigene primers revealed the association of two groups (16SrI and 16SrVI-D) of phytoplasma.

In elucidating the diversity, species spectrum and management of *Alternaria* spp. infecting apple (*Malus domestica* Borkh), thirteen fungicides were evaluated under *in vitro* against *Alternaria spp*. causing leaf spot of Apple. Among different fungicides, Hexaconazole5EC, Propiconazole25EC, Fluxapyroxad 250 G/L + Pyraclostrobin 250 G/L SC showed complete inhibition (100%) of the pathogen at all the test doses and minimum by Metalaxyl 4 WP + Mancozeb 64 WP (50 %) compared to untreated control. Among the contact fungicides the highest percent inhibition (80%) was found in Ziram 80WP, while as in systemic fungicides highest percent inhibition (100%) was found in Hexaconazole 5EC and Propiconazole 25EC. Among combo products highest percent inhibition (100%) was found in Fluxapyroxad 250 G/L + Pyraclostrobin 250 G/L SC. The overall inhibition of *Alternaria* at different doses by various fungicides Besides this, seven different botanicals extracts were evaluated *in vitro* against *Alternaria spp*. of apple. Among different extracts Oreganum leaf and flower extracts completely inhibited (100%) the growth of *Alternaria* at all test doses compared to untreated control. The evaluation of various natural and synthetic medias for growth parameters of *Alternaria* and *Diplodia* pathogens four synthetic media viz., Potato Dextrose Agar (PDA), Agar Medium C (AMC), Rose Bengal Agar (RBA), Nutrient Agar (NA) and three laboratory made media viz., Oregon leaf extract agar (OLEA), Vista Bela leaf extract agar (VLEA), Apple peel juice agar (APJA) were evaluated for the growth parameters of *Alternaria* and *Diploidia*. Highest colony growth of Alternaria after 15 days of incubation was observed in PDA and AMC medium while least colony diameter was observed in NA medium. In all the media, the colony morphology was observed dark green to light green except in Apple peel juice agar (APJA) in which the colony was translucent in appearance.While in case of *Diploidia* highest colony growth after 25 days of incubation was observed in PDA, OLEA, VLEA and APJA media, while least in AMC media. The colony morphology varied from light green to brown in colour and sporulation was observed only in OLEA.

In bionomics, modeling and management of sucking pest complex of temperate fruits, to determine the effect of the growth stage of current-year shoots and their location within the tree on the pattern of *A. pomi* incidence, the aphid populations were sampled from apple cv Coe Red Fuji and other standard varieties in high and medium-density orchards. Based on the growth activity, each sampled shoot was categorized as growing, hardening-off, or hardened-off. It was found that the shoots in the growing stage were most susceptible followed by the hardening-off and hardened shoots. To determine the spatial distribution of the green apple aphid, *Aphis pomi* along the apple shoots, the effect of leaf position on the incidence of green apple aphid was significant

throughout the season. In the early season, the aphids tend to clump on leaves 1 to 5. And the the incidence of the aphids is highest at the beginning of infestation (June). By mid-season (July), the aphid incidence declines slightly with the production of a large number of winged adults. The aphid infestation spreads to leaf number 10. By the end of the season (August), the aphid incidence spreads to most of the leaves present, mainly because of the maturation of the growing tip and setting off of the terminal bud.

Post-Harvest Management

The storage study on fruits of pear cvs. Starkrimson, Red Bartlett and Carmen) was carried out at ambient temperature. Various post-harvest treatments viz. cold shock (CS) or ice-cold water, calcium chloride (CC) and oxalic acid (OA) were given to the fruits of all varieties alongside untreated fruit samples kept as control. During this study, Starkrimson was observed to have the lowest TSS in controlled sample followed by Carmen and Red Bartlett. During the storage period all three varieties showed increase in TSS value which is due to the continuation of conversion of starch into sugars even after harvesting. It was found that samples treated with oxalic acid and calcium chloride had lower rise in TSS, which may be due to the fact that these chemicals retards the ripening rate after harvesting. The decrease in ripening rate is desirable since it extend the shelf-life of the fruit. The firmness of fruits decreased with storage periods with all treatments irrespective of varietal effect. It was observed that cv. Carmen had lowest firmness among the three varieties and effect of oxalic acid and calcium chloride on preserving the firmness of fruit over the storage period was clearly evident.

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 26 meetings/events were organized in which an Apple Day was a mega event. ICAR- CITH, Srinagar has organized one 7 days training programme for officers, one five days training programme for departmental personnel and one five days training programme for nursery growers from Himachal Pradesh were conducted**.** Five one day training programme on walnut propagation were conducted for forest departmental personnel in varios nurseries in Uttarakhand. Six students training/visits, one day programme fo r farmers of Ladakh, one for farmers of

Himachal Pradesh, two programmes for official from deptt of Horticulture Meghalaya along with one diagnostic visit were conducted. A theedays training programme on value added products was conducted for AFWWA and 10 programmes for farmers of Jammu & Kashmir were conducted. Similarly at Regional station Mukteshwar, two programmes for officers/ SMS, 3 farmers visit and 20 different programmes (trainings/ demonstrations etc) were conducted besides the display of three exhibition at various occasions. At RS Dirang, one three days training programme was organized for officers and five training programmes of one day duration for farmers and agricultural inputs were provided at four locations. In TSP, 3 programmes were conducted at two programmes were organized under SCSP scheme and inputs were provided to the beneficiaries. IN MGMG, 6 trainings, 6 visits and four demonstrations were provided in Uttarakhand. During the year , scientists of Institute published 26 research papers, 3 review papers, 17 book chapters and 11 popular articles/ phamplets etc. In addition to various appreciations, the scientists of ICAR-CITH, Srinagar received 6 awards during the year. Besides providing need based information through various social media, scientists of Institute have delivered 24 TV/Radio talks.

Introduction

The horticulture is a fast emerging sector contributing sufficient in agricultural GDP of the country. It is most important from nutritional, economic, and livelihood point of view. The varied agro climatic conditions of the country are suitable and had led us to enjoy production and supply of many horticultural crops. Although there is increase in area and production after independence due to various R&D activities but it is not sufficient to feed the increasing population and there is sufficient scope for its expansion. In India, during 2020-21, the area under horticultural crops was 27.48 million hac with the production of 334.6 million tons which is an increase of about 14.13 Million Tons accounting about 4.4% increase in production over 2019-20. The production of fruits is estimated to be 102.48 Million Tons compared to 102.08 Million in 2019-20, a marginal increase of 0.48 Million Tons while the production of vegetables is estimated to be 200.45 Million Tons in 2020-21 compared to 188.3 Million Tons in 2019-20, an increase of 6.5 percent.

The agro climatic conditions in most parts of Himalayan hill states which extends from Jammu and Kashmir in north to Arunachal Pradesh in east has a unique and fragile eco-system which is highly suitable for growing temperate fruit crops like apple, pear, peach, plum, apricot, almond, walnut, pecan, kiwi fruit, strawberry, hazelnuts, pistachio nuts and other small fruits and berries. These crops serve as the backbone of region's economy and source of empoloyment. 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 tons to 40.0 lakh tones. Among various crops apple , walnut and pear are the major crops of temperate fruits covering about 85 of the total area and accounting for 90% 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 2020-21 apple crop covered an area of 313 thousand ha and 2726 thousand MT national production. Walnut being second important crop covering an area of 109 thousand ha with 281 thousand MT productions 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 276, 000 MT production, peach with 18, 000 ha area and 111, 000 MT production, plum with 24, 000 ha area and 84, 000 MT production and strawberry with 3, 000 ha area and 20000 MT production etc. Although a manifold increase in area and production of temperate fruits after independence due to continuous efforts of various Institutes/ universities for development of technologies/ varieties for boosting production and their dissemination by line departments to farmers field. Temperate fruit crops are contributing significantly to the economic development of the country. As compared to average world productivity and

productivity of advanced countries in these crops our productivity is still low which can be increased by technological interventions.

Keeping in view the importance of these crops with respect to involvement of major population in temperate region in their cultivation and their contribution towards national economy a separate institution has been established under the aegis of Indian Council of Agricultural Research at Srinagar, Jammu and Kashmir. ICAR- Central Institute of Temperate Horticulture, Srinagar with its two regional stations at Mukteshwar, (Uttarakhand) and Dirang, (Arunachal Pradesh) is playing a great role in designing and developing research programmes on crop improvement, production, protection and post-harvest management for achieving economic and nutritional security in the entire Himalayan region. Institute is mainly focusing on research and development in temperate fruits, nuts, vegetables, ornamentals, medicinal & aromatic plants and saffron. To overcome the production constraints and to improve quality of produce, the research on temperate horticultural crops is being carried out both at main campus Srinagar and at its Regional Stations with the following mandate and objectives:

Mandate

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

Objectives

- Establishment of field gene bank and management of genetic resources and scientific data base of temperate horticultural crops.
- Genetic improvement of temperate horticultural crops for yield, maturity, quality, resistance to biotic and abiotic stresses through conventional breeding methods and biotechnological tools.
- Standardization of nursery management and high tech propagation techniques of temperate horticultural crops.
- To device efficient and cost effective production technologies and cropping systems for increasing productivity and improving quality of temperate horticultural crops.
- To develop eco-friendly integrated diseases/pest management modules and diagnostics.

- Post-harvest value addition, product diversification and waste utilization for increasing availability and returns.
- To work out economics of production and impact assessment of technologies.
- Commercialization and transfer of technologies and skilled manpower development.

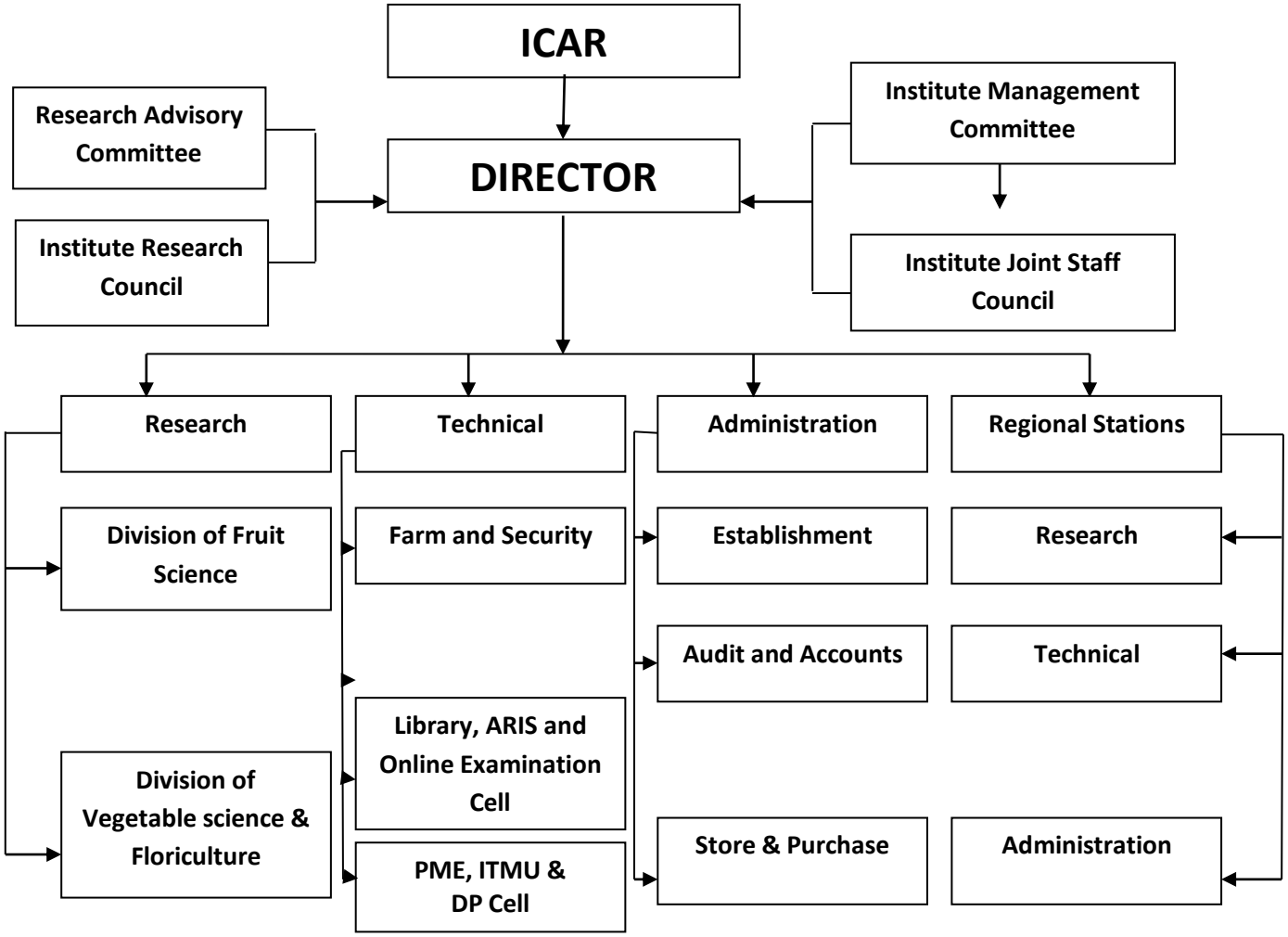
Staff Position (as on 31st December, 2021)

Category	Sanctioned	Filled (as on 31st March, 2020)	Vacant (as on 31st March, 2020)
Scientific	33+1RMP	11	21+1 RMP
Administrative	20	12	8
Technical	16	9	7
Supporting	11	11	0
Total	80+1RMP	43	37+1RMP

Financial Statement (2021-22)

S. No.	Sub-Head	Expenditure (Rs in Lakhs)
1	Capital	**92.0**
2	Establishment Charges	**484.89**
3	T.A.	**23.30**
4	Research & Operation Expenses	**317.54**
5	Administrative Expenses	**175.31**
6	Miscellaneous Expenses	**0.51**
7	Pension	**145.10**
8	Loans and Advances	**7.0**
Total		**1245.65**

ORGANOGRAM OF CITH



Research Achievements

Crop Improvements

A spectacular increase in horticultural area and production has been noticed during 2020-21. The area under horticultural crops in India increased from 26.48 Million hectare to 27.48 Million hectare during 2020-21. An increase of about 14.13 Million tons was noticed during 2020-21 as compared to 2019-20 which is about 4.4 % increase in production over last year. The total production of Horticultural crops was 320.47 MT in 2019-20 which increased to 334.60 MT during 2020-21. This increase has been noticed in fruits, vegetables, Aromatics & medicinal plants, spices and plantations crops**.** 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. More over the variability is also 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 and to a limited extent quince, kiwifruit, hazelnut, 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. 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 2021 at main campus and its regional stations is presented project wise below:

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

ICAR-CITH, Srinagar is National Active Germplasm Site for temperate fruit crops. The germplasm wealth is precious wealth to cater the present and future need of any country. To utilize the available diversity in temperate horticultural crops as well as its conservation for future use, ICAR- CITH , Srinagar along with its regional stations is continuously enriching germplasm wealth. Continuous efforts are going on for collection, evaluation, characterization and documentation of germplasm in temperate horticultural crops. During 2021, 53 germplasm of different fruit and vegetable crops were collected and introduced at ICAR- CITH, Srinagar in the form of plant/ scionwood/ bulbs/ runners/seeds. 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, 90 germplam were planted in the field.

Table-1. Germplasm status at ICAR-CITH, Srinagar (2021)

Sr No	Group	Germplasm Status (2020)	Added during 2021	Germplasm Status (2020)
1	Fruits	1323	25	1348
	Pome fruits	450	9	459
	Stone fruits	271	8	279
	Nuts	403	-	403
	Others	199	8	207
2	Vegetables	1105	28	1133
3	Ornamentals	341	-	341
4	Medicinal and aromatic plants	33	-	33
Total			60	2855

APPLE

Evaluation of columnar apple cultivars for physicochemical characteristics

In collaboration with BAIF, evaluation of columnar apple varieties at ICAR-CITH, Srinagar is being conducted for yield and quality traits to elucidate their potential for commercialization under temperate conditions of J & K. These cultivars possess the traits like scab resistance, low chill requirement, columnar growth habit etc. Their quality with respect to fruit size, TSS, acidity and other physicochemical traits is being ascertained by evaluating these cultivars under open field conditions over the years. During 2021 four columnar apple cultivars

viz. Sunlight, Moonlight, Redlane and Goldlane were evaluated for fruit quality traits like TSS, acidity, pH, firmness, ascorbic acid, color parameters and for antioxidant potential through DPPH, FRAP, total phenols, flavonoids and flavonols assays. Sunlight showed maximum fruit weight (170g) and ascorbic acid (8.82%) in addition to its good antioxidant potential. (Table. 2).

Table-2. Physico and biochemical parameters of different columnar apple cultivars

Parameters	Sunlight	Moonlight	Redlane	Goldlane
Weight	170.0^{a}	128^{c}	52.60^{d}	142.5^{b}
TSS (%)	13.5^{a}	13.8^{a}	13.4^{a}	12.6^{b}
Firmness (RI)	62.5^{b}	60.2^{c}	65.3^{a}	59.5^{d}
Acidity (%)	0.29^{b}	0.27^{c}	0.25^{cd}	0.32^{a}
Ascorbic Acid (%)	8.82^{a}	8.23^{c}	8.19^{d}	8.60^{b}
FRAP (µmol $FeSO_4$ E/100g FW)	180.5^{a}	154.42^{c}	168.10^{b}	120.60^{d}

Fig 1. Physicochemical analysis of apple columnar varieties

Moonlight **Sunlight** **Redlane**

Fruits of some columanar apple cultivars

Evaluation of commercially important apple cultivars for yield and quality traits

Newly introduced commercially important apple cvs. including Gala Redlum, Super Chief, Red Velox, Golden Delicious Reindeers, Golden Delicious Clone B, Elstar, Jonaprince, Pinnova, and Red Chief were evaluated for yield and fruit quality parameters. Highest fruit weight was recorded in Red Chief

(212.5g) followed by Super Chief (195.5 g). Based on fruit quality traits Gala Redlum, Red Chief, Super Chief and Red Velox are showing very good performance (Table 3). Apple varieties like Pinnova, Elstar and Jonaprince have also the potential for commercialization owing to their desirable fruit quality traits.

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

Cultivars	Weight (g)	Number of fruits/plant	Firmness (RI)	TSS (%)	Acidity (%)	Ascorbic Acid (mg/100g)
Gala Redlum	162.4^{c}	65 ^{a}	59.5^{f}	15.0^{c}	0.30^{ab}	10.5^{b}
Elstar	100.0^{i}	40 ^{d}	61.5^{d}	14.4^{ef}	0.28^{c}	8.9^{e}
Jonaprince	150.2^{f}	45 ^{d}	63.1^{c}	15.7^{a}	0.31^{a}	8.5^{f}
Pinnova	133.2^{g}	32^{e}	68.1^{a}	15.0^{c}	0.32^{a}	9.0^{d}
Super Chief	195.5^{b}	22^{ef}	65.2^{b}	14.2	0.25^{d}	8.9^{e}
Red Velox	159.8^{e}	40^{d}	60.1^{e}	13.0^{g}	0.23^{e}	8.0^{g}
Golden Del Reinders	160.5^{d}	56 ^{c}	60.1^{e}	14.9^{d}	0.25^{d}	9.4^{c}
Golden Del Clone B	120.5^{h}	16 ^{ef}	57.4^{h}	15.2^{b}	0.27^{c}	11.8^{a}
Red Chief	212.5^{a}	60 ^{b}	58.9^{g}	14.5^{e}	0.30^{ab}	10.5^{b}

Gala Redlum

Super Chief

Golden Delicious Clone-B

Elstar **Pinnova** **Red Velox**

Fruiting/ Fruits of different apple cultivars

Apple orchard planted under high density on Tall spindle training system

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

During 2020 and 2021, total 203 apple cultivars maintained in field gene bank at ICAR-CITH Srinagar, were screened under field conditions for scab disease incited by *Venturia inaequalis*. On the basis of disease reaction (1-5 scale), 62 cultivars/lines were found resistant (1) as compared to susceptible check Oregon Spur (4). The biochemical profiling of various types of phenolic compounds (total phenol content-TPC, DPPH, flavonoids and flavanols) in all 62 lines along with susceptible (Oregon Spur) and resistant check (Prima) was carried out as studies have suggested their role in plant defence. The role of flavonoids in plant defence is related to their antimicrobial activity against fungi and bacteria, as these molecules have the ability to inhibit biological processes like membrane transport, energy processing and the biosynthesis of nucleic

acids. However, some studies have suggested that their role in plant defence could be associated with the antioxidant activity exhibited by these compounds, which could be used by the plants to regulate the levels of reactive oxygen species (ROS) that are generated during infection processes. In present study, the total phenol content ranged from 4 mg GAE/g FW (Bilmer Norma) -10.26 mg GAE/g FW (*Malus baccata* 2) as compared to 7.58 mg GAE/g FW and 1.55 mg GAE/g FW in resistant and susceptible checks respectively. The DPPH values ranged from 0.08 mg AA/g FW (Bilmer Norma) to 0.21 mg AA/g FW (*Malus baccata* 2) as compared to 0.15 & 0.03 mg AA/g FW in resistant (Prima) and susceptible (OS) check respectively. The flavanoid values ranged from 0.04 mg QE/g (Bilmer Norma) to 0.10 mg QE/g FW (*Malus baccata* 2) as compared to 0.08 & 0.02 mg QE/g FW in resistant (Prima) and susceptible (OS) check respectively. The flavanols values ranged from 0.02 mg QE/g FW (Bilmer Norma) to 0.05 mg QE/g FW (*Malus baccata* 2) as compared to 0.04 & 0.01 mg QE/g FW in resistant (Prima) and susceptible (OS) check respectively. Higher phenol and flavonoids in addition to higher antioxidative and free radical scavenging potential observed in 63 resistant lines in comparison to scab susceptible check confirms our phenotypic studies under field condition.

Evaluation of Pear cultivars for various fruit quality traits

During the year 2021, 27 European/Asian cultivars of pear have been evaluated for fruit quality-related attributes (Fig-2). Among the evaluated cultivars, maximum fruit weight (175.14 g) was recorded in Kashmiri Nakh, maximum fruit length (91.35 mm) was recorded in Burrea de Hardi and maximum fruit diameter (67.84 mm) was recorded in Kashmiri Nakh while these parameters were recorded minimum in Red Anjou (43.72), (47.38) and (40.04). Maximum pedicle length (51.71mm) was recorded in Pear-R-T-10 and minimum (23.74) in King Pear. Fruit firmness in pear cultivars ranged from 45.07 RI in Punjab Beauty to 84.00 RI in Pyrus Behapa. Maximum TSS was recorded in Punjab Soft (21.47) and minimum in fertility (11.07). Maximum values for TSS were recorded in Mayan (1.62) and minimum in Doyenne De Commice. The colour characteristics (L*, a*, b* and tint) of pear were also determined with a chromameter and the L* values ranged from (35.08) in Starkrimson to (72.49) in ZH Copeace while, a* value ranged from (-14.07) in King Pear to (17.22) in Max Red Bartlett. Values for b* scale ranged from 24.97 in Red Anjou to 52.82 in ZH Copeace and no accession showed a negative b* value revealing that there is no blue-colored variety. Values for Tint ranged from –71.79 in Max Red Bartlett to 4.86 in Gent Drouard. The values for Chroma

ranged from 25.46 in Red Anjou to 53.20 in ZH Copeace while values for Hue angle ranged from -86.13 in Punjab Nectar to 85.40 in Pyrus Behapa and values for color index ranged from -8.65 in King Pear to 10.08 in Starkrimson.

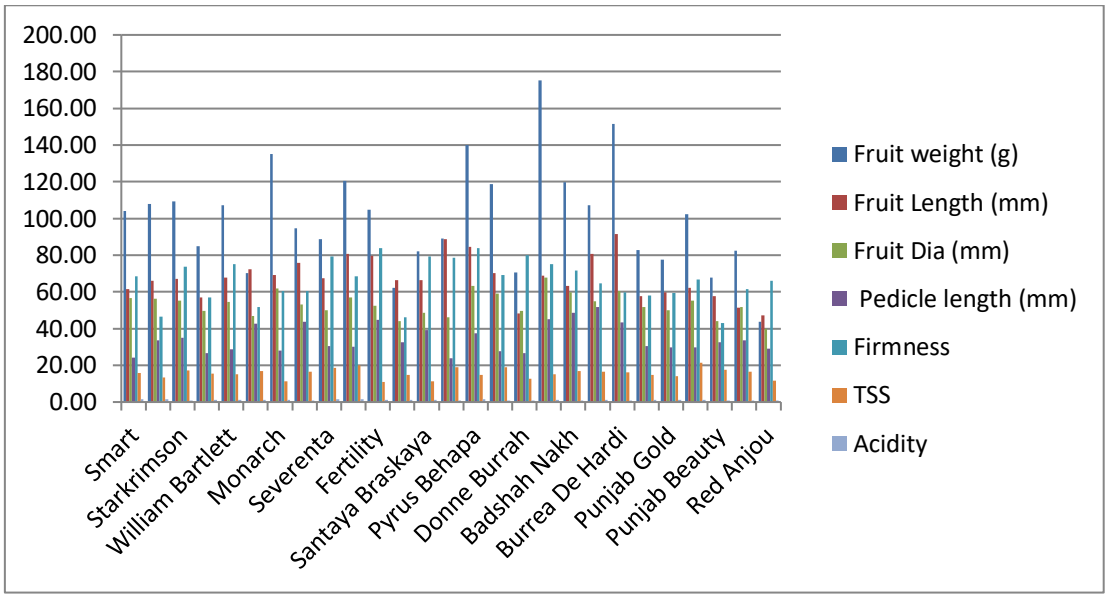


Fig-2:-Quality traits of different pear cultivars.

Max Red Bartlett ***Starkrimson*** ***Gent Drouard***

Monarch ***Z.H. Copaceae*** ***Fertility***

William Bartlet ***Starkrimson*** ***Smart***

Evaluation of cherry germplasm for various fruit related traits.

In cherry, 23 cultivars/genotypes were evaluated for various traits Fig-3. data evaluation of 23 cherry cultivars/genotypes indicated the wide variability among various physio-chemical parameters such as fruit weight, length, dia, thickness, pedicle length, Firmness, TSS. Stone parameters were also recorded for these 23 cultivars/genotypes and colour characteristics were also determined. Among the evaluated cultivars the maximum fruit weight, fruit diameter and fruit thickness were recorded in Bigarreau Noir (Double) (6.25g), (19.27mm) and (22.51) respectively, whereas the lowest parameters were recorded for Sour Cherry (1.75), (12.83) and (13.91). Maximum fruit length was recorded in cultivar Van (20.95) and minimum in Sour Cherry (12.10). Maximum Pedicle length was recorded in Selection-08 (43.37mm) while the minimum in Selection-10 (25.98). Maximum TSS was recorded in Selection-05 (22.27°B) and the minimum in Early Mishri (9.60°B). The maximum value of firmness was recorded in Makhmalli (22.43RI) and minimum in Bigarreau Noir (Double) (14.87RI). Among the stone parameters highest stone weight was recorded in Selection-12(0.50g), maximum stone length in Selection-06 (12.04mm), maximum stone dia. and maximum stone thickness in Lapins (9.66) and (7.54mm), whereas the minimum parameters were recorded for Sour Cherry (0.21g), (7.31mm), (7.07mm) and (5.47mm) respectively. Among colour characteristics, L* value ranged from 22.50 in Sour Cherry to 58.24 in Bigarreau Noir (Double) while values of a* scale ranged from 4.99 in Sour Cherry to 30.52 in Selection-06. In

case of b* scale the value ranged from 2.16 in Sour Cherry to 35.72 in Bigarreau Noir. The values for tint ranged between -153.15 in Selection-05 to -22.83 in Sour Cherry. The values for chroma ranged from 5.44 in Sour Cherry to 40.59 in Bigarreau Noir (Double). The values for Hue angle ranged from 23.72 in Selection-18 to 62.41 in Selection-14 and the values for color index ranged from 9.26 in Bigarreau Noir to103.04 in Sour Cherry. From the data it can be concluded that two cultivars Bigarreau Noir Grossa (Double) and Van performed better in comparison to other cultivars and genotypes.

		
Early Mishri	***Makhmalli***	***Stella***
		
Lapins	***Mishri***	***Bing***

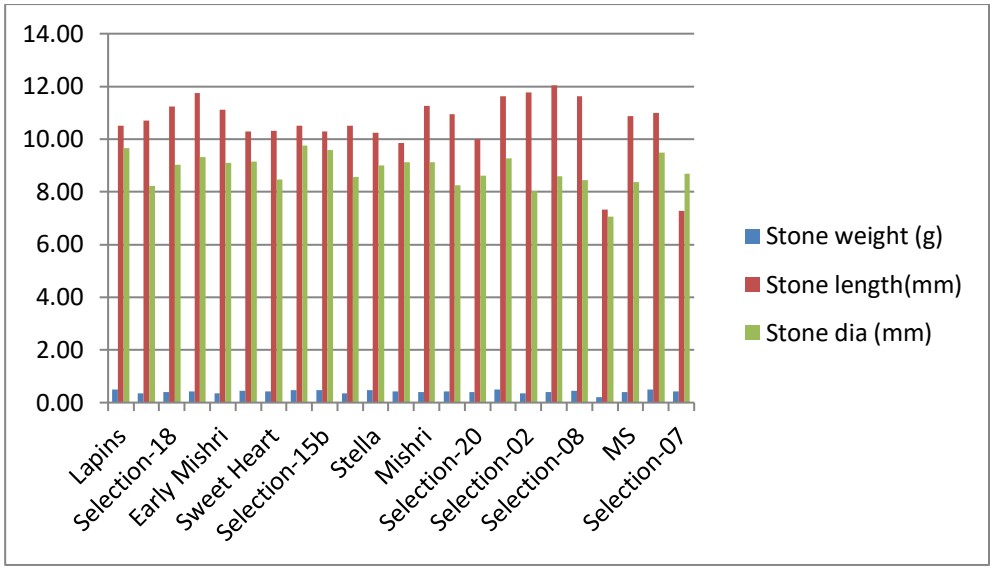


Fig3: - Variability on cherry genotypes for stone traits.

Evaluation of plum germplasm for various fruit related traits.

In plum, 24 cultivars (Japanese and European) were evaluated for various Physico-chemical and colour parameters (Table-). Among the evaluated cultivars the maximum fruit weight, fruit length, fruit diameter, and fruit thickness were recorded in Kubio-26 (75.50g), (54.80), (47.80), and (45.41) respectively whereas the minimum parameters were recorded for Kala Amritsari (4.17), (17.76), (19.01) and (19.31). Maximum Pedicle length was recorded in Stanley (20.05mm) while the minimum in Torrel (8.44mm). Maximum TSS was recorded in Stanley (24.63°B) and the minimum was in Beauty (11.10°B). The maximum value of firmness was recorded in Frair (65.40RI) and the minimum in Au-Cherry (36.90RI). Among the stone parameters highest stone weight was documented in Grand Duke (1.93g) and minimum in Kala Amritsari (0.35g), the highest stone length in Grand Duke (31.24mm) and minimum in Kala Amritsari (9.16) and maximum stone dia in Grand Duke (19.45) and minimum in Kala Amritsari (7.16) and maximum stone thickness in Red Beauty (9.36mm) and minimum in Kala Amritsari (3.66mm). Among colour characteristics, the L* value ranged from 31.24 in Stanley to 63.77 in Green Gauge while values of a* scale ranged from 3.21 in Monarch to 34.83 in Red Plum. In the case of the b* scale, the value ranged from 4.25 in Stanley to 45.96 in Kanto-5. The values for tint ranged between -119.98 in Kubio-26 to -17.20 in President Plum. The values for chroma ranged from 10.00 in Stanley to 47.11 in Kanto-5. The values for Hue angle ranged from 20.11 in Santa Rosa to 85.89 in Monarch and the values for color index ranged from 1.16 in Monarch to 77.49 in Black Amber.

Burbank

Black Amber

Au-Cherry

Black Beauty

Sutluj Purple

KalaAmritsari

Burbank

Sutluj Purple

Burbank

Evaluation of quince genotypes for various fruit related traits.

In quince 17 genotypes were evaluated for physical characteristics during the year 2021, Among the genotypes fruit weight ranges from 68.69 in CITH-Q-02 to 216.79 in CITH-Q-06. The maximum fruit length is 73.74mm in CITH-Q-06 while the minimum is 47.04mm in CITH-Q-02. A maximum fruit diameter of 77.53 mm was recorded in CITH-Q-06, while the minimum fruit length was 52.17 mm in CITH-Q-23. Among colour characteristics, the L* value ranged from 66.65 in CITH-Q- 06 to 80.61 in CITH-Q- 11 while values of a* scale ranged from -5.39 in CITH-Q- 13 to 9.50 in CITH-Q-22. In the case of the b* scale, the value ranged from 43.75 in CITH-Q-06 to 52.31 in CITH-Q-01 The values for tint ranged between -43.87 in CITH-Q- 22 to -9.74 in CITH-Q- 25. The values for Chroma varied from 44.23 in CITH-Q-06 to 52.71 in CITH-Q-22. The values for Hue angle ranged from -86.34 in CITH-Q-25 to 87.13 in CITH-Q-07and the values for color index ranged from -1.64 in CITH-Q- 13 to 2.56 in CITH-Q-22. The maximum value of firmness is 70.57 RI in CITH-Q-02 and a minimum of 50.33RI in CITH-Q- 20.

Photographs of Superior quince genotypes at ICAR- CITH, Srinagar

		
CITH-Q-04	**CITH-Q-08**	**CITH-Q-25**
		
CITH-Q-06	**CITH-Q-25**	**CITH-Q-09**

Apricot

In apricot, 65 varieties/ genotypes were evaluated for various fruit and colour traits. The fruit weight, fruit length, fruit width, fruit thickness varied from 11.23g to 89.97g, 28.03 to 51.95 mm, 26.85 to 57.61 mm, 24.14 to 52.54 mm with minimum value in CITH-AP 31 and maximum in CITH-AP-1. The fruit firmness ranged from 28.47 in CITH- AP-13 to 73.63 in CITH AP -7A while TSS varied from 10.5 ^{0} B in CITH-Ap-9 to 29.57^{0} B in CITH –Ap 36. Similarly, among colour parameters L ranged from 43.95 in New Castle to 75.26 in Yarvani while value of 'a' varied from -3.55 in CITH-AP-7 A to 56.82 in CITH AP-11. Similarly b ranged from 29.46 (Viva Gold) to 56.82 (CITH-AP-11) while value of tint varied between -143.29 (CITH AP 14) to -9.64 (CITH AP 7A). Out of 65 genotypes, 8 genotypes produced fruits having TSS more than 20^{0} B. The henotypes having highest TSS were CITH-AP-11 (22.63), CITH-AP-13 (23.73), CITH-AP-17 (21.33), CITH-AP-24 (20.07), CITH-AP-36 (29.57), CITH-AP-32 A (24.87), CITH-AP-32 B (21.37) and Afgani (20.23). Maximum pulp weight was recorded in CITH-AP-1 while pulp percentage was highest in Heartley and pulp : stone ratio (weight basis) was highest in PAS-1.The stone weight ranged from 1.417 g (CITH-A-35) to 4.937g (CITH-AP-1). Based on yield parameters, highest yield and yield efficiency was recorded as 73.1 kg/ plant and 0.3151 kg/cm ^{2} in CITH AP-1. The top high yielding genotypes during the year were CITH-AP-1, CITH-AP-2, CITH-AP-5, CITH-AP-6, Heartley, New Castle, Nari, Plumcot, PAS-1 and PAS-2. On the basis of yield efficiency, top ten genotypes were CITH-AP-1, CITH-AP-2, CITH-AP-6, CITH-AP-36, plumcot, PAS-2, Turkey, CITH-AP-7, Nari and Erani.

Peach

In evaluation of 34 peach/ nectarine cultivars/ genotypes for bud burst & floral traits, 12 were early (3rd week of March), 21 were mid (4th week of March) and one was late (2nd week of April) for bud burst. Similarly for initiation of flowering (first flower open); 7 were early (3rd week of March), 26 were mid (4th week of March) and 1 was late (2nd week of April). The flowering peak was observed early (last week of March) in 11, mid (1st week of April) in 19 and late (2nd week of April) in 4 varieties/ genotypes. Similarly end of flowering was early (1st week of April) in 8, mid (2nd week of April) in 24 and late (3rd week of April) in 2 varieties/ genotypes. The varieties which were early for initiation of flowering are Early Red June, Early Grande and Shan e Punjab which initiated flowering on 20th March while Glohaven was last to initiate flowering on 11th April).

Among all germplasm, 21 were evaluated for various fruit, colour and stone traits. The fruit weight ranged from 36.7 (Vance Missuri) to 119.33g (Cresthaven), fruit length from 36.40 (Vance Missuri) to 60.58 mm (Quetta), fruit width from 41.54 (Vance Missuri) to 60.81 mm (Red Globe) and fruit thickness from 38.42 (Vance Missuri) to 64.12 mm (Glohaven).The TSS ranged between 10.1 ^{0}B (CITH-P-7& Nimla) to 17.1^0 B in July Elberta while fruit firmness varied between 25.1 (Southland P-2) to 83.5 (Red Globe). Among colour parameters; L varied between 37.1 (Vance Missuri) to 66.1 (CITH-P-2), a from 0.1 (Red Globe) to 28.0 (CITH P-8), 'b' from 16.3 (Vance Missuri) to 45.7 in (CITH P-3) while tint ranged between -16.7 (Red Globe) to 1114.9 (Early Red June. The pulp percentage varied from 85.56 (Vance Missuri) to 97.06 % in Peshawari.

Strawberry

In strawberry, 90 germplasm were evaluated for initiation of flowering and duration of flowering. Out of 90, 75 genotypes initiated flowering in 2nd week of April while 15 genotypes initiated in 3rd week of April. The peak flowering was in 2nd week of April in 4, 3rd week in 84 and 4th week in 2 genotypes. The end of flowering was in 3rd week of April in 10 and 4th week of April in 80 genotypes. The earliest flowering was recorded on 8th April in Gorilla. The duration of flowering varied from 9 days to 15 days. Out of these genotypes 87 were also evaluated for fruit and yield traits. Considerable variations were recorded for various fruit and yield traits among the genotypes. The fruit weight ranged from 3.19g to 23.42g , fruit length from 24.59 mm to 48.67 mm , fruit diameter from 17 mm to 39.2 mm and fruit thickness from 15.3 to 29.7 mm . Among fruit colour parameters, L varied from 20.3 to 50.5, value of 'a' from14.3 to 44.5, 'b' from 15.2 to 38.7 and tint from -67 to -246. The TSS was in the range of 5^0 B to 18^0 B. The number of fruits ranged from 8 to 28. The yield/plant ranged from 43.44g to 455.5 g in Chandler. The top 10 highest yielding genotypes were Chandler, Katrian Sweet , I C 319093, Cammarosa, E C 22355, Sweet Heart, Heera, Douglas, Shasta and Majestic.

Persimmon

In persimmon, two cultivars nameny Hachiya andFuyu were evaluated for physical fruit traits. The fruit weight, length and diameter were 126.52 g, 63.11mm & 61.39mm in cv. Hachiya and 79.67g, 42.64 mm & 56.51 mm in cv Fuyu.

Almond

In almond, 10 cultivars and 20 Selections were evaluated for various traits related to nut and kernel. Among the evaluated almond cultivars the nut weight

ranged from 1.96 (Pranyaj) to 3.06g (California Paper Shell). Similarly the kernel weight varied from 0.84g (Non Pareil) to 1.95 g (Merced) and kernel percentage from 43.37 (Pranyaj) to 61.59 percent (Shalimar).

Merced performed better in respect of physical attributes of nut and kernel. Among the evaluated, almond selections the nut weight ranged from 1.62 (CITH A 22) to 4.29g (CITH A 15). Similarly the kernel weight varied from 0.67g (CITH A 22) to 1.95 g (CITH A 3) and kernel percentage from 27.78 (CITH A 20) to 48.21 percent (CITH A 21).

Walnut

In walnut 246 genotypes/ varieties were evaluated for various nut and kernel traits. Among various parameters, nut weight ranged 7.16 to 25.98g, length from 28.36 to 54.60mm, width from 21.77 to 43.70 mm, thickness from 24.54 to 42.86mm, pad width from 1.96 to 7.66mm, pad thickness from 1.05 to 3.66 m, shell thickness from 0.92 to 3.67 mm, kernel weight from 3.79 to 12.35 mm and kernel percentage from 39.78 to 61.79 percent. The coefficient of variation for these traits was 6.12, 4.10, 4.18, 3.31, 6.67, 7.90, 7.34, 6.18 and 4.87 percent respectively. Among all , 15 varieties/ genotypes produced nuts having weight more than 20g (CITH W 1, CITH W 4, CITH W 1, CITH W 6, CITH W 7, CITH W 22, CITH W 41, CITH W 66, CITH W 88, CITH W 117, CITH W 121, CITH W 123, CITH W 124, CITH W 125, LBT-1 & BSS 1) while the 15 varieties/ genotypes which produced kernel weight more than 10g (CITH W 1, CITH W 6, CITH W 7, CITH W 12, CITH W 22, CITH W 66, CITH W88, CITH W 97, CITH W 118, CITH W 124, YD-1, LBT -1, BSS 1, BSS4 and No 41/2. Among 246 genotypes, 20 genotypes produced nuts having kernel percentage more than 55 per cent (CITH W 23, 48, 53, 54, 58, 67,68,89,93,85,101,105,109,110,65 A,HCB 3, BC 1, LBT 1, NB 2 and Shalimar 2.) .

The observation on female flowering was recorded for 225 genotypes and frequency of the genotypes in different groups were 17.77 % in early (4th week of March (63.55 % in mid (1st week of April), 13.33 % in late (2nd week of April) and 5.33% were very late (3rd week of April). Simalarly for male flowering, 223 genotypes were observed and 0.44% were extra early (1st week of March), 23.31 were very early (4th week of March), 30.49 % were early (1st week of April), 33.18 % were mid (2nd week of April), 12.10 % (3rd week of April) were late and 0.44 % were very late (4th week of April).

The brancing density is an important trait especially in the terminal bearing genotypes and contributes significantly for yield. Walnut genotypes having more branching density (8 or more) were CITH W 5, CITH W 15, CITH W 47, CITH W 59, CITH W 62, CITH W 69, CITH W 73, CITH W 79, CITH W 83, CITH

W 85, CITH W 88, CITH W 95, CITH W 105, CITH W 112, CITH W 114, CITH W 120, PTS-5, 45/1, PB-1, Shalimar 2, PSB, Tutle & Opex Caultuary.

Pistachio Nut

In Pistachio, there are 6 female and two male selection and out of these six female selections, CITH Pistachio 2 and CITH Pistachio 6 produced more blank nuts (68% & 76%, respectively) 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 3, CITH Pistachio 4 & CITH Pistachio 5. The heaviest nut and kernels (0.750g & 0.33 g) were produced by CITH Pistachio 1 while kernel percentage was maximum (51.2%) in CITH Pistachio 4.

Hazelnut

In hazelnut, nine cultivars were evaluated and significant differences were recorded
for most of the physical nut parameters. Nut weight ranged from 2.40g (Segorbe) to 3.23 g (Tonda Romana). Maximum nut length (22.07 mm), nut width (20.23 mm) and nut thickness (17.32 mm) were recorded in cultivar Morville, Tonda Romana and Fertila respectively

Pecan

In pecan, three seedling selections fruited and nut parameters like nut weight, nut width, nut thickness and shell thickness were 3.94g, 27.38mm, 19.25mm,20.68 mm &1.02mm in Selection 1, 2.59g, 26.45 mm, 16.07mm, 16.43 mm & 1.0 mm in Selection 2 and 4.51 g, 27.55mm, 19.47 mm, 19.89mm &1.14mm in Selection 3, respectively. The kernel weight and kernel recovery was recorded at the tune of 2.01 g & 50.98 % in Selection 1, 1.28g & 47.76 % in Selection 2 and 1.94 g &43.11 % in Selection 3, respectively.

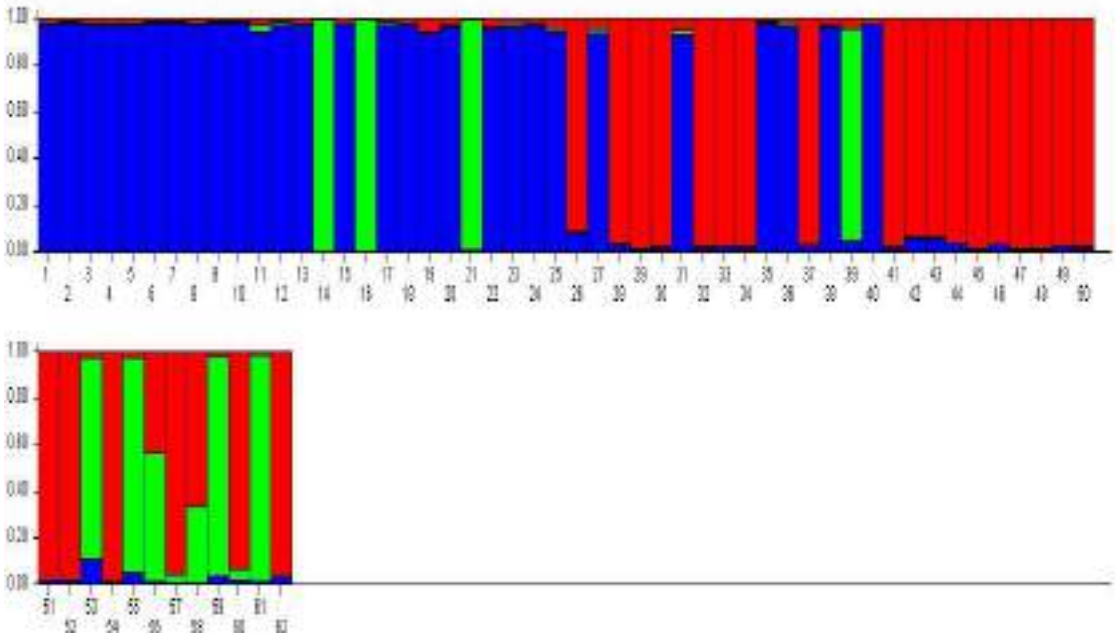
Vegetable Crops

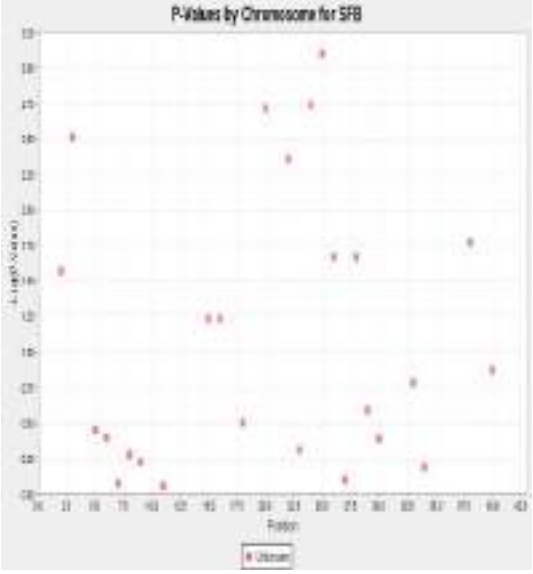
Survey, collection, characterization and documentation of temperate horticultural crops

Kale, pea, root vegetables and exotic vegetables were maintained and evaluated under field conditions. Fifty eight genotypes of kale were evaluated against 4 checks. Leaf yield of the germplasm ranged from 111.50 q/ha to 521.50 q/ha, leaf length from 13.88 cm to 27.04 cm and leaf width from 9.53 cm to 22.37 cm. NW-Saag-27 expressed highest leaf yield.

SSR genotyping of kale germplasm comprising 62 lines was done with 46 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 22 traits. Marker-trait association was performed by using Tassel 4.0. and fourteen markers were found associated with different traits. Eleven of these markers were detected to be associated with 6 agronomic traits at either $p<0.01$ % or $p<0.05$ %. At 1 % level of significance, markers were associated with Days to Maturity, Plant Height and Number of Leaf Lobes. At 5 % level of significance, marker associations were found for Number of Leaf Lobes, Number of Seeds per Siliqua, Size of Floral Buds and Siliqua Length. The population structure analysis has categorized the germplasm into 3 sub-populations. The study is under progress with inclusion of more markers for obtaining better population structure estimates and marker – trait association.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.

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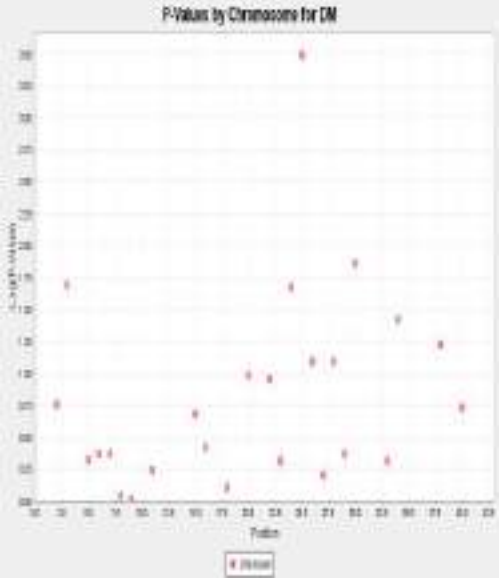
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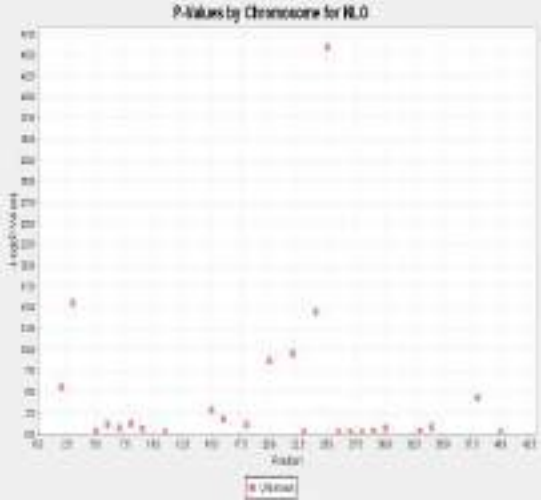
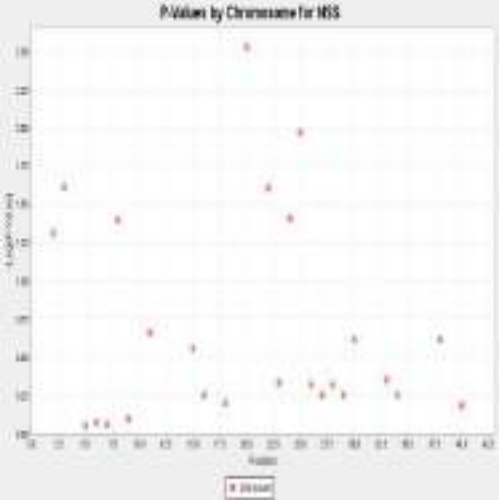
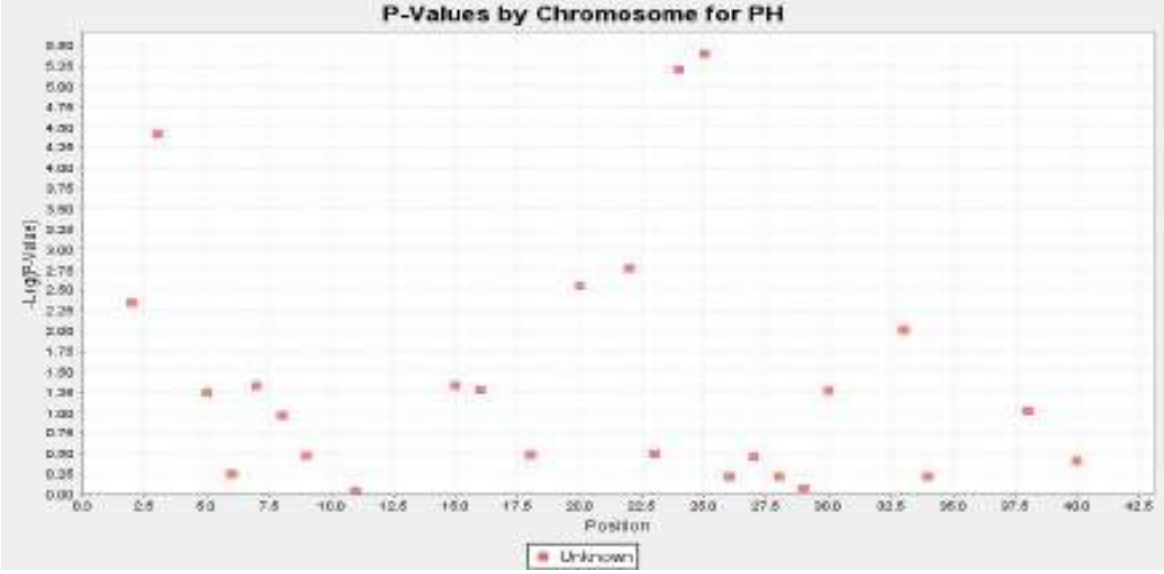

P-Values by Chromosome for NLO


P-Values by Chromosome for NSS


P-Values by Chromosome for PH
-Log(P-Value)
Position
Unknown

Among root crops, 3 genotypes of radish, namely, CITH-R-5, CITH-R-6 and Scarlet Globe were evaluated along with two checks Palam Hriday and Japanese White Long. Root yield of 205.70 q/ha to 378.16 q/ha was observed in Japanese White Long having statistically highest yield. The following table illustrates the performance of radish germplasm.

Table-4: Evaluation of radish germplasm

Genotypes evaluated	Root yield (q/ha)	Root length (cm)	Root diameter (cm)	Root type
CITH-R-5	210.12	6.12	7.29	Red globe
CITH-R-6	217.94	5.95	7.38	White globe
Scarlet Globe	205.70	2.94	3.38	Red globe
Japanese White Long (C)	378.16	24.37	2.75	White tapering
Palam Hriday (C)	320.62	6.61	3.72	Green white oval
CD (p<0.05)	*37.070*	*3.156*	*0.994*	-

In turnip, 18 lines including 3 checks Pusa Swarnima, Pusa Chandrima and Nigeen-1 were assessed for root yield (q/ha), root length (cm) and root diameter (cm). None of the lines performed statistically superior to best check Pusa Chandrima (357.78 q/ha).

Table-5: Evaluation of turnip Germplasm

S. no.	Genotypes evaluated	Root yield (q/ha)	Root length (cm)	Root diameter (cm)
1	**CITH-T-1**	343.78	4.63	7.49
2	**CITH-T-2**	255.11	4.70	5.57
3	**CITH-T-3**	236.44	5.09	5.61
4	**CITH-T-4**	323.56	4.55	7.00
5	**CITH-T-6**	348.44	6.73	7.35
6	**CITH-T-8**	205.33	4.36	5.40
7	**CITH-T-White Flat**	329.78	6.61	7.34

8	**CITH-T-Green Top**	353.11	6.20	6.89
9	**CITH-T-Sel-1**	373.33	6.11	8.30
10	**CITH-T-Sel-2**	336.78	6.64	6.90
11	**PTWG**	350.00	6.32	7.21
12	**PTWG-Flat selection**	365.56	5.04	9.54
13	**PSB**	362.44	5.57	6.80
14	**PS x PTWG**	262.89	5.37	6.15
15	**PT x PC**	357.77	6.74	7.18
16	**Pusa Swarnima (C)**	189.78	4.67	5.45
17	**Pusa Chandrima (C)**	357.78	5.88	7.08
18	**Nigeen-1 (C)**	334.44	7.11	6.29
CD (p< 0.05)		*110.35*	*0.802*	*1.183*

Among leafy, exotic and *Brassica* crops, Chinese cabbage line CITH-CC-1 expressed 413.00 q/ha of net head yield. The head height was recorded as 23.96 cm, head width 16.81 cm, net head weight if 1.239 kg and TSS was 4.63 %. Broccoli line CITH-Broccoli-1 gave net head yield of 198.06 q/ha with a head height of 12.30 cm, head width of 14.93 cm, net head weight of 0.475 kg, TSS of 11.87 %, plant height of 73.07 cm and plant spread of 73.97 cm. In cabbage, the following traits were evaluated in Golden Acre and CITH-Cabbage Hybrid-1.

Table-6: Evaluation of Golden Acre and CITH-Cabbage Hybrid-1 for yield and related traits

	Head height (cm)	**Head width (cm)**	**Net head weight (Kg)**	**Net head yield (q/ha)**	**TSS (%)**
CITH-Cabbage Hybrid-1	14.12	14.37	0.945	346.65	9.25
Golden Acre	15.00	12.84	1.074	358.07	8.39
Critical difference	*NS*	*NS*	*NS*	*NS*	*0.653*

ICAR-CITH, Regional Station, Mukteshwar

The project survey, collection, maintenance and evaluation of temperate fruits is also going on at ICAR-CITH, RS Mukteshwar.

The collection of germplasm was carried out in the form of plants/ scion wood/ runners in various crops like apple, pear, peach, plum, apricot, walnut, strawberry and chestnut and about 90 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, 17 apple cultivars were evaluated for and maximum fruit weight (181.90 g) and fruit volume (185 mm) was recorded in Oregon Spur, respectively. The maximum fruit firmness (12.06 mm), T.S.S. (15.06 °B), acidity (1.20 %), ascorbic acid (67.26 mg/100g), reducing sugar (4.63 %) and total sugar (7.84 %) were recorded in different apple cultivars. In peach, total eight cultivars namely Red June, FLA-16-33, Flordasun, Flordaking, Reliance, Rio-Oso-Gem, Red Nectarine & Paradelux were evaluated and maximum fruit weight (184.01 g), fruit volume (194 mm), fruit diameter (68.70 mm), fruit length (69.77 mm) and acidity (2.27 %) were recorded in Red June and the maximum T.S.S. (13.13 °B) and total sugar (6.32 %) were recorded in Paradelux and Reliance as compared to other peach cultivars, respectively.

In plum, total six cultivars were evaluated and based on the physico-chemical characteristics of fruits, the highest fruit weight (52.65 g), T.S.S. (13.13 °B) acidity (2.21 %), ascorbic acid (30.90 mg/100g) were reported in Late Plum, Satsuma, Santa Rosa and Ramgarh Monarch as compared to other plum cultivars respectively. In apricot, total four cultivars evaluated and fruit weight (50.59 g), TSS (13.10 °B), ascorbic acid (23.63 mg/100g) and total sugar (9.34 %) were found in Gola as compared to other apricot cultivars. In pear, total three germplasm *i.e.*, Jagnel Sunkiya, Kakriya Sunkiya-1 and Kakriya Sunkiya-2 were evaluated and maximum fruit weight (258.40 g) and total sugar (4.43 %) was recorded in Kakriya Sunkiya-1 whereas, maximum TSS (13.13°B) and ascorbic acid (26.36 mg/100g) was recorded in Jagnel Sunkiya and Kakriya Sunkiya-2 as compare to other germplasm respectively.

In kiwifruit, five cultivars were evaluated for physico-chemical characteristics and Hayward and Allison were found superior in as compared to other cultivars. In strawberry nine cultivars were evaluated and based on the physico-chemical characteristics of fruits, the highest fruit weight (12.54 g) and TSS (10.36 ^{0}B) were reported in Pajaro as compared to other genotypes.

Vegetables

In cherry tomato, total twelve germplasm were evaluated under polyhouse at ICAR- CITH, Regional Station, Mukteshwar. Among all genotypes, the maximum plant height was recorded in CT-4 (286.20 cm) followed by CT-7 (280.70 cm), Manisha (277.00 cm) and CT-8 (264.40 cm) respectively. The highest total soluble solid was recorded in CT-5 (8.9 °B) followed by CT-8 (8.6 °B), CT-4 (8.5 °B) and CT-6 (8.1 °B) respectively. The maximum anti-oxidant, ascorbic acid, reducing sugar and total sugar was recorded in CT-1 (1.603 %), CT-8 (55.44 mg/100g), CT-4 (2.381 %) and CT-7 (5.155 %) respectively. The highest yield was recorded in VL-4 (33.972 q/ha) followed by Manisha (31.792 q/ha), CT-2 Red (25.618 q/ha), CT-9 (22.931 q/ha) and CT-8 (22.208 q/ha) respectively.

In capsicum, total seven genotypes were evaluated for their growth & yield and among all genotypes, the highest plant height (135.10 cm), number of branches/plant (6.3) and TSS (9.3 °B) w recorded in Paprika. The highest yield was recorded in VLSM-3 (310.30 q/ha) followed by CITH SEL-5 (235.00 q/ha), CITH SEL-7 (191.96 q/ha), CITH SEL-6 (186.17 q/ha) and CITH SEL-2 (159.39 q/ha), respectively.

In garlic, total six genotypes were evaluated and maximum plant height was observed in SEL-7 (40.8 cm) followed by SEL-11 (40.3 cm), SEL-12 (36.8 cm), SEL- 10 (32.0 cm) and CITH-MG-1 (31.6 cm) respectively. However, maximum leaf length was recorded in SEL-7 (25.3 cm) while maximum leaf width was recorded in SEL-6 (2.2 cm). The maximum number of leaves/plant was recorded in CITH-MG-1 & SEL-12 (9.3 leaves). The highest total soluble solid was recorded in SEL-10 (36.0 °B) followed by SEL-7 (35.0 °B), SEL-12 (34.4 °B) and SEL-11 (33.4 °B) respectively. The highest yield was recorded in CITH-MG-1 (100.0 q/ha) followed by SEL-7 (65.7 q/ha), SEL-12 (60.0 q/ha), SEL-10 (57.5 q/ha) and SEL-6 (49.7 q/ha) respectively.

ICAR-CITH, Regional Station, Dirang

Survey collection and evaluation of temperate fruits in North Eastern States of India

The land was by ICAR-CITH taken over from RAN, Dirang during last year and work was although started earlier years and strengthened this year by planting of mother blocks and start of fruit plants nursery in which sufficient material of temperate fruits were grafted.

During the year 2021, The exploration and collection of wild species temperate fruit crops in West Kameng Districts of Arunachal Pradesh was carried out and 7 accessions were collected from different locations at Shergoan, Dirang and adjoining areas West Kameng District, Arunachal Pradesh. The preliminary survey revealed the information regarding the presence of wild specieswhich seems to belonging to *Malus* and *Actinidia* and will be verified in future after through taxonomic studies. The physico- chemical performance of these wild fruits has also been recorded (Table-7).

Table-7*:-Malus species* collected from different locations of west Kameng District of Arunachal Pradesh.

Scientific name: *Malus Skimensis* Family: Rosaceae	Location: Shergaon 790002 Altitude 1950 m a.s.l N 27°8′16.60704″(latitude) E 92°16′12.38556″(longitude) Date: 10/07/21 Tim: 11.12 AM	
	Location: Shergaon 790002 Altitude 1946 m a.s.l N 27°8′24.15912″(latitude) E 92°16′11.44056″(longitude) Date: 12/10/21 Time: 11.01 AM	

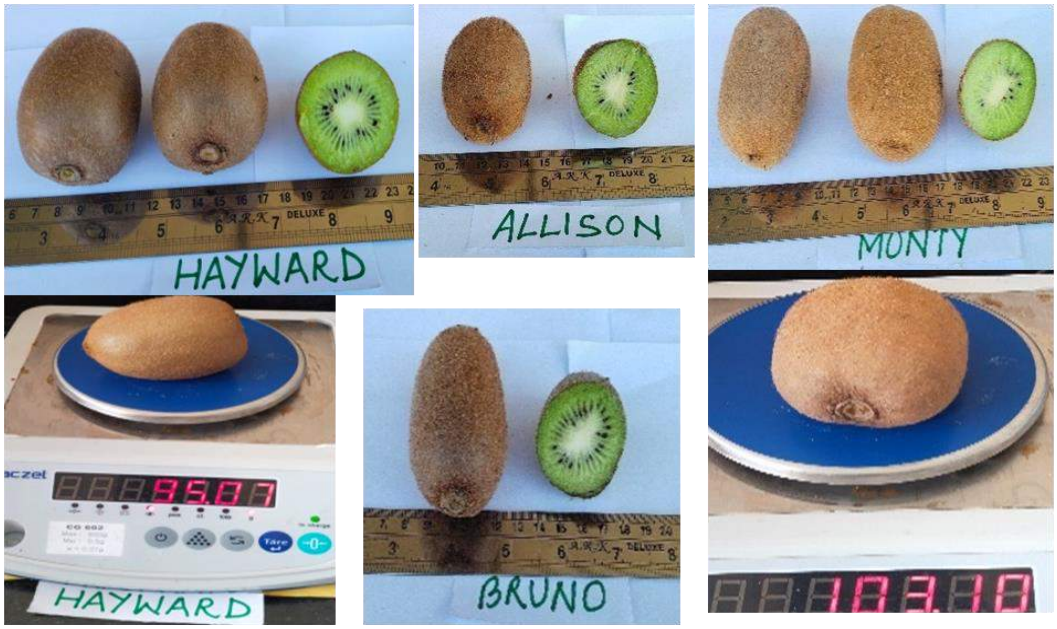
	Location: Shergaon 790002 Altitude 1950 m a.s.l N 27°8′18.31668″(latitude) E 92°16′12.56664″(longitude) Date: 12/10/21 Time: 11.54 AM	
	Location: Shergaon 790002 Altitude 1955 m a.s.l N 27°8′3.11568″(latitude) E 92°15′57.46608″(longitude) Date: 12/10/21 Time: 11:34 AM	
	Location: Shergaon 790002 Altitude 1950 m a.s.l N 27°8′18.52512″(latitude) E 92°16′13.69416″(longitude) Date: 12/10/21 Time: 11.44 AM	

Table-8*:-Actinidia species* collected from different locations of west Kameng District of Arunachal Pradesh

Common name: Wild kiwi Scientific name: *Actinidia callosa* L Family: Actin idiaceae 	Location: Bomdila 790001 Altitude 2184 m a.s.l N 27°15′40.6764″ (latitude) E 92°24′52.01424″ (longitude) Date: 10/07/21	
	Location: Yewang 790101 Altitude 1727 m a.s.l N 27°21′17.58528″(latitude) E 92°14′10.3758″(longitude) Date: 10/03/21 Time: 11:20 AM	

Evaluation of kiwifruit cultivars at ICAR CITH RS Dirang West Kameng, Arunachal Pradesh

Physico-chemical performance of four kiwi varieties i.e. Hayward, Allison, Bruno and Monty established at ICAR CITH RS Dirang was studied and it was found that cultivar Bruno matures early in the season followed by Allison, Monty and Hayward. The highest fruit weight (89.65g) was recorded in Monty and lowest (65.58g) in Allison. The highest TSS was found in cultivars Monty (14.93 ^{o}B), while the lowest was recorded in Bruno having TSS (11.06 ^{o}B).



Pic: Different cultivars of Kiwifruit established at ICAR CITH, RS Dirang.

Evaluation of different cultivars of Persimmon at ICAR-CITH-RS Dirang, West Kameng, Arunachal Pradesh

Evaluation of two varieties Hachiya (astringent) and Fuyu (non-astringent) of persimmon were evaluated and maximum fruit weight, fruit length and fruit diameter were recorded in the cultivar Hachiya while their lowest value was recorded in the cultivar Fuyu. Similarly highest TSS was found in Hachiya and lowest found in Fuyu.

Pic: Different cultivars of Persimmon established at ICAR CITH, RS Dirang.

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

Apple

During 2021, evaluation of apple hybrids obtained from previous crosses was done to identify the superior hybrids with respect to traits like scab resistance, fruit quality, pollinizer ability etc. Six identified apple hybrids were again evaluated for fruit quality traits *viz* antioxidative and free radical scavenging potential. Studies revealed that superior quality parameters with respect to TSS, acidity, ascorbic acid content, fruit weight and bioassays were obtained in hybrids with respect to their parents. Three hybrids, Priame (Prima X Ambri), Pride (Prima x Red Delicious) and Pritor (Prima x Top Red) were selected based on presence of *Vf* gene responsible for inducing scab resistance in these hybrids. These hybrids were evaluated for scab resistance through molecular and pathological means and were found scab resistant. Two hybrids, Ammol (Ambri x Mollies Delicious) and Ambrit (Ambri x Top Red) were developed as improvements of fruit quality in Ambri. Hybrid Golden Snow (Golden Delicious x Snow Drift) was developed as an improvement of fruit quality in Golden Delicious as a pollinizer. Highest fruit weight was observed in Golden Delicious x Snow Drift (232 g) followed by Prima x Ambri (192 g) which is significantly higher than their respective parents. Hybrid Priame (Prima x Ambri) is showing higher crop density, TSS, fruit weight and anti-oxidative potential over their parents in addition to scab resistance owing to presence of resistant gene analogue "*Vf*". Similarly scab resistant hybrid Pride (Prima x Red Delicious) posses higher fruit quality parameters viz a viz free radical scavenging potential. Ammol (Ambri x Mollies Delicious) and Amrit (Ambri x Top Red) do not have scab resistance but have better quality traits over their respective parents. Pritor (Prima x Top Red) is having scab resistant gene with better quality fruits having higher fruit size, TSS, firmness and phenol content with respect parents (Table ----). Two hybrids have been registered through ICAR-NBPGR, New Delhi and INGR numbers were obtained. 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.

Mutation breeding in apple cultivar Ambri

Physical and chemical mutagenesis has been exploited in fruits for inducing desirable characteristics viz; fruit colour, fruit size, blooming time etc. The indigenous apple variety Ambri posses' desirable characteristics like long shelf life and aroma but the colour the colour development is poor which restricts its consumer acceptance and market demand. Hence to bring about improvement in colour the technique of physical and chemical mutations was applied. For physical mutations, 250 Ambri sticks with around 830 buds were irradiated with gamma radiation of dosage 20 Gy for 25 min at BARC centre, Zakura in the month of September and for chemical mutations 50 Ambri sticks with 204 buds were treated with 1% EMS for 6 hours. Both the physical and chemically treated material was then grafted on M9 Pajam-1 rootstock. The technique is expected to produce a positive bearing on fruit colour apart from other desirable traits like fruit size, fruit texture, fruit ripening and so forth which will be evaluated in the subsequent years.

Hybrid and mutant populations (Pre-breeding/breeding populations) developed have been grafted on precocious M9 clonal rootstocks for inducing precocity are being maintained and evaluated for different traits. Development of linkage map and QTL analysis will be done in these populations for identification and validation of trait linked makers/QTLs to be utilized for further crop improvement studies

Improvement of Ambri apple cultivar through mutation (gamma radiation and EMS) has been taken up with the objective for improvement of colour. About 4000 buds each were treated with different doses of EMS and Gamma radiation for generating the mutant population. These treated buds were budded on M-9-Pajam-I clonal rootstocks. Feathering has been induced in these plants by applying BAP during May, 2021 to induce precocity for early evaluation of mutant population. Radiation and chemical treatment (EMS) is proven as an effective method to increase the genetic variation within the species.

Almond

Under almond breeding programme crossing was done 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 include:

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

The hybrid seeds obtained from the crosses were harvested and kept for stratification and sowing in coming season.

Table-9: Physico-chemical and Biological Analysis of Hybrids developed at ICAR-CITH, Srinagar

Parameters	Prima x Ambri (Priame)	Ambri x Mollies Delicious (Ammol)	Ambri x Top Red (Amrit)	Prima x Red Delicious (Pride)	Golden Delicious x Snow Drift (Golden Snow)	Prima x Top Red (Pritor)	Prima	Ambri	Mollies Delicious	Top Red	Red Delicious	Golden Delicious	Snow Drift
Weight (g)	192^{a}	150^{c}	130de	132de	232^{a}	180^{b}	120^{e}	140^{d}	135^{d}	100^{f}	146^{cd}	130de	175^{b}
TSS (%)	19.5^{a}	15^{c}	17.0^{b}	17.4^{b}	17.0^{b}	17.5^{b}	12.5^{d}	14.2^{cd}	14.5^{cd}	15.4^{c}	14.5^{cd}	15.0^{c}	13.8^{d}
Firmness (RI)	70.0^{a}	58.0^{c}	66.6^{b}	65.4^{b}	72.4^{a}	70.5^{a}	60.0^{b}	65.0^{b}	56.0^{c}	54.0^{c}	65.0^{b}	65.0^{b}	60.0^{b}
Acidity (%)	0.26^{a}	0.23^{a}	0.24^{a}	0.30^{a}	0.21^{a}	0.25^{a}	0.25^{a}	0.30^{a}	0.25^{a}	0.23^{a}	0.23^{a}	0.30^{a}	0.29^{a}
Ascorbic Acid (%)	12.72^{a}	10.90^{c}	10.53^{c}	11.28^{b}	11.32^{b}	9.15^{d}	9.22^{d}	11.1^{b}	11.71^{b}	8.92^{d}	11.72^{b}	10.25^{c}	11.70^{b}
Phenols (mgGAE/100g FW)	167.22^{c}	148.68^{e}	203.11^{a}	165.33^{c}	254.66^{a}	212.13^{a}	166.4^{c}	192.2^{b}	136.08^{cd}	114.6^{d}	144.3^{e}	196.08^{b}	226.15^{a}
Flavonoids (mg QE/100g FW)	160.1^{ab}	118.2^{c}	187.2^{ab}	131.2^{c}	214.4^{a}	200.2^{a}	110.1^{c}	138.9^{b}	142.6^{b}	198.0^{a}	115.2^{c}	177.9^{a}	188.34^{a}
Flavonols (mg QE/100g FW)	1.34^{d}	1.48^{cd}	2.21^{a}	1.89^{b}	1.79^{b}	1.36^{d}	1.84^{b}	1.56^{c}	1.11^{e}	1.65^{c}	1.22^{e}	2.23^{a}	2.64^{a}
DPPH (µM AAE/g FW)	23.22^{c}	28.44^{b}	18.33^{d}	23.31^{c}	32.12^{a}	18.56^{d}	20.45^{d}	19.56^{d}	27.89^{b}	20.56^{d}	28.78^{b}	17.44^{d}	28.66^{b}
FRAP (µM $FeSO_4$/100g FW)	192.65^{c}	224.56^{a}	182.23^{c}	163.17^{d}	142.12^{d}	134.87^{e}	186.21^{c}	177.87^{cd}	103.23^{f}	130.12^{e}	105.67^{f}	204.22^{b}	170.23^{cd}

Apple Hybrids developed and Identified for release

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

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

<table>
<tr><th colspan="3">Ambri improvement with respect to quality and scab resistance</th></tr>
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td>Ammol (Ambri x Mollies Delicious)
- Fruit quality/Early maturity</td><td>Ambrit (Ambri x Top Red) – High yield, bearing habit</td><td>Priame (Prima x Ambri) – Scab resistance</td></tr>
<tr><th colspan="2">Introgression of scab resistance in other commercial cultivars</th><th>Quality improvement</th></tr>
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td>Pride (Prima x Red Delicious)– Scab resistance</td><td>Pritor (Prima x Top Red) - Scab resistance</td><td>Golden Snow (Golden Delicious x Snow Drift)– Quality improvement in Golden Delicious</td></tr>
</table>

1. **PRIAME (Prima X Ambri)**

Priame is hybrid between Prima and Ambri. It matures one week later than Prima but two months prior to Ambri *i.e.*, in 2nd week of August. It is scab resistance due to presence and expression of Vf (Rvi6) gene. It produces larger fruits (192 g) than parents Prima (120 g) and Ambri (140 g) with moderate acidity (0.26%). Fruits have higher TSS (19.5°B) than Prima (12.5 °B) and Ambri (14.2 °B). Firmness of fruits is also higher (70 RI) than Prima (60 RI) and Ambri (65 RI) which contributes to higher shelf life. Fruits have higher phytoanticipins having 167 mgGAE/100g FW phenols, 160 mg QE/100g FW flavonoids and 1.34 mg QE/100g FW flavanols. The anti-oxidative and free radical scavenging potential is significantly higher than parents. The DDPH activity of hybrid is 23.22 µM AAE/g FW against Prima (20.45 µM AAE/g FW) and Ambri (19.56 µM AAE/g FW) and FRAP activity is 192.65 µM FeSO4/100g FW in comparison to Prima (186.21 µM FeSO4/100g FW) and Ambri (177.87 µM FeSO4/100g FW). Thus, in addition to Resistant Gene Analog (Vf gene) this hybrid posses' additional resistance due to presence of higher phytoanticipins

2. **PRIDE (Prima X Red Delicious)**

Pride is hybrid between Prima and Red Delicious. It matures ten days later than Prima but forty days prior to Red Delicious (i.e., in 3rd week of August). Scab resistance is due to presence and expression of Vf (Rvi6) gene. Fruit size is moderate (132 g) with respect to parents Prima (120 g) and Red Delicious (146 g) with moderate acidity (0.30%). Fruits have higher TSS (17.4°B) than Prima (12.5°B) and Red Delicious (14.5°B). Firmness of fruits is also higher (65.4 RI) than Prima (60 RI) and Ambri (65.0 RI) which contributes to its higher shelf life. Fruits have higher phytoanticipins having 165.33 mgGAE/100g FW phenols, 131.2 mg QE/100g FW flavonoids and 1.89 mg QE/100g FW flavanols. Anti-oxidative and free radical scavenging potential is moderate. DDPH activity of hybrid is 23.31 µM AAE/g FW against Prima (20.45 µM AAE/g FW) and Red Delicious (28.78 µM AAE/g FW) while FRAP activity is 163.17 µM FeSO4/100g FW in comparison to Prima (186.21 µM FeSO4/100g FW) and Red Delicious (105.667 µM FeSO4/100g FW).

3. **AMMOL (Ambri x Mollies Delicious)**

Ammol is hybrid between Ambri and Mollies Delicious. It matures three weeks later than Mollies Delicious and forty days prior to Ambri *i.e.* in 4th week of August. Fruit size is higher (150 g) than parents Ambri (140 g) and Mollies Delicious (135 g) with moderate acidity (0.23%). Fruits have higher TSS (15°B) than Ambri (14.2°B) and Mollies Delicious (14.5°B).

Firmness of fruits is lower (58 RI) than Ambri (65 RI) but higher than Mollies Delicious (56 RI). Fruits have moderate phytoanticipin content, having 148.68 mg GAE/100g FW phenols, 118.2 mg QE/100g FW flavonoids and 1.48 mg QE/100g FW flavanols. Anti-oxidative and free radical scavenging potential is significantly higher. DDPH activity of hybrid is 28. 44 µM AAE/g FW against Ambri (19.56 µM AAE/g FW) and Mollies Delicious (27.89 µM AAE/g FW) and FRAP activity is 224.56 µM FeSO4/100g FW in comparison to Ambri (177.87 µM FeSO4/100g FW) and Mollies Delicious (103.232 µM FeSO4/100g FW).

4. AMRIT (Ambri x Top Red)

Amrit is hybrid between Ambri and Top Red. It matures one week after Top Red and two weeks before Ambri *i.e.,* in last week of September. Fruit size is moderate (130 g) than parents Ambri (140 g) and Top Red (100 g) with moderate acidity (0.24%). Fruits have higher TSS (17^{o}B) than Ambri (14.2^{o}B) and Top Red (15.4 ^{o}B). Firmness of fruits is high (66.6 RI) as Ambri (65 RI) than Top Red (54 RI). Fruits have higher phytoanticipin content, having 203.11 mg GAE/100g FW phenols, 187.2 mg QE/100g FW flavonoids and 2.21 mg QE/100g FW flavanols. Anti-oxidative and free radical scavenging potential is moderate. DDPH activity of hybrid is 18. 33 µM AAE/g FW against Ambri (19.56 µM AAE/g FW) and Top Red (20.56 µM AAE/g FW) while FRAP activity is 182.23 µM FeSO4/100g FW in comparison to Ambri (177.87 µM FeSO4/100g FW) and Top Red (130.12 µM FeSO4/100g FW).

5. GOLDEN SNOW (Golden Delicious X Snow Drift)

Golden Snow is hybrid between Golden Delicious and Snow Drift. It possesses pollinizer ability/ quality of Golden Delicious and russeting tolerance from Snow Drift. It is late in maturity (three weeks after Snow Drift and 50 days before Golden Delicious i.e., in first week of October. Fruits are larger in size (232g) than parents Golden Delicious (130 g) and Snow Drift (175 g) with moderate acidity (0.21%). Fruits have higher TSS (17^{o}B) than Golden Delicious (15^{o}B) and Snow Drift (13.8 ^{o}B). Firmness of fruits is higher (72.4 RI) than Golden Delicious (65 RI) and Snow Drift (60 RI). Fruits have higher phytoanticipin content, having 254.66 mg GAE/100g FW phenols, 214.4 mg QE/100g FW flavonoids and 1.79 mg QE/100g FW flavanols. Anti-oxidative and free radical scavenging potential is very high. DDPH activity of hybrid is 32.12 µM AAE/g FW against Golden Delicious (17.44 µM AAE/g FW) and Snow Drift (28.66 µM AAE/g FW) while FRAP activity is 142.12 µM FeSO4/100g FW in comparison to Golden Delicious (204.22 µM AAE/g FW) and Snow Drift (170.23 µM AAE/g FW).

6. PRITOR (Prima x Top Red)

Pritor is hybrid between Prima and Top Red. The scab resistance is due to presence and expression of Vf (Rvi6) gene. Maturity time is similar to Top Red but seven-eight weeks after Prima i.e., in 3rd week of September. Fruit size is higher (180g) than parents Prima (120 g) and Top Red (100 g) with moderate acidity (0.25%). Fruits have higher TSS (17.5°B) than Prima (12.5°B) and Top Red (15.4°B). Firmness of fruits is higher (70.5 RI) than Prima (60 RI) and Top Red (54 RI). Fruits have higher phytoanticipin content, having 212.13 mgGAE/100g FW phenols, 200.2 mg QE/100g FW flavonoids and 1.36 mg QE/100g FW flavanols. Anti-oxidative and free radical scavenging potential is moderate. DDPH activity of hybrid is 18.56 µM AAE/g FW against Prima (20.45 µM AAE/g FW) and Top Red (20. 56 µM AAE/g FW) and FRAP activity is 134.87 µM FeSO4/100g FW in comparison to Prima (186.21 µM AAE/g FW) and Top Red (130.12 µM AAE/g FW).

Germination of hybrid seeds (>20000)

Raising of seedlings (>15000)

Grafted plants of crosses for evaluation (>10000)

Grafted plants of identified hybrids for mother block establishment (>500)

Fig-5: Maintenance of hybrid breeding/pre-breeding populations in the field

Walnut

During 2021, hybridization work was carried out to combine various traits like nut size, bearing potential, kernel traits etc. Total 9 cross combinations were tried and various crosses attempted were CITH-W 4 X CITH-W 121, CITH-W 1 X CITH-W 121, CITH-W 121 X CITH-W 4, Opex Caultuary X CITH-W 121 , Opex Caultuary X CITH-W 4 , Serr X CITH W 121, Serr X CITH 4, Franquette X CITH W 12, and Franquette X CITH W 4. The nuts of crosses were harvested, stratified and sown in nursery for further evaluation.

Pear

In pear improvement program, during the year 2021, 1152 crosses were attempted. The crossing was done using four parents including Badshah Nakh (BN), Max Red Bartlett (MR), Kashmiri Nakh (KN), Sand Pear (SP) and Starkrimson (ST), and Carmen (CM). Among the crosses performed the fruit set success percentage ranges from 8.33% (Badshah Nakh x Max Red Bartlett) to 28.30per cent (Badshah Nakh x Starkrimson. The population obtained from the previous year's crosses has been grafted of BA 29 C rootstock in the field for further evaluation and some of the hybrids will come to the bearing during the coming years.

Evaluation of Pear hybrids in field for quality at ICAR CITH Srinagar

Table-10. Fruit set percentage in different cross combinations in pear

Crosses	Percent Fruit set
Badshah Nakh x Max Red Bartlett	8.33
Badshah Nakh x Sand Pear	9.34
Badshah Nakh x Starkrimson	28.30
Badshah Nakh x Carmen	17.31
Badshah Nakh x Max Red Bartlett	11.79
Max Red Bartlett x Carmen	18.33
Max Red Bartlett x Starkrimson	19.44
Kashmiri Nakh x Carmen	1.59

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

Transcriptome analysis in almond genotypes at flowering stage: Functional Annotation of Predicted CDS

Transcriptome analysis of almond genotypes was done at flowering stage (pop corn stage of flowering) to identify the genes responsible for flowering time and other important metabolic pathways. The protein sequences corresponding to the predicted coding regions within the unigenes were subjected to similarity search against NCBI's non-redundant (nr) database using the BLASTP algorithm with an e-value threshold of 1e-5. The statistics of blast annotation are shown in Table –

Table-11: Blast statistics against NR database

Sample Name	Total CDS	# CDS with Hits	# CDS with No Hits
Complete CDS	52305	46482	5823

The top-hit species distribution revealed that majority of the hits was found to be against the species *Prunus dulcis* followed by *Prunus persica* and *Prunus armeniaca* (Fig-6).

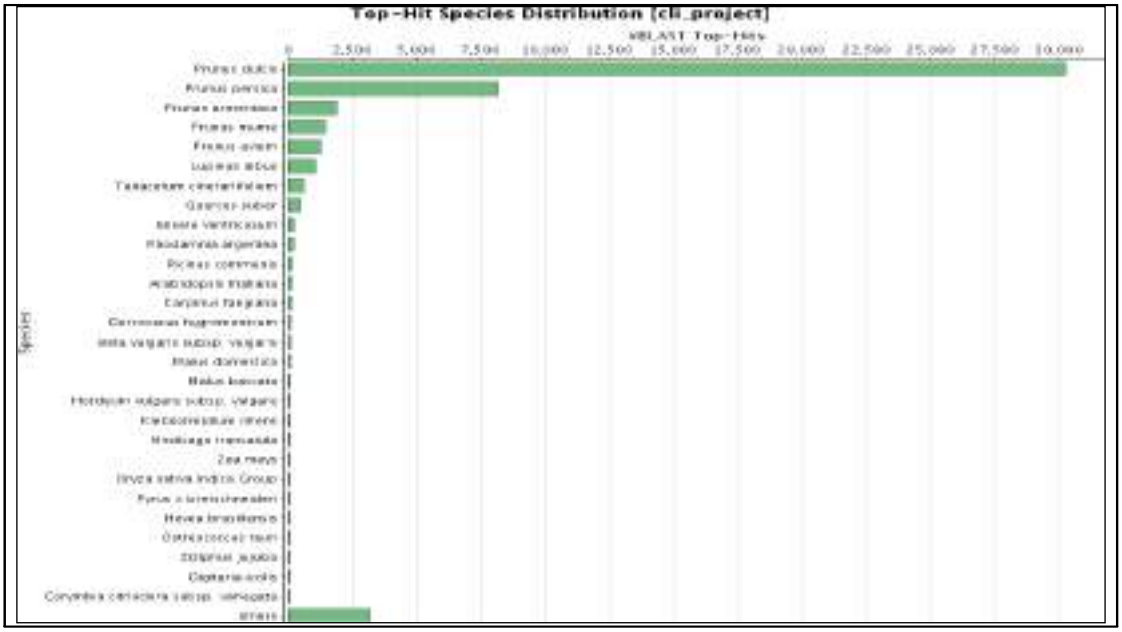


Fig -6 : Top hit species distribution

All protein sequences were searched for similarity against Uniprot, KOG and Pfam database using BLASTP with an e-value threshold of 1e-5. Results for similarity search against all 4 databases shown in Table –. KOG analysis showed that most enriched KOG category was “Signal transduction mechanisms (T)” followed by “General function prediction only (R)” and "Posttranslational modification, protein turnover, chaperones (O)” (Fig-7). In Pfam analysis, most abundant domains identified were representing “Protein kinase domain” followed by “Protein tyrosine kinase”.

Table12: Blast statistics against NR, Uniprot, KOG and Pfam database

Blast Database	**# Hits in database**
Total	52305
NR	46482
Uniprot	37596
KOG	22352
Pfam	23856
Annotated in all 4 database	15514
Annotated in at least 1 database	47855

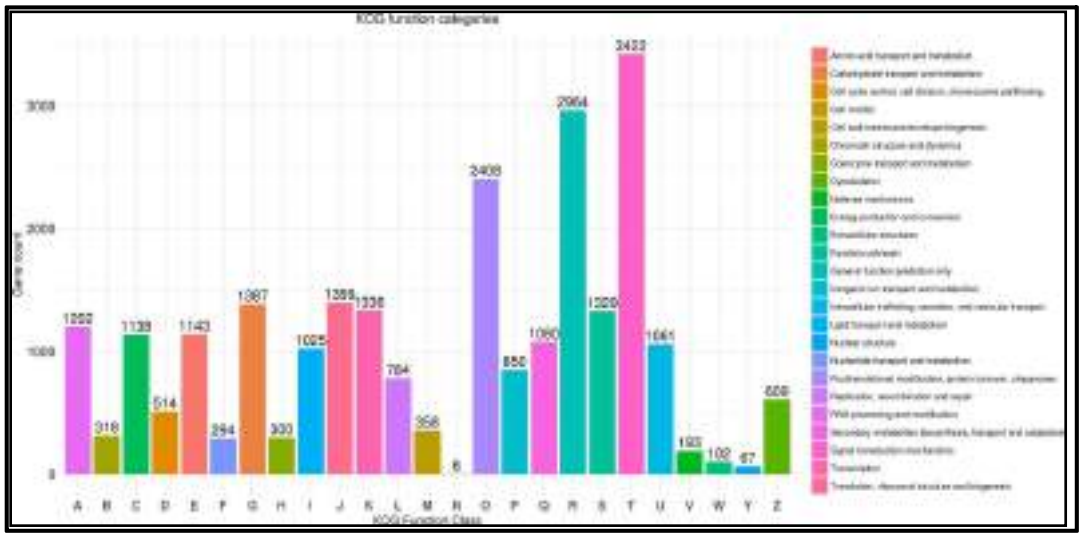


Fig-7: KOG analysis and classification

Comparative account of CDS annotation in different databases was represented in form of Venn diagram using interactivenn. Further differential expression between early flowering (Shalimar, Mokhdoom, Waris and Non Pariel) and late flowering almond cultivars (Tardy Non Pariel, Ferragnese and Ferralise) has been initiated to identify the genes and pathways differentially expressed is either early flowering or late flowering genotypes. Transcriptome studies will provide the insights about the genes/markers associated with late flowering and nut quality. These identified markers

will be very useful in selection of hybrids possessing traits like late flowering and better nut quality in early stages to speed up the breeding programme in almond.

Transcriptomic analysis was performed in almond cultivars to identify the genes associated with blooming. RNA seq data of Almond cultivars Waris and Ferralise was processed using FASTQ, Trimmomatic, HISAT2, Stringtie, Stringtie merge and DESeq2 pipeline. Results revealed the differentially expressed genes. The prominent genes with significant up-regulation in local cultivar Waris included Ethylene Insensitive 3 while BADH acyltransferase and accelerated cell death were down-regulated

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

No morphologically scorable male sterile plants were observed in the flowers of F1 generation grown from crossings between male sterile lines from PAU and promising varieties/ lines at the institute. The parental combinations are shown below.

Table-13: Parental combinations of F1 progeny obtained in 2021

Female parent (MS line)	Male parent
D-103-A	Brown Spanish
D-102-A	
D-73-A	
D-97-A	
D-266-A	

In a separate crossing programme, bulbs of F2 generation were evaluated for storability before planting them in December, 2021. Brown Spanish when crossed with either MS-1 line or MS-2 line resulted in highest storability in F2 generation. There were negligible bulb rotting and sprouting in both F2 generations (i.e. derivatives of MS-1 x Brown Spanish and MS-2 x Brown Spanish). Hig storability was also observed I F2 derived from MS-2 x CITH-O-33 cross. Moderate storability was observed when these lines were crossed with Yellow Globe. When crossed with CITH-O-2 and CITH-O-13 both MS lines resulted in low storability.

With respect to bulb color obtained in F2 generation, all crosses resulted in highest proportion of red bulbs irrespective to parental bulb color. Also, brown color was observed only in crosses involving Brown Spanish. White color was observed only if at least one of the parents of F1 was white except in case of F2 derived from crossing red colored MS-2 and red colored CITH-O-2 where 3.33 % bulbs were white. The details of evaluation are given in the following table.

Table-14: Parentage, storability and bulb color segregation in F2 generation obtained in 2021

Female parent (bulb color)	Male parent (bulb color)	F2 (bulb storability)	F2 (bulb color)			
			% White	% Red	% Yellow	% Brown
MS-1 (W)	Brown Spanish (B)	High	21.43	38.10	0	40.48
	Yellow Globe (Y)	Moderate	26.62	51.95	21.43	0
	CITH-O-2 (R)	Low	13.70	74.66	11.64	0
	CITH-O-13 (Y)	Low	24.20	51.80	23.99	0
MS-2 (R)	Brown Spanish (B)	High	0	65.38	0	34.62
	Yellow Globe (Y)	Moderate	0	70.54	29.46	0
	CITH-O-2 (R)	Low	3.33	90.67	8.16	0
	CITH-O-13 (Y)	Low	0	59.02	40.98	0
	CITH-O-33 (R)	High	0	84.62	15.38	0

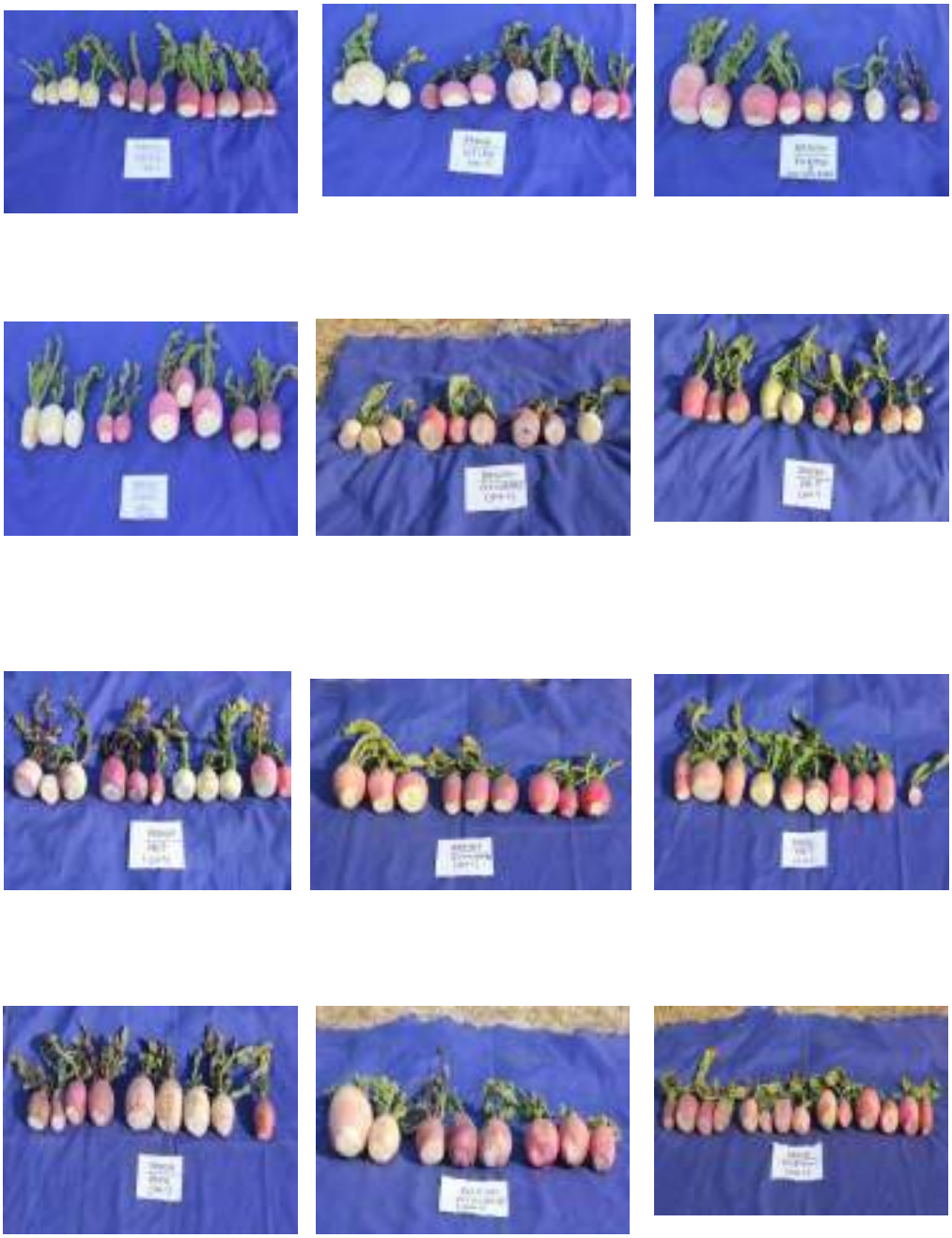
W: white, R: red, Y: yellow, B: brown

Bulb storability

High: No or negligible sprouting 5 months after harvesting
Moderate: Less than 50 % sprouting 5 months after harvesting
Low: More than 50 % sprouting 5 months after harvesting

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. The pictures of progeny roots are presented below with labels citing the name of previous generation or single cross parents:



Progenies of different crosses between colored radish genotypes

These progenies were then 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. By doing this, 13 new lines were constituted. The details are given in the following table.

Table-15: Morphological characteristics of advanced generation progenies

	Category	Root surface color	Skin color in transverse section	Pith color	Images
1	Light purple radish	White with purple streaks	White-light purple	White-light purple	
2	Medium purple radish	White with purple streaks	White-medium purple	White-medium purple	
3	Dark purple radish	Dark purple	Dark purple	White-dark purple	
4	Dark purple radish-2	Dark purple	White-dark purple	White-dark purple	
5	Dark purple radish-3	Dark purple	Dark purple	Dark purple-white	
6	Dark purple radish-4	Dark purple	Green	Green	

7	Light pink radish	White with pink streaks	White-pink	White-pink	
8	Pink radish	Pink	White	White	
9	Pink radish-2	Pink	White-pink	White-pink	
10	Pink radish-3	Pink	Green	Green	
11	Medium pink radish	Medium pink	White-medium pink	White-medium pink	
12	Medium pink oval radish	Medium pink	Green	Green	
13	Dark pink radish	Dark pink	Dark pink	Dark pink	

14	Chimeric purple radish	Sections of white and purple	Sections of white and purple	Sections of white and purple	
15	Chimeric pink radish	Sections of white and pink	Sections of white and pink	Sections of white and pink	

Rootstock improvement in temperate fruits

Apple

During the year 2019, crossing was preformed between *Malus baccata* L. with different Malling and Malling Merton series rootstocks as well as between different Malling and Malling Merton series of apple rootstocks apple for cross compatibility and rootstock improvement. The population raised during the previous years was subjected to evaluation for multiplication in stool beds during the year 202. The different crosses were evaluated and the crossing population which showed the rooting ability in stooling were evaluated for other parameters like Plant height, plant diameter, number of nodes per. intermodal distance (cm), number of lenticels/ 5 cm length, total root length, total root diameter and number of adventitious roots.

M. baccata* × *M9 population

Among the crossed population 15 numbers were coded and evaluated. From the data it can be revealed that plant height varied from 67cm to 132cm with maximum in CITH-A-RS-MB-01and minimum in CITH-A-RS-MB-14. Plant diameter ranged from 5.13cm to 7.65cm with maximum value in CITH-A-RS-MB-06 and minimum value in CITH-A-RS-MB-10.Maximum total root length (30cm) was found in CITH-A-RS-MB-07 and minimum (9cm) in CITH-A-RS-MB-03.Total root diameter was found maximum in CITH-A-RS-MB-01 and minimum in CITH-A-RS-MB-03. The number of adventitious roots varied from 1to10 with maximum value in CITH-A-RS-MB-04 and minimum value in CITH-A-RS-MB-14. Maximum number of nodes per 5cm length were in the range of 3to5 with maximum value in CITH-A-RS-MB-02, CITH-A-RS-MB-10, CITH-A-RS-MB-11. Maximum inter nodal distance (2cm) was found in CITH-A-RS-MB-

01, CITH-A-RS-MB-04, CITH-A-RS-MB-07 and minimum (1cm) in CITH-A-RS-MB-02 and CITH-A-RS-MB-03. The number of lenticels per 5cm varied from 17 to 92 with maximum in CITH-A-RS-MB-06 and minimum in CITH-A-RS-MB-08. All these crosses shown the potential for multiplication under in stool beds and profuse rooting were observed and superior crosses will be subjected to further multiplication under field conditions.

CITH-A-RS-MB-01

CITH-A-RS-MB-06

CITH-A-RS-MB-12

CITH-A-RS-MB-14

Crosses of *M.baccata* × M-9 showing the rooting ability in comparison to parents.

MM-106 × M9 population

Among the total population a total 23 numbers of crosses were evaluated. From the data it can be revealed that among the rootstocks plant height varied from 43cm to 104cm with maximum in CITH-A-RS-M6m-16 and minimum in CITH-A-RS-M6m-23. Plant diameter ranged from 3.93cm to 7.01cm with maximum value in CITH-A-RS-M6m-10 and minimum value in CITH-A-RS-M6m-15. The number of nodes per 5cm were in the range of 4 to10 with maximum value in CITH-A-RS-M6m-08. Maximum inter nodal distance (2.0cm) was found in CITH-A-RS-M6m-05 and minimum (0.6cm) in CITH-A-RS-M6m-08 while the number of lenticels per 5cm varied from 10 to 98 with maximum in

CITH-A-RS-M6m-02 and minimum in CITH-A-RS-M6m-23. Maximum total root length (30cm) was found in CITH-A-RS-M6m-05 and minimum (10cm) in CITH-A-RS-M6m-23. Maximu root diameter (10.29) was found in CITH-A-RS-M6m-05 and minimum (1.15) in CITH-A-RS-M6m-11. The number of adventitious roots varied from 2 to 13 with maximum value in CITH-A-RS-M6m-05 and minimum value in CITH-A-RS-M6m-13. All these crosses have shown the potential for multiplication and profuse rooting in stool beds and superior crosses will be further evaluation for desirable traits.

CITH-A-RS-M6m-04

CITH-A-RS-M6m-05

CITH-A-RS-M6m-07

CITH-A-RS-M6m-16

CITH-A-RS-M6m-18

CITH-A-RS-M6m-19

Crosses of MM-106 × M-9 showing the clonal multiplication and rooting in comparison to parents.

MM-111 x M9 Pajam population

Among the total population 13 numbers of crosses were evaluated plant height varied from 51cm to 81cm with maximum in CITH-A-RS-M1m-11 and minimum in CITH-A-RS-M1m-02 while plant diameter ranged from 4.28cm to 5.86cm with maximum value in CITH-A-RS-M1m-08 and minimum value in CITH-A-RS-M1m-03. Maximum total root length (18cm) was found in CITH-A-RS-M1m-09 and minimum (8cm) in CITH-A-RS-M1m-03.Total root diameter was found maximum (3.97) in CITH-A-RS-M1m-13 and minimum (1.03) in CITH-A-RS-M1m-06. The number of adventitious roots varied from 3 to 8 with maximum value in CITH-A-RS-M1m-08 and minimum value in CITH-A-RS-

M1m-06while the number of nodes per 5cm were in the range of 4 to 9 with maximum value in CITH-A-RS-M1m-03. Maximum inter nodal distance (1.8cm) was found in CITH-A-RS-M1m-04 and minimum (0.7cm) in CITH-A-RS-M1m-03. The number of lenticels per 5cm varied from 12 to 62 with maximum no. in CITH-A-RS-M1m-01 and minimum no. in CITH-A-RS-M1m-10. All these crosses has shown the potential for multiplication under stool beds and profuse rooting were observed and superior crosses will be evaluated for other desirable traits.

Crop Production

The cultivation of temperate horticultural crops is associated with many production problems time to time and were solved through scientific interventions to reach at present day scenario. But it is not sufficient because the productivity level is still low compared to advanced countries. There are many factors responsible to the low productivity including quality planting material supply coupled with production technologies like training, pruning, nutrient and 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 2021, institute has supplied about 24000 plants of different temperate fruit crops besides the supply of 23900 scionwood, 267 runners, 6174 plants/ seedlings of flowers, 86.34 kg vegetable seeds, 23000 vegetable seedlings and 13.5 kg onion seedlings to different stakeholders, vegetable growers & research organization etc. During the year 2021 about 3000 from Srinagar and 1000 grafted plants of walnut from Mukteshwar 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 outcomes of various experiments on production aspect for generating farmer friendly technologies presented below:

Management of pre harvest fruit drop in apple by fruit load management

Effect of thinning on quality and fruit drop in Apple (Malus domestics Borkh).

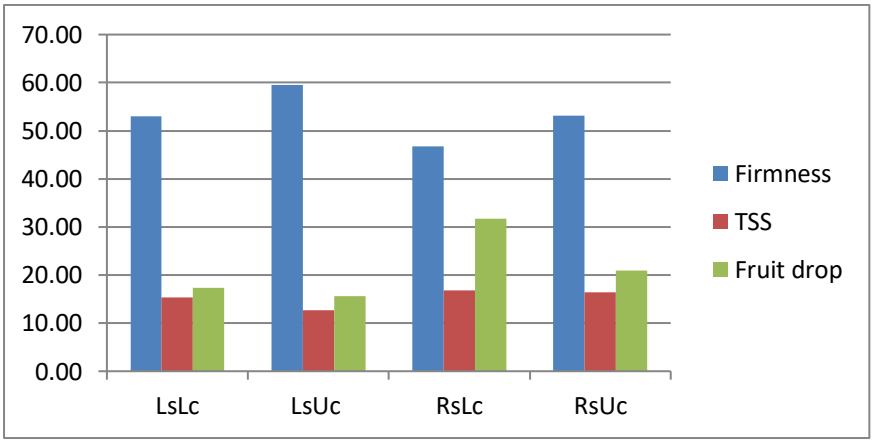
The experiment was conducted during 2021 at ICAR CITH training block, established during the year 2016. Two varieties (standard and spur) of apple viz. Gala Redlum and Super Chief on M9-T337 rootstock planted at (3.0 m x 1.0 m) spacing, trained in tall spindle system were selected. Manual thinning was practiced to observe its effect on quality, yield and fruit drop. From the data it was observed that in case of cultivar Gala Redlum, maximum fruit weight (125.30g), fruit length (54.21mm), fruit diameter (64.40mm) was recorded in the thinning Treatment 1 (1 fruit/cluster per cluster) and minimum fruit weight (100.22g), fruit length (49.41mm), fruit diameter (60.11mm) were recorded in control. The maximum pedicle length (26.53mm) was

recorded in Treatment 1 (1 fruit per cluster). The colour characteristics (L*, a* b*and tint) were determined on sun-exposed side of each fruit with a Hunter lab colorimeter. L* value ranged from 38.37 in Treatment 2 (2 fruits per cluster) to 47.53 in control the, a* values ranged from 23.85 Treatment 2 (2 fruits per cluster) to 35.98 in control and the values for b* scale range from 9.28 in Treatment 2 (2 fruits per cluster) to 19.10 in control. The values for tint ranged between -123.51 in control to -94.00 in Treatment 2 (2 fruits per cluster). The values for Chroma ranged from 25.61 in Treatment 2 (2 fruits per cluster) to 40.78 in control. The values for Hue angle ranged from 21.30 in Treatment 2(2 fruit per cluster) to 27.74 in Control and the values for color index ranged from 41.02 in control to 67.49 in Treatment 2 (2 fruits per cluster).The firmness of the fruits ranges from 59.48 Treatment 1 (1 fruits per cluster) to 69.33 in Treatment 3 (3 fruits per cluster). Irrespective of varieties maximum fruit drop % was recorded in control in all varieties and minimum in Treatment Control (1 fruit per cluster). In case of cultivar Super Chief, maximum fruit weight (160.12g), fruit length (63.57mm), fruit diameter (68.86mm) and pedicel length (57.06mm) was recorded in the thinning Treatment 1 (1 fruit per cluster) and minimum fruit weight (113..07g), fruit length (49.41mm)and fruit diameter (59.83mm) were recorded in control. The colour characteristics (L*, a* b*and tint) were determined on sun-exposed side of each fruit with a Hunter lab colorimeter. The value of L* ranged from 37.78 in Treatment 3(3 fruits per cluster) to 43.34 in Treatment 1 (1 fruit per cluster), the value for a* ranged from 23.04 in control to 36.75 in Treatment 1 (1 fruit per cluster), values for b* scale range from 10.93 in control to 16.17 in Treatment 2 (2 fruits per cluster). The values for tint ranged between -106.39 in Treatment 3 (3 fruits per cluster) to -84.66 in control. The values for Chroma ranged from 25.52 in control to 40.18 in. Treatment 1 (1 fruit per cluster) The values for Hue angle ranged from 22.31 in Treatment 3 (3 fruits per cluster) to 34.57 in Treatment 2 (2 fruits per cluster) and the values for color index ranged from 39.09 in Treatment 2 (2fruits per cluster) to 66.08 in Treatment 3 (3 fruits per cluster). The firmness of the fruits ranges from 47.56 (RI) in Treatment 1 (1 fruits per cluster) to 57.45 in Treatment 2(2 fruits per cluster). Irrespective of varieties maximum fruit drop % was recorded in control in all varieties and minimum in Treatment Control.

Effect of canopy position on quality and fruit drop of apple cultivar Golden Delicious

To see the effect of canopy on fruit quality and pre harvest fruit drop, Golden Delicious cultivars on seedling rootstock was selected. All fruit were counted and each individual fruit on canopy side were tagged and were evaluated for various physico-chemical and colour parameters and fruit drop percentage. The canopy as the tree was

divided into four sections based on the position and all the fruits of each section were tagged i.e., Right side Lower canopy (RSLC), Left side Lower canopy (LSLC), Right side Upper canopy (RSUC) and Left side Upper canopy (LSUC). Maximum fruit drop (31.71%) was found in RSLC and minimum (15.63%) in LSUC. Among the evaluated parameters, maximum fruit weight, fruit length and fruit diameter were recorded in LSLC (88.63g), (52.89) and (57.02), respectively where as the lowest parameters were recorded for RSLC (56.91), (43.84) and (47.03). Maximum pedicle length was recorded in RSLC (31.76mm) while as the minimum in LSLC (28.92mm). Number of seeds in fruit varied from 10.00 in LSLC, LSUC and RSUC to 13.00 in RSLC; however all the seeds were found plump. Highest seed weight was recorded for LSUC (0.04g) and minimum in RSUC (0.03g). Maximum TSS was recorded in RSLC (16.86°B) and the minimum was in LSUC (12.70°B). The maximum value of firmness was recorded in LSUC (59.48RI) and minimum in RSLC (46.74RI). Among the colour characteristics, the L* value ranged from 64.77 in RSLC to 69.71in LSUC while values of a* scale ranged from 3.92 in RSLC to 10.24 in RSUC. In case of b* scale the value ranged from 37.73 in RSLC to 46.67 in RSUC. The values for tint ranged between -50.93 in RSUC to -26.30 in RSLC. From the data it can be presumed that there is a significant influence of canopy position on fruit drop and other quality traits but the experiment needs to be repeated for reaching the logical conclusion and other facets will be taken into account to generate more information.



Fruit parameters of Golden Delicious based on canopy position of fruit.

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

Multiplication of clonal rootstocks of apple through cutting under shade net conditions.

Multiplication of rootstocks through cuttings is of special significance as it is an additional tool to increase the production of rootstocks because during grafting top portion of rootstock (> 80%) goes to waste. A novel technology was developed at ICAR-CITH Srinagar for the production of apple clonal rootstocks through cuttings using a soilless rooting medium under protected conditions and has already been developed and popularized among the nursery growers. A new attempt on this aspect has been done in farmer's field (Hi-Five Nursery) at Seelo Sopore (Lat 34.32569^{o} and Long 74.421766^{o} during 2021. **Seelo** village is located in **Sopore tehsil** of Baramula district in Jammu & Kashmir, India. It is situated 60 km away from the institute's headquarter. Three clonal rootstocks (MM-106, M9-T337, and M-7 based on popularity and demand were selected for the experiment. The fresh cuttings were collected and disinfected by Carbendazim (2g/l) solution for 10 seconds, then dipped in 2500 ppm IBA for 10 seconds, and then planted in rooting medium (Soil 75% + Vermicompost 25%) using a randomized complete block design (RCBD) in a shade net (30 × 6.0 meters) dimension. The hardwood cuttings were kept 25-30 cm in length and 0.8-1.2 cm in diameter having 9-11 buds prepared from dormant twigs of rootstock. The field has been prepared by cultivating the soil in the month of February. The upper one ft (30.48 cm) of soil has been removed and filled with top soil mixed with vermicompost in the last week of February. The cuttings have been planting on 10th March 2021; 3-4 buds (about 5 cm) were buried in the rooting medium. The cutting was planted at a spacing of 1.2 ft between rows and 7 inches between cuttings. Immediately after the planting irrigation was provided to the cuttings. **After 10 days growth has initiated and** after 45 days of growth when the shoots have attained 3-5cm growth only a vigorously growing shoot was kept and the rest of the shoots were removed and recommended cultural practices for nursery raising were followed. Drenching of cutting with the fungicide (Carbendazim @2g/l) of water) up to the first 60 days of growth at 15-day intervals was also applied to control root rot. The weeding operation was performed at 15 days intervals to reduce the weed competition. Various parameters related to growth viz plant height, plant diameter, root length, root diameter, and number of adventitious roots were recorded. The plants were given irrigation twice a week except in case of rains. The recommended phytochemicals were also sprayed (chlorophyriphos

@ 1ml/liter of water) for managing the aphid infestation. From the data, it can be confirmed that a maximum survival percentage of 64.3% was recorded in MM-106 RS followed by M-7 (53.0%) and a minimum in M-9 T337 (43.5%). The maximum plant height (138.25 cm) in rootstock MM-111 followed by MM-106 (125.35cm) and minimum (118.23cm) was recorded in M-7 rootstock. Regarding the plant diameter which is very important as far as grafting or budding is concerned was maximum (10.81mm) recorded in rootstock MM-106 followed by M-7(10.46 mm) and minimum (10.29 mm) in MM-111. The maximum root length (33.70 cm)was recorded in MM-106 followed by M-7 (33.60cm) and minimum (30.20 cm) in MM-111 whereas roots diameter, the maximum (12.95mm) was recorded in MM-111 and the minimum (9.14cm) in clonal rootstock M-7. The number of adventitious roots ranges from 4-5 in all rootstocks. Although the success percentage (43.5% -64.3%) is less in comparison to protected conditions in soilless medium but this technology will surely help the framers in increasing the production of clonal rootstocks of apple with minimal cost.




Fig:-Different growth stages of production of clonal rootstocks of apple by cutting under shade net.

Vertical Expansion of Nursery in open field conditions using soilless rooting medium

The vegetative propagations by air layering are becoming more and more popular because it is a quick, efficient & simple, way to clone apple clonal rootstocks and could be the most inexpensive technique. The apple clonal rootstocks in open filed nursery some rootstocks grow more than 3ft in height. 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, technology for in protected conditions and has already been popularized among the nursery growers. Now the same has been tried in open field conditions for the maximum benefit of nursery growers. The trail has been done in open field nursery during 2021 using two rootstocks MM-106 and M-9-pajam and cocopeat as rooting medium. First those plants having a diameter above 6 mm) and height (2-3 feet) in the months of June-July were selected and wounding/incision has been given and rooting hormones IBA (3000 ppm) was applied in the to the wounded portion. Small bags filled with rooting medium has been fastened at those points where rooting needs to be initiated. Light weight substrate having high water holding capacity

(cocopeat) used as rooting medium. Staking was done to hold the bags in fixed position. Watering at regular intervals was done to keep the rooting media moist. From the data it can be stated that maximum plant length (78.10 cm) has been recorded in MM-106 and lowest (72.25cm). Regarding the other parameters, the maximum plant diameter (8.14mm), root length (9.00cm), root diameter (2.33mm) and number of adventitious roots (5.40) were recorded in rootstock MM-106 and these parameters were recorded lowest in M-9 rootstock. On an average one additional rootstock were harvested in comparison to single rootstocks in both the rootstocks. This technology needs further refinement so that maximum number of rootstocks can be harvested but the farmers can adopt this technology as this technology will be very useful in promoting the vertical expansion of the nursery and number of plants per unit area can be increased.

Air layering and rooting in layered plants

Nutrient profiling of Nursery Blocks of the Fruits crops of ICAR-CITH, Srinagar.

Collected soil samples from the Apple, Peach, Plum and Walnut blocks for nutrient profile studies and samples were analyzed for pH, Electrical Conductivity, Organic Carbon, Nitrogen, Phosphorous, Potassium and micronutrients such as Iron, Zinc, Manganese and **Cupper**. The nutrient profiling studies showed that major nutrients such as Nitrogen and Phosphorous was found deficit in apple, plum and walnut nursery blocks whereas micronutrients like Iron and **Cupper** levels were below average in the apple and walnut blocks. Based on soil test reports the recommendations for the nutrients management according to the nursery block wise with respect to fruit crop wise was developed.

Survey of temperate fruit orchards in Arunachala Pradesh and identification of potential areas suiting for promotion of Temperate fruit crops

A survey was undertaken to determine the soil quality in temperate parts of Arunachala Pradesh and nearly about forty-seven locations were surveyed in and around Dirang found to have potential scope for growing of temperate fruit crops as they partially practicing the orchards. The soil samples of these locations were analyzed for its nutrient quality and analysis is in progress

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 to among farmer under MGMG and SCSP scheme at Sunkiya, Nainital and Odlohar-Simsyari, Bageshwar villages during the year 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.

Development of almond based intercropping system involving saffron

The saffron cultivation has witnessed many biotic and abiotic leading to more losses to farmers. So to avoid losses to farmers an attempt has been done to develop an almond based intercropping system involving saffron. In almond different type of varieties having varied growth habit viz. erect, semi erect and spreading type were tried along with sole saffron crop and effect of various almond varieties was studied on saffron. In this year very less yield were recorded in various treatments due to very old plantation of saffron and damage by rodents as well as weather conditions during flowering. The highest almond was recorded in erect type (18.37 q/h) followed by semi erect (11.86 q/h) and spreading (10.77 q/h). From present saffron yields it was concluded that, 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. Non significant effect has been observed for most of plant and flower traits. Thus saffron-almond is the best combination and the almond crop can give additional returns to growers and will be more beneficial to compensate losses during adverse biotic and abiotic stresses. Besides this effect of various planting systems i.e. raised bed planting, ridge and furrow and flat bed was also studied for saffron yield. Highest saffron yield was recorded in raised bed system followed by flat bed system and ridge & furrow. The damage of rodents was observed more and snow fall during flowering may be the reasons for low yield in this year.

Off-season cultivation of onion in Kashmir valley (New Technology)

In Kashmir, onion is almost always cultivated in *Rabi* season that encompasses sowing in October, transplanting in December 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. During the first year (2020-21), major challenges in onion offseason cultivation had been bolting and bulb splitting/ doubling. However, three varieties out of those tested (7) were identified for superiority with respect to these negative traits at different planting dates during 2020-21. During 2021-22 trial, these selected varieties were evaluated on larger scale to ascertain their suitability for offseason (July/ August planting) production under Kashmir valley conditions. The varieties selected were Punjab White, PRO-6 and PRO-7. The bulbsets obtained from these varieties were planted on 30.7.2021, 16.8.2021 and 30.8.2021. The bulbs obtained from planting bulbsets on first two dates were harvested on 21.10.2021 and 6.11.2021, respectively. No harvesting was done for date corresponding to last planting because there was very poor crop growth and development. From experimentation, it was concluded that end July planting of bulbsets was more congenial than mid August planting for total bulb yield and average bulb weight in all three varieties; for marketable bulb yield and average marketable bulb weight in all varieties except PRO-7 that had higher values for these traits when planted in mid August. Average total bulb yield obtained from end July planting of onion (all varieties averaged) was 29.85 t/ha, whereas that obtained from mid August planting was 22.59 t/ha. Average marketable bulb yield obtained from end July planting of onion was 20.07 t/ha, whereas that obtained from mid August planting was 20.41 t/ha. Average marketable bulb weight obtained from end July planting of onion was 51.73 g, whereas that obtained from mid August planting was 49.16 g.

Recommendation

Overall, Punjab White was superior for offseason cultivation of onion in Kashmir valley conditions with marketable bulb yields of 27.89 to 28.81 t/ha and marketable bulb weight of 57.92 to 64.83 g obtained with end July to mid August planting of bulbsets and harvesting in second fortnight of October to first week of November.

Table-16: Observations on varieties for yield, physiological disorders and bulb traits during offseason cultivation

Varieties	Total bulb yield (t/ha)	Marketable bulb yield (t/ha)	% bolters	% splits	Average bulb weight (g)	Average marketable bulb weight (g)	Neck thickness (cm)	PD/ED (cm)	Bulb color
30.7.2021									
Punjab White	34.33	28.81	7.41	3.70	68.66	64.83	1.90	4.91/6.03	White
PRO-6	20.32	18.67	0	0	56.76	52.14	1.55	4.77/5.93	Dark red
PRO-7	34.89	12.74	6.25	37.50	58.88	38.22	1.47	4.46/4.51	Medium red
16.8.2021									
Punjab White	29.00	27.89	0	0	60.23	57.92	1.94	5.63/6.14	White
PRO-6	17.50	13.11	0	17.86	45.00	41.04	2.06	5.63/5.57	Dark red
PRO-7	21.28	20.22	0	6.25	47.88	48.53	2.26	5.21/5.17	Medium red
30.8.2021									
Punjab White	Plant growth was restricted and no economically viable bulb size was obtained								
PRO-6									
PRO-7									

Punjab White

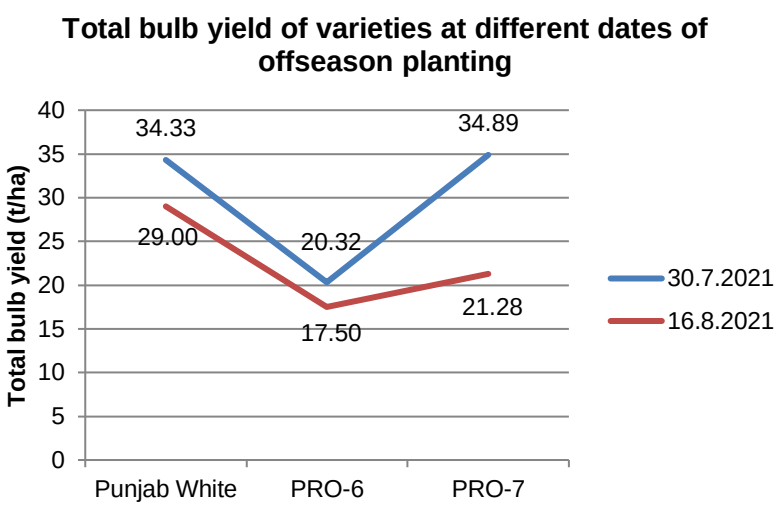
PRO-6

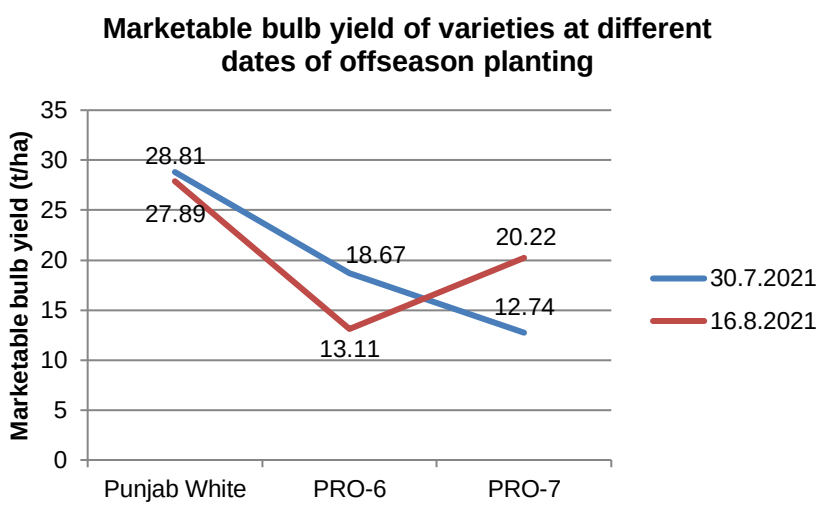
PRO-7

Date of bulbset planting: 30th July : Date of harvesting: 21st October

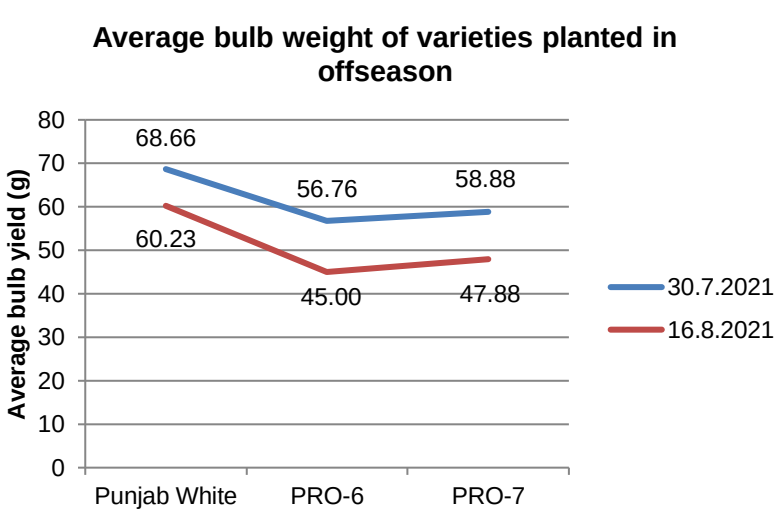
Fig-8 Bulbs obtained in offseason from tested varieties

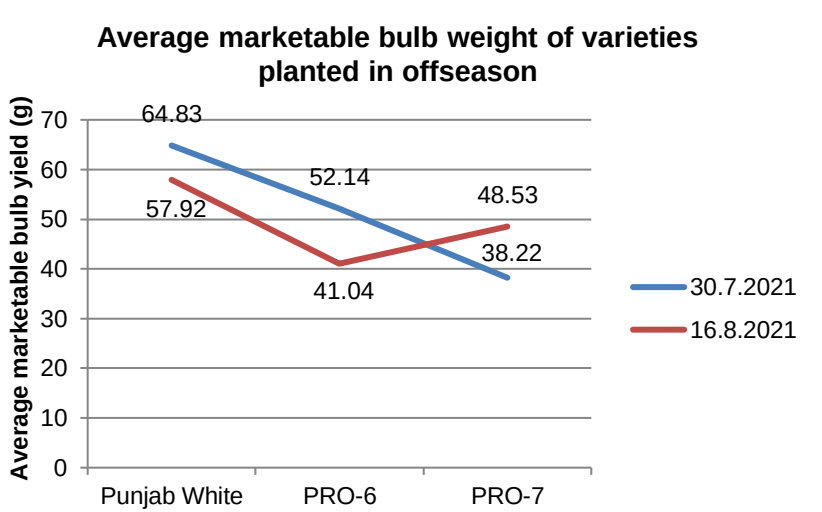
Table-17: Yield and bulb traits of varieties cultivated in offseason





Yield traits





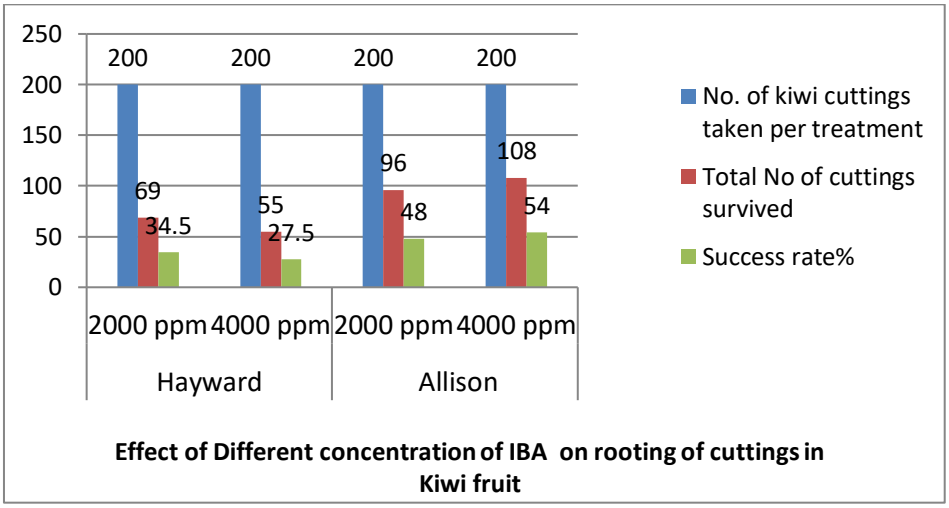
Bulb traits

Regional Station, Dirang

Effect of different concentrations of IBA on rooting of cutting using in soil under naturally ventilated green house at ICAR-CITH RS Dirang

This experiment was conducted at ICAR-CITH Regional Station, Dirang, West Kameng, District Arunachal Pradesh. Two cultivars of kiwi i.e. Hayward and Allison have been used for the experiment. The size of cuttings was kept at 15 cm with 2 to 3 buds each. The hardwood kiwi cuttings have been collected in March 2021 from the Kiwi mother block of Regional Apple Nursery, Dirang. The objective of this experiment was to observe the growth and development of kiwi cuttings by employing different concentrations of Indole Butyric Acid (IBA) i.e. 2000 ppm and 4000 ppm. It has been observed that the kiwi cv Allison treated with IBA 4000 ppm has a higher rooting success rate of 54%, whereas the lowest has been recorded case of Hayward 4000 ppm with a success rate of 27.5% rooting. From the experiment, it can be concluded that higher conc. of IBA (4000) has been found to produce the highest rooting success rate (Fig-9).

Fig-9: Effect of Different concentration of IBA on rooting of cuttings (IBA)



Different stages of rooting of cutting in kiwifruit using different conc. of IBA

Plant Protection

The temperate horticultural crops are infested a large number of pests and diseases which results into a huge loss to farmers in term of plant health and economic point of view. ICAR-CITH is continuously carrying research on various aspects for generation of ecofriendly technologies. The research work carried out during the year is presented under various projects.

Diagnosis and prognosis for viruses in apple (*Malus domestica* Borkh)

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

Viral diseases pose a real challenge in temperate fruit production and the losses due to viral damage may involve a reduction in plant vigour, delay in fruit ripening, graft compatibility issues etc. Apple mosaic disease (AMD) is economically most important viral disease, having widespread distribution and a major threat to apple industry throughout the world. In infected leaves, the AMD reduces photosynthetic rate from 3-46percent, which results in yield losses from 30 to 40 percent. Besides apple mosaic virus (ApMV) one more virus, viz., apple necrotic mosaic virus (ApNMV) has also been found associated with AMD. Both ApMV and ApNMV being labile in nature and their titre varies negatively with high temperatures, so to detect both the viruses needs proper tissue as well as proper time to avoid non-detection despite being present in the plants. Detect and quantification of ApMV and ApNMV from different plant parts (spatial) in two cultivars (Oregon Spur and Golden Delicious) of apple trees during different seasons (temporal) for optimisation of tissue and time for their rapid and early detection was conducted during 202. Detection and relative quantification using molecular diagnostic techniques viz., Reverse Transcription-PCR and RT-qPCR in various plant parts (anther, leaf, petal, pedicel, stigma with style, stem, fruit and seed) during different seasons was done. Depending upon the availability of tissues during different seasons, both ApMV and ApNMV were detected in all the plant parts during spring season using RT-PCR. During the summer season both viruses were detected in leaves, seed and fruits. 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 pedicel. During these seasons, both ApMV and ApNMV were detected in leaves in measurable titre using RT-qPCR. Periodic detection of these viruses in different plant parts during all the seasons revealed varied virus titer

from one season to another in the same plant. Hence leaves during spring season and fruits/seeds during summer can be directly used as detection material for their early and rapid detection of both the viruses. The relative quantification/fold changes of the viral (ApMV and ApNMV) titre in different parts of the plants during spring and summer season using RT-qPCR are shown in figure 10 and 11.

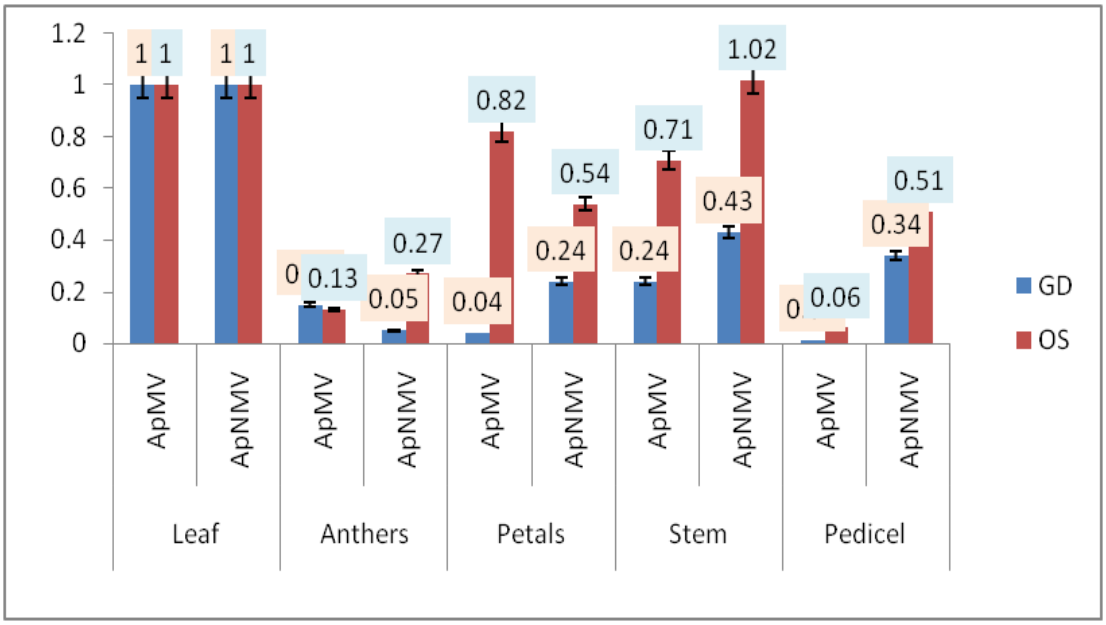


Fig 10: Comparative Infection of APMV and APNMV in Golden Delicious (GD) and Oregon Spur (OS) tissues in spring season. Y-axis represents different tissues tested for both the viruses and X axis fold increase.

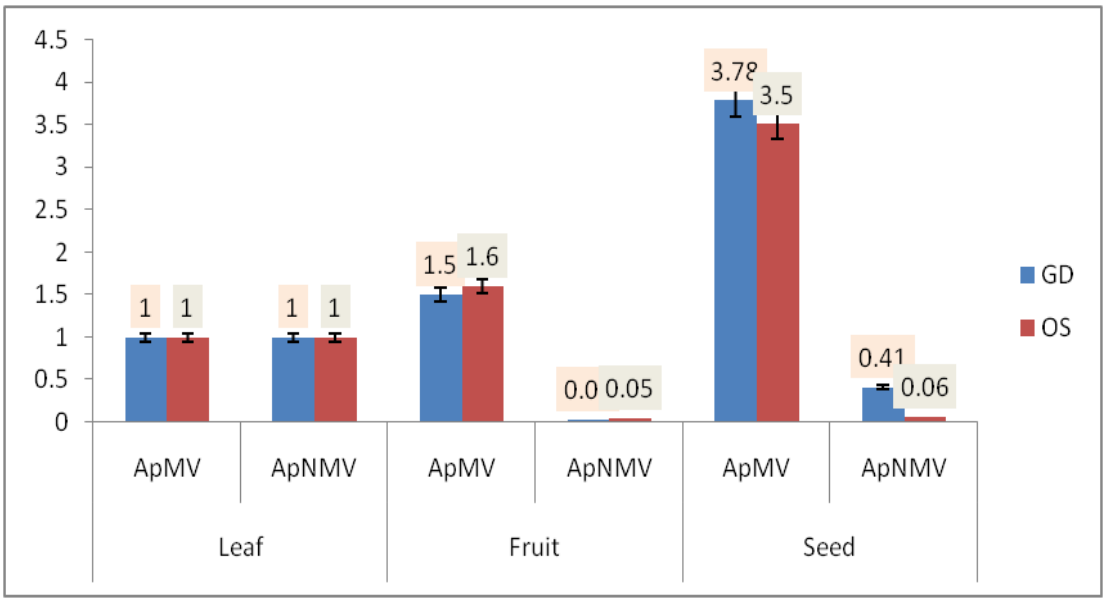


Fig-11: Comparative ApMV and ApNMV Infection in Golden Delicious (GD) and Oregon Spur (OS) tissues in summer season. Y-axis represents different tissues tested for both the viruses and X axis fold increase

Diagnosis, Transmission and Management of Virus/Virus like Diseases of Temperate Fruit Crops

Detection and diagnosis of pome and stone fruit viruses using DAS-ELISA

During 2021 survey was conducted in apple germplasm bank of ICAR-CITH Srinagar and among the 203 lines, various cultivars viz., Golden Delicious, Oregon Spur, Ambri, June Eating, Welson Red June, Sharp Earliest and Gala Mast were found infected with mosaic and necrosis mosaic disease (Fig xc). The apple germplasm (200) was tested for three viruses (ApMV, apple stem pitting virus-ASPV and apple stem grooving virus-ASGV) using DAS-ELISA. Some of the symptomatic varieties (4) were found infected with ApMV along with ASPV and ASGV; however 50 and 54 varieties/lines were found infected with ASPV and ASGV respectively. During the survey conducted in stone fruit germplasm (cherry, apricot, peach, plum and nectarine) maintained in the field gene bank of ICAR-CITH, suspected viral symptoms like leaf roll, necrosis, ring spots, shot holes, Leaf crinkling, small leaves, chlorosis and yellowing was observed (Fig 12). Based on the symptoms plants were screened for 6 viruses (prunus necrotic ring spot virus-PNRSV, plum pox virus-PPV, prune dwarf virus-PDV, cherry leaf roll virus-CLRV, strawberry latent ring spot virus-SLRSV) using DAS-ELISA. The incidence of PNRSV was more in cherry followed by plum, nectarine peach and apricot, where as CLRV incidence was more in apricot followed by cherry. The incidence of PPV and PDV was very less compared to PNRSV and CLRV, however no infection of SLRSV was found in all the stone fruits plants tested.

Necrosis-mosaic

Mosaic

Necrosis and leaf rool

Leaf crinkling **Ring spots** **Shot holes**

Fig-12: Suspected viral symptoms observed on apple and different stone fruits (cherry, plum, apricot, peach, nectarine)

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

The transmission studies of AMD caused by ApMV and ApNMV were conducted during 2020 and 2021 using virus infected bud wood. Both the viruses were transmitted by infected buds. The budding was done on different rootstocks (MM106, MM111, M26, M9, M27, Pajam, M9-T339 and M9-T337. The rate of AMD was observed differently on different rootstocks via budding of scion from mosaic infected plants (Oregon Spur).The disease transmission rate using budding varied from 0-100%. The highest was on rootstocks MM106 and MM111 (100%) and lowest on T339 and T337 with 0%.

During 2020-21, 8 rootstocks were evaluated for their effect on mosaic disease of apple cv.Golden Delicious. The mosaic or mosaic/necrotic symptoms were observed on six root stocks, viz, MM106, MM111, M26, M27, M9 and Pajam. No symptoms were observed on two root stocks i.e., M9-T337 and M9-T339. It was also observed that the symptom development in Malling Merton (MM) series was earlier as compared to Malling series of rootstocks and absence of the of mosaic symptoms on M9-T337 and M9-T339 gives indication of effect of rootstock on sensitivity of mosaic. During 2021, the mosaic was transmitted to 20 plants each of M9-T337 and M9-T339 to see the effect of these rootstocks on mosaic development. It was observed that out of 40 plants mosaic was developed on 3 plants during early spring season; however the symptoms were masked in all three plants after one month and were not retrieved back throughout the growing season. However the symptoms of mosaic were constantly present on plants which were grafted on MM106 and MM111 (check).

So to determine the effect of rootstock on mosaic further, the detection and quantification of viruses is needed in both the rootstocks as compared to MM106 and MM111.

Comparative Transcriptomal studies in mosaic infected apple cultivars comparison to asymptomatic cultivar

In this study, transcriptome analysis was used to identify the gene expression profiles in ApMV and ApNMV infected apple cultivars (Oregon Spur-AIN and Golden Delicious-AP) in comparison to healthy cultivar Red Fuji. In this study, high throughput RNA sequencing approach was used to analyze response to ApMV and ApNMV infection at the transcriptome level. Equal quantities of total RNA from the two viruses infected (AIN and AP) and one healthy leaf samples (AH) were separately used for library construction. The libraries were sequenced on an Illumina NovaSeq 6000 platform. A total of 5430896, 82536472 and 64967410 paired end read were obtained from virus infected Oregon Spur, Golden Delicious and healthy Red Fuji cultivars respectively. The Hisat2 programme was used to align the reads to the apple genome. The alignments were done in a splice-aware fashion, using known splice-sites from the annotation GTF. This allows placing the reads across the junctions if needed and split reads as RNASeq is performed using mature mRNAs, thus it will facilitate placing the reads across multiple exons. During this analysis, we tend to quantify the samples at Gene level including multimapped reads, and then exported to Gene-Counts. These were then annexed with BioMart annotation for retrieving GO, Pathway, GC% of Gene, Chromosomal-coordinates and the BioTypes of the genes.

Identification of DEGs in ApNMV/APMV infected apple in comparison to healthy

The NOISeq was used to calculate CPMs (counts per million, which is a normalized scale) of the Genes to explore the thresholds that would be decided to filter out slow expressed or unexpressed genes, which might have quantifications due to a variety of artefacts. Genes with CPM > 1 were retained for analyses, which led to retention of 22,776 Genes (includes other Biotypes than Protein-Coding as well) from a total of 42,497 features. NOISeq matrixes with the 22,776 genes were used for analyzing the modulation of expression without replicates using TMM normalization, selected for probability values of > 0.95. The modulated genes or differentially expressed genes (DEGs) identified in each contrast are shown in table-19.

Table-19: Differentially expressed genes identified in each contrast

S.No.	Comparison	Significant DEGs*	Up regulated genes	Down regulated genes
1	AIN vs AH	1251	656	595
2	AP vs AH	632	352	280
3	AP vs AIN	2126	1102	1024

**Significant DEGs are the sum of Up+Down regulated genes*

Functional annotation of DEGs in ApNMV/APMV infected apple cultivars in comparison to healthy

To obtain a functional categorization of the DEGs, Gene ontology (GO) analysis was used to classify the DEGs. The roles of genes and their products are organized into 3 categories, i.e., biological process (BP), molecular function (MF) and cellular component (CC). Each GO term has a term name and a unique term accession number, and a single gene product can be associated with many GO terms, since a single gene product may function in several processes, contain domains that carry out diverse molecular functions, and participate in multiple alternative interactions with other proteins, organelles or locations in the cell. For the above 3 comparisons, the GO Term enrichments were carried out by top GO using the Parent-Child Fisher algorithm, which essentially categorizes the terms by their hierarchical order, and performs a hyper geometric test. The main GO classification categories in three comparisons viz., AIN vs AH revealed 59, 77 and 141 annotations belonging to the BP, CC and MF categories respectively, in AP vs AH, 34, 61, 241 annotations belonging to the BP,CC and MF categories respectively and in AP vs AIN 402, 196, 680 annotations belonging to the BP,CC and MF categories respectively. Gene ontology classification of DEGs in comparison of AIN vs AH are shown in Fig xg. In summary, based on GO and KEGG pathway analyses, the difference in response to ApMV/ApNMV between infected and healthy mainly involved transport, photosynthesis, plant–pathogen interaction, protein synthesis, defence against pathogen, cell division, oxidative stress in all three comparisons.

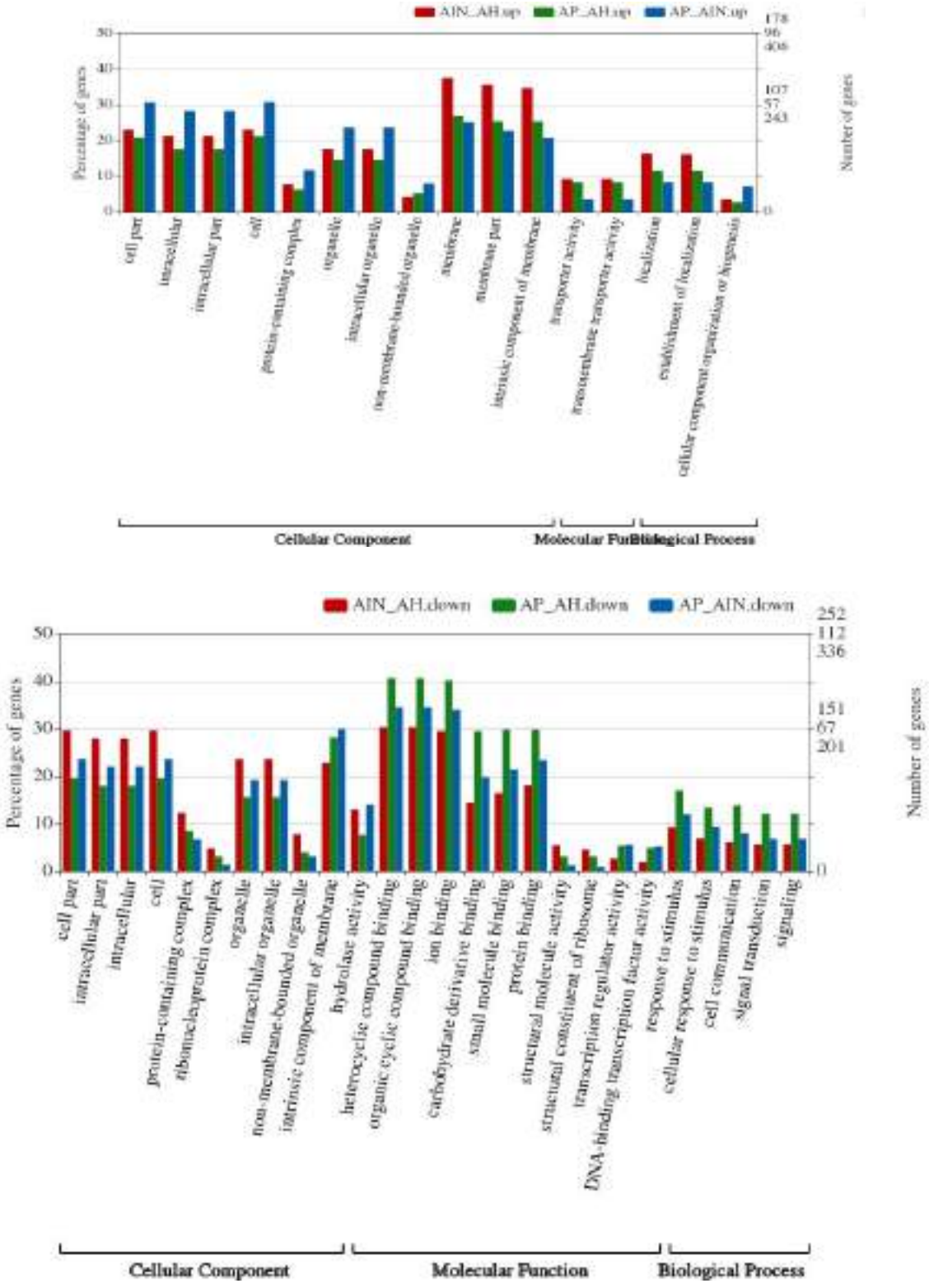


Fig 13: Gene ontology classification of differentially expressed genes (DEGs) using WEGO plots for Up and Down regulated genes (top to bottom). The results are summarized in three main categories: biological process (BP), cellular component (CC), and molecular function (MF)

Estimation of chlorophyll (chl) content of mosaic infected apple cultivars in comparison to asymptomatic cultivar

Mosaic disease is economically most important viral disease of apple, having widespread distribution and a major threat to apple industry throughout the world. In infected leaves, this diseases reduces photosynthetic rate from 3%-46%, which results in yield losses from 30%-40%. 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. Hence the objective was to quantify the chlorophyll from mosaic infected cultivars in comparison to asymptomatic ones. During 2021, both symptomatic as well as asymptomatic leaf samples were taken from 7 cultivars to quantify the chlorophyll content (Chl_a, Chl_b, total chlorophyll and carotenoids). Significant reduction in chlorophyll content was observed in 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.

Characterization of virus like pathogens

Identification of phytoplasmas strains associated with sweet cherry (Prunus avium L)

During 2019-2021, the suspected phytoplasmas symptoms of flat branch, little leaves and witches' broom were observed in sweet cherry cultivars (cvs) Bigarreau Nepoleon (BN) (Double), Bigarreau Noir Grossa (BNG) (Mishri), CITH-Cherry-9, CITH-Cherry-6 and CITH-Cherry-8 and CITH-C-14, whereas, swollen nodes, stunting, leaf roll and rosette symptoms were observed in cultivars Stella and Sunburst at ICAR-CITH, Srinagar during May-Sept 2020 to 2021 (Fig. xd). About 50 shoot and leaf samples were collected from asymptomatic and symptomatic cherry trees and were sent to ICAR-IARI for phytoplasmas detection. The PCR based amplification using multigene primers revealed the association of two groups (16SrI and 16SrVI-D) of phytoplasma. The details of phytoplasmas groups associated with symptomatic cherry samples are presented in table-20.

Flat Branch

Swollen nodes

Witches broom

Fig. 14: Various types of symptoms of phytoplasmas infected cherry plants

Table-20. Symptoms, incidence and identification of phytoplasmas strains associated with sweet cherry in Jammu and Kashmir, India

S.No.	Variety	Symptoms	Incidence (%)	Phyto-plasmas group/ subgroup identified
1	Bigarreau Nepoleon (Double)	Flat branch, little leaves and witches' broom	5.80	16SrVI-D

2	Bigarreau Noir Grossa (Mishri)	Flat branch and witches' broom	7.95	16SrVI-D
3	CITH-Cherry-9	Flat branch and witches' broom	25.0	16SrVI-D
4	Stella	Stunting, leaf roll and rosette	7.50	16SrI
5	Sunburst	Swollen nodes and shoot proliferation	3.25	16SrI

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

Evaluation of fungicides, botanicals and bio agents against Alternaria spp. an incitant of Alternaria leaf and fruit blotch in apple

Evaluation of different fungicides

Thirteen fungicides were evaluated under *in vitro* against *Alternaria spp*. causing leaf spot of Apple. All the treatments significantly inhibited mycelial growth of *Alternaria* over untreated control. Among different fungicides, Hexaconazole5EC, Propiconazole25EC, Fluxapyroxad 250 G/L + Pyraclostrobin 250 G/L SC showed complete inhibition (100%) of the pathogen at all the test doses and minimum by Metalaxyl 4 WP + Mancozeb 64 WP (50 %) compared to untreated control. Among the contact fungicides the highest percent inhibition (80%) was found in Ziram 80WP, while as in systemic fungicides highest percent inhibition (100%) was found in Hexaconazole 5EC and Propiconazole 25EC. Among combo products highest percent inhibition (100%) was found in Fluxapyroxad 250 G/L + Pyraclostrobin 250 G/L SC. The overall inhibition of *Alternaria* at different doses by various fungicides is shown in Table 21.

Table-21: Evaluation of different fungicides at different concentrations against *Alternaria* under *in-vitro* conditions

Fungicide name	**R.D**	**Colony Diameter (CM)**			**Percent inhibition over control**			**Mean**
		2500 PPM	**3000PPM**	**3500PPM**	**2500 PPM**	**3000PPM**	**3500PPM**	
Propineb 70WP	0.3	2	2.3	2.5	60	54	50	54.6
Copper oxy chloride 50WP	0.3	1	1.5	2	80	70	60	70.0
Ziram 80WP	0.3	1	1	1	80	80	80	80.0
Captan 50 WP	0.3	2	2.3	2.5	60	54	50	54.6
Fungicide name	**R.D**	**Colony Diameter (CM)**			**Percent inhibition over control**			**Mean**
		1500PPM	**2000PPM**	**2500PPM**	**1500PPM**	**2000PPM**	**2500PPM**	
Hexaconazole 4 SC + Carbendazim 16 SC	0.1	0	0	0.5	100	100	90	96.6
Fluxapyroxad 250 G/L + Pyraclostrobin 250 G/L SC	0.1	0	0	0	100	100	100	100.0
Tebuconazole 50WG+Trifloxystrobin 25 WG	0.1	0	0.5	1	100	90	80	90.0
Fungicide name	**R.D**	**Colony Diameter (CM)**			**Percent inhibition over control**			**Mean**
		500PPM	**1000PPM**	**1500PPM**	**500PPM**	**1000PPM**	**1500PPM**	
Hexaconazole 5EC	0.2	0	0	0	100	100	100	100
Propiconazole 25EC	0.2	0	0	0	100	100	100	100
Myclobutanil 10WP	0.2	1	1	1.5	80	80	70	76.6
Metiram 55WG + Pyraclostrobin % WG	0.2	1.5	1.8	2	70	64	60	64.6
Metalaxyl 4 WP + Mancozeb 64 WP	0.2	2	2.5	3	60	50	40	50
Chlorothalonil 40 SC + Difenconazole 4 SC	0.2	1	2	3	80	60	40	60
Control	5cm							

Evaluation of different botanical extracts and bioagents

Seven different botanicals extracts were evaluated *in vitro* against *Alternaria spp*. of apple. Among different extracts Oreganum leaf and flower extracts completely inhibited (100%) the growth of *Alternaria* at all test doses compared to untreated control. The growth inhibitions are shown in table Y6. Total six isolates of *Trichoderma harzianum* isolated from soil and apple endophytic microbiota were evaluated *in vitro* against *Alternaria spp*. causing leaf spot of Apple. All the isolates significantly inhibited mycelial growth of *Alternaria* over untreated control. Isolate TH-6 has been found effective with 95% inhibition of mycelial growth and dominated fast rigours growth of *Alternaria* mycelium. All other *Trichoderma* isolates equally inhibited mycelium growth (90%) compared to untreated control.

Table-22 Evaluation of different botanical extracts at different concentrations against *Alternaria*.

Botanical extracts	**Colony diameter (cm)**		**Percent inhibition over control**		**Mean**
	1000 PPM	**2000PPM**	**1000 PPM**	**2000PPM**	**Mean**
Origanum leaf	0	0	100	100	100
Origanum flower	0	0	100	100	100
Lemon balm	4	4	0	0	0
Artemisia	4	4	0	0	0
Lavendar	4	4	0	0	0
Walnut leaf	4	4	0	0	0
Walnut fruit	4	4	0	0	0
Control	4				

Evaluation of various natural and synthetic Medias for growth parameters of Alternaria and Diplodia pathogens

Four synthetic media viz., Potato Dextrose Agar (PDA), Agar Medium C (AMC), Rose Bengal Agar (RBA), Nutrient Agar (NA) and three laboratory made media viz., Oregon leaf extract agar (OLEA), Vista Bela leaf extract agar (VLEA), Apple peel juice agar (APJA) were evaluated for the growth parameters of *Alternaria* and *Diploidia* causing leaf spot and canker disease in apple. Highest

colony growth of Alternaria after 15 days of incubation was observed in PDA and AMC medium with 4cm and 3.5 cm respectively. While least colony diameter was observed in NA (1.5cm) medium.In all the media, the colony morphology was observed dark green to light green except in Apple peel juice agar (APJA) in which the colony was translucent in appearance.While in case of *Diploidia* highest colony growth after 25 days of incubation was observed in PDA, OLEA, VLEA and APJA media, while least (3cm) in AMC media. The colony morphology varied from light green to brown in colour and sporulation was observed only in OLEA as shown in Table-23.

Table-23 Evaluation of various media for various parameters of *Alternaria* and Diplodia pathogens

Name of media	Alternaria			Diplodia		
	Colony diameter (cm) after 7 days	Colony morphology	Sporul-ation	Colony diameter (cm)	Colony morphology	Sporul-ation
Potato Dextrose Agar (PDA)	4	Greenish	Present	4	Brownish	Absent
Agar Medium C (AMC)	3.5	Dark green	Present	3	Whitish fluffy mycelium	Absent
Rose Bengal Agar (RBA)	2	Dark-brown	Present	3.5	Whitish	Absent
Nutrient Agar (NA)	1.5	Brown	Present	-	-	-
Apple cv. Oregon Spur leaf extract agar (OLEA)	2.7	Whitish	Present	4	Brownish	Present
Apple cv. Vista Bela leaf extract agar (VLEA)	2	Dark green	Present	4	Light green	Absent
Apple peel juice agar (APJA)	3.5	Translucent	Few spores	4	Light brown	Absent

Agricultural Entomology

Bionomics, modeling and management of sucking pest complex of temperate fruits

Effect of growth stage and location of shoots within apple tree on the incidence of green apple aphid, Aphis pomi DeGeer

To determine the effect of the growth stage of current-year shoots and their location within the tree on the pattern of *A. pomi* incidence, the aphid populations were sampled from apple cv Coe Red Fuji and other standard varieties in high and medium-density orchards. On each tree, 15-20 shoots from both the top and bottom halves of the canopy were sampled. Based on the growth activity, each sampled shoot was categorized as growing, hardening-off, or hardened-off. The data were subject to binomial regression. It was found that the growth stage of the shoots ($\chi^2_{(2,\ N = 918)} = 485.57,\ p < 0.01$) as well as their location within the canopy ($\chi^2_{(1,\ N = 918)} = 91.33,\ p < 0.01$) have a significant effect on the incidence of green apple aphid. It was found that the shoots in the growing stage were most susceptible followed by the hardening-off and hardened shoots (Fig-15).

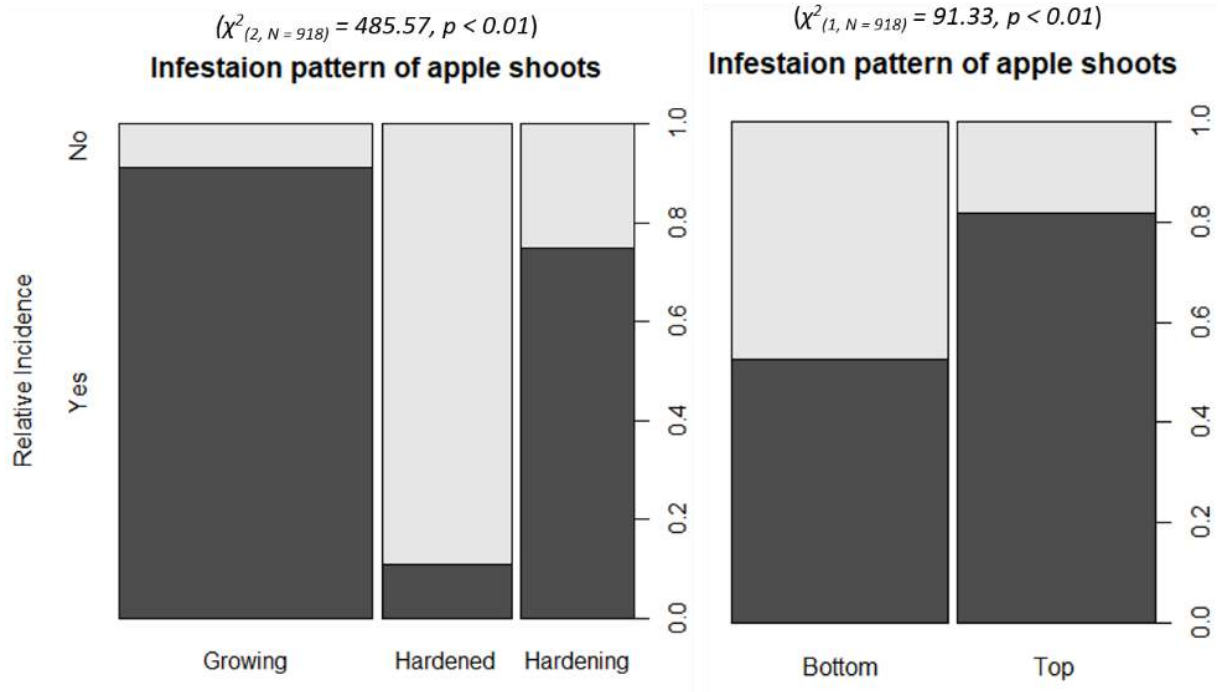
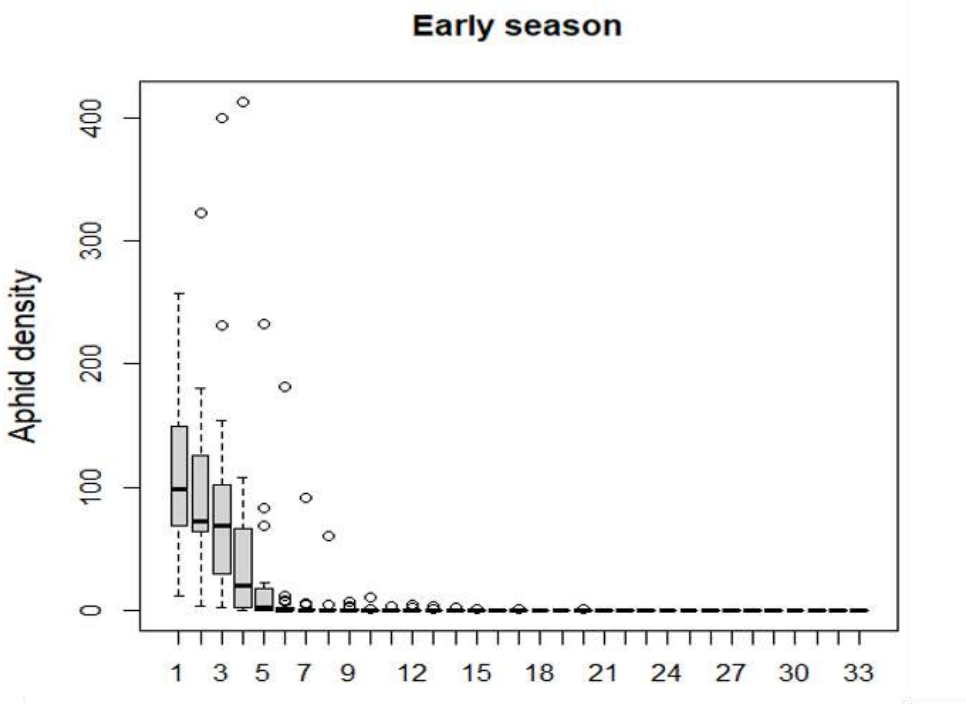


Fig-15. Effect of growth stage and location of the shoots within the canopy of the apple tree on the incidence of green apple aphid, *Aphis pomi*.

Spatial distribution of green apple aphid, Aphis pomi DeGeer on apple shoots

To determine the spatial distribution of the green apple aphid, *Aphis pomi* along the apple shoots, the aphid populations were sampled by destructive sampling among Coe Red Fuji trees and the shoots were brought to the laboratory to count the number of aphids on each leaf. On each shoot, the leaves were numbered consecutively from the tip to the base. The terminal bud along with unexpanded leaves was considered leaf number 1. The sampling was continued throughout the season. The effect of leaf position on the incidence of green apple aphid was significant throughout the season (Fig-16).



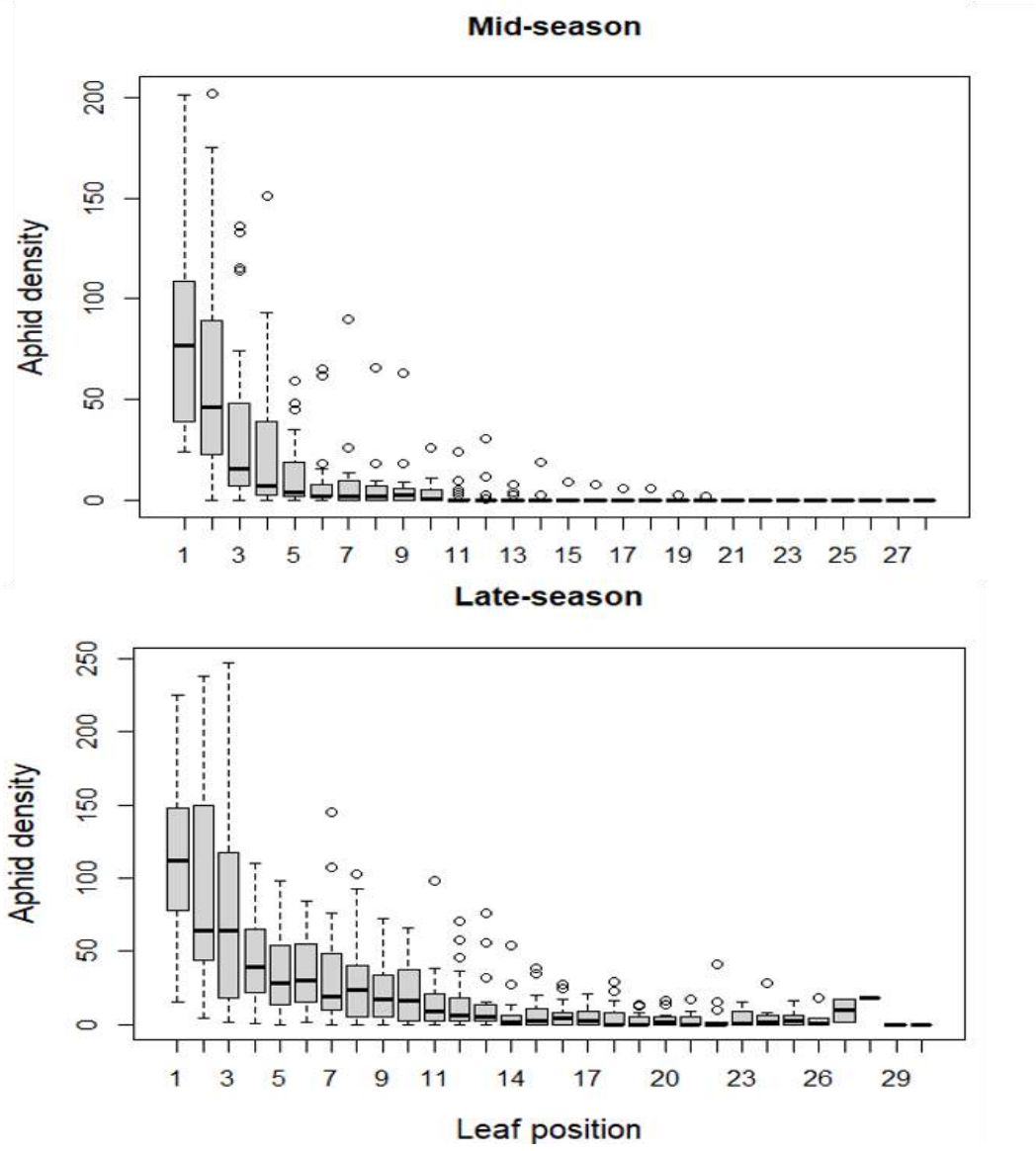


Fig.16: Season-long spatial distribution of *Aphis pomi* on apple shoots by leaf position

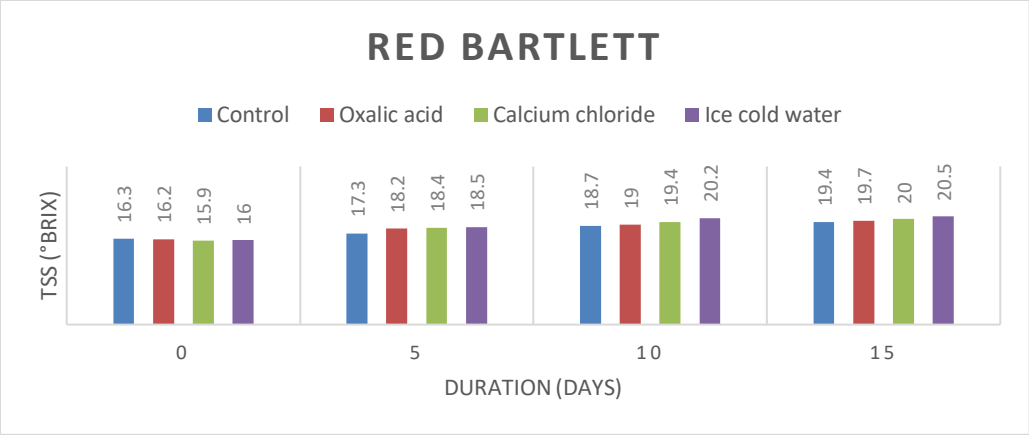
In the early season, the aphids tend to clump on leaves 1 to 5. Also, the incidence of the aphids is highest at the beginning of infestation (June). By mid-season (July), the aphid incidence declines slightly with the production of a large number of winged adults. The aphid infestation spreads to leaf number 10. By the end of the season (August), the aphid incidence spreads to most of the leaves present, mainly because of the maturation of the growing tip and setting off of the terminal bud.

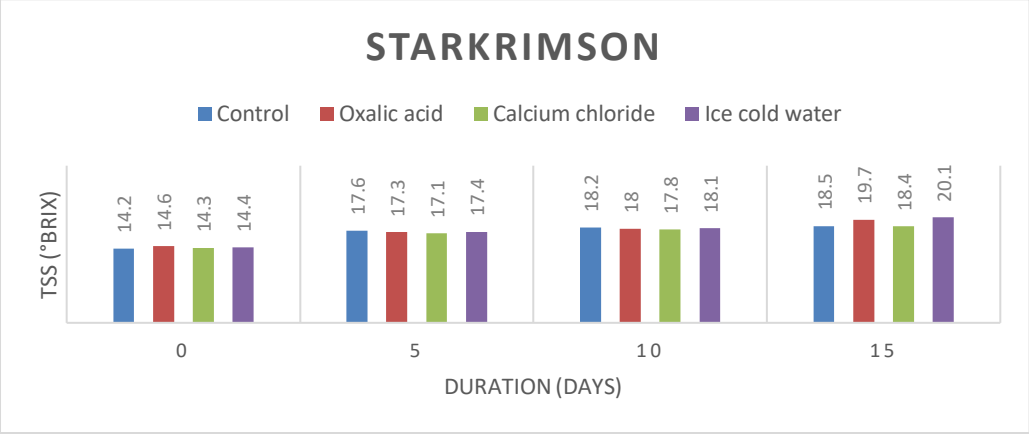
Post Harvest Technology

Effect of various post harvest treatments on storage in pear

The storage study on fruits of pear cvs. Starkrimson, Red Bartlett and Carmen) was carried out at ambient temperature. Various post-harvest treatments viz. cold shock (CS) or ice-cold water, calcium chloride (CC) and oxalic acid (OA) were given to the fruits of all varieties alongside untreated fruit samples kept as control. The physico-chemical properties such as colour (l*, a*, b*), firmness (number) and total soluble solids (TSS, °Brix) were studied over the period of storage at ambient conditions and comparison was made between treated and untreated samples. The fruits were thoroughly washed under running tap water to remove the field heat and dust present on their surfaces. After washing samples were treated with 2% $CaCl_2$ solution, 1% oxalic acid solution and ice-cold water for 2 min, 10 min and 2 min, respectively. The storage study was carried out for 15 days, zero day being the day of harvesting. Observations were made at 5 days interval.

During this study, Starkrimson was observed to have the lowest TSS in controlled sample followed by Carmen and Red Bartlett. During the storage period all three varieties showed increase in TSS value which is due to the continuation of conversion of starch into sugars even after harvesting. It was found that samples treated with oxalic acid and calcium chloride had lower rise in TSS, which may be due to the fact that these chemicals retards the ripening rate after harvesting. The decrease in ripening rate is desirable since it extend the shelf-life of the fruit.





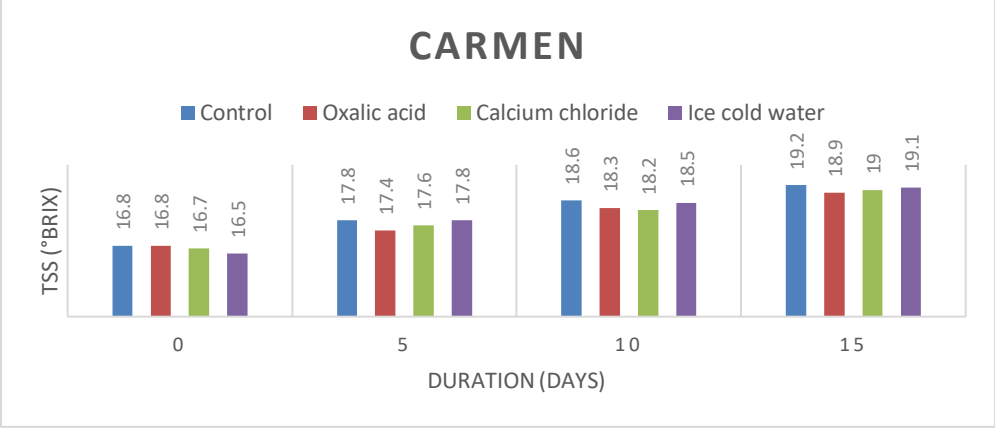


Fig-17 Effect of chemical treatments and storage duration on TSS (°Brix) of pear varieties during ambient storage.

In case of Carmen, samples treated with cold shock showed similar trend of rise in TSS, which implies no significant effect of cold shock on extending its shelf life. The difference in rise in TSS in Starkrimson was not significant during the first ten days. However after 15 days. there was significant rise in TSS of samples treated with oxalic acid. Similarly, cv.Red Bartlett samples treated with calcium chloride had higher TSS value in comparison with oxalic acid, but that difference was not statistically significant.

The firmness of fruits decreased with storage periods with all treatments irrespective of varietal effect. It was observed that cv. Carmen had lowest firmness among the three varieties ~49.4 to 51.1 (at 0^{th} day). The effect of oxalic acid and calcium chloride on preserving the firmness of fruit over the storage period was clearly evident.

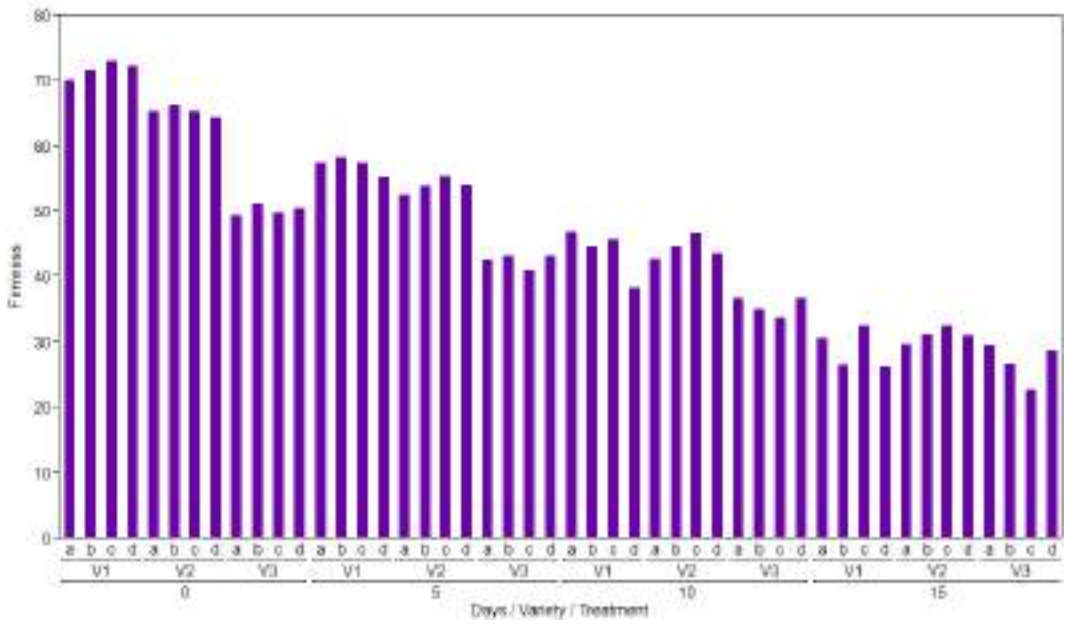


Fig-18. Effect of treatments (variety, duration and chemical treatments) on firmness of fruits during ambient storage

Note: V1, V2 and V3 are Red Bartlett, Starkrimson, Carmen, respectively; a, b, c and d are control, oxalic acid treated, calcium chloride treated and cold shock treated respectively.

The colour of treated sample stored in ambient conditions were studied using colour HunterLab (Model: ColorFlex EZ). The color values were measured in L*, a* and b* color space values. It was observed in all the treated samples that there was slight rise in L* values and b* values, which meant an increase in yellowness and whiteness. But in case of control, L* and b* values decreased with storage period. The L* value was increased with storage time in all the varieties when treated with **CC.** In case of **OA** treated samples Red Bartlett showed an increase in L* values up to 5 days followed by decrease. Whereas the, other two varieties always showed a rise rise in the whiteness. The a* values represent the redness or greenness in samples. It was observed that a* values significantly decreased in control and **CS** treated samples.

Starkrimson (Control at 0 day)

Starkrimson (Control at 15 day)

Starkrimson treated with CC and OA at 15 day

Carmen (Control at 0 day)

Carmen (Control at 15 day)

Carmen treated with CC and OA at 15 day

The OA and CC very well-preserved a* values with slight decrease in all the varieties but Starkrimson preserved its redness constantly over the storage periods (**Fig-19.).** But in other two varieties the redness decreased during storage.

Table-24: Effect of pre-treatments on colour spaces (L*, a* and b* values) of fruit of different pear cultivars during ambient storage

		Storage			
Cultivars	**Treatment**	**Day 0**	**Day 5**	**Day 10**	**Day 15**
L*					
Red Bartlett	Control	46.01	38.15	32.68	25.67
	Oxalic acid	42.32	44.3	43.13	37.1
	Calcium chloride	41.91	51.1	52.04	50.36
	Cold shock	48.7	49.55	53.67	49.5
Starkrimson	Control	38.88	38.15	37.12	35.87
	Oxalic acid	37.7	43.1	45.04	47.17
	Calcium chloride	36.5	37.95	38.17	40.6
	Cold shock	39.72	34.37	31.12	29.17
Carmen	Control	54.62	64.12	65.57	67.12
	Oxalic acid	53.4	60.2	61.4	62.71
	Calcium chloride	54.83	67.57	68.4	69.45
	Cold shock	52.4	62.17	64.19	65.12
a*					
Red Bartlett	Control	14.07	10.18	8.6	6.08
	Oxalic acid	15.96	16.47	15.36	11.17
	Calcium chloride	16.2	17.25	17.22	14.57
	Cold shock	14.8	14.86	13.3	11.9
Starkrimson	Control	15.1	10.18	9.78	7.12
	Oxalic acid	14.5	15.3	15.17	17.12
	Calcium chloride	14.8	15.2	15.4	16.4
	Cold shock	14.49	11.03	10.05	8.12
Carmen	Control	17.02	13.6	12.61	10.5
	Oxalic acid	20.78	15.2	13.5	12.67
	Calcium chloride	18.7	14.75	13.7	13.6

	Cold shock	19.7	14.2	12.17	12.1
b*					
Red Bartlett	Control	15.13	3.63	4.87	3.12
	Oxalic acid	17.24	17.6	18.4	9.27
	Calcium chloride	15.14	18.87	19.62	16.22
	Cold shock	18.91	19.1	22.23	20.3
Starkrimson	Control	5.84	3.63	3.12	2.47
	Oxalic acid	4.33	6.99	7.49	9.11
	Calcium chloride	3.43	3.96	5.6	7.12
	Cold shock	5.49	3.79	2.97	1.7
Carmen	Control	25.14	31.9	33.1	34.17
	Oxalic acid	23.49	29.01	32.7	33.13
	Calcium chloride	28.66	36.62	37.1	37.5
	Cold shock	24.8	33.11	34.12	35.01

In case of CC treated samples the decrease in redness was less in comparison with OA treated samples. Among three cultivars, Starkrimson had lowest b* values ranged between 3.43 (i.e., CC treated at 0^{th} day) and 5.84 (Control) followed by Red Bartlett and Carmen. The b* values increased in all treated sample in all three varieties but decreased in Red Bartlett and Starkrimson in control sample.

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:

DUS centre for temperate fruits and nuts

Meeting convened at MARES, SKUAST-Kargil on 7th August 2021 for establishment of reference bank of protected varieties under PPV&FRA, New Delhi

A meeting was convened on 7th August, 2021 at Mountain Agriculture Research & Extension Station, SKUASI-K, Kargil by DUS Centre for temperate fruits and nuts, ICAR-Central Institute of Temperate Horticulture, Srinagar for establishment of reference gene bank of varieties protected by PPV&FRA in Ladakh region. Due to a pest called Codling moth which is a quarantine pest for Ladakh region precautionary measure was taken to avoid penetration of pest to other areas. It was therefore discussed with MARES, SKUAST-K, Kargil that a separate reference gene bank of protected varieties may be established at MARES, SKUAST-K, Kargil in addition to other reference varieties available at ICAR-CITH, Srinagar and the same was agreed by the ln-charge station. During the meeting it was also discussed that the Ladakh region is having entirely different agro-climate (cold arid region) and expression of traits in other reference varieties can be studied in comparison to ICAR-CITH, Srinagar. In this regard it was decided that field gene bank of reference varieties of protected apricot varieties (30 No.) will be initiated during 2021-22. For establishment and maintenance of varieties budget requirement for procuring rootstocks, labour engagement in grafting & budding, field operations, plant protection measures, nutrition management, irrigation etc. and for procurement of fertilizers, pesticides, irrigation pipes etc will be needed for better survival and performance of the varieties. Therefore, annual budget requirement (additional budget to DUS Centre) for the station was proposed to PPV&FRA, New Delhi and same was received and sent to MARES, SKUAST-K, Kargil.

DUS testing of farmers varieties

DUS testing of farmers varieties was done during 2021 in Ladakh (pear, peach and walnut) and Himachal Pradesh (walnut and apple). The data has been compiled as per the DUS testing parameters for further submission to PPV&FRA for their protection.



Reg/2016/1122 **Reg/2016/1124** **Reg/2016/1125**



Reg/2015/1527 **Reg/2016/1097** **Reg/2016/1098**



Reg/2016/1096 **Reg/2016/1128**

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

Harvesting apples at optimum ripening stage is very crucial for maintaining the quality attributes and shelf life of those fruits. When fruit are harvested at the sub-optimal ripening stage, their taste, aroma and nutritional qualities do not reach up to the mark for the consumer's acceptance. Alternatively, when these fruits are harvested at a late ripe stage, they rapidly spoil and their shelf life becomes significantly low along with difficulties in transport. Current harvesting practice of apple mainly relies on visual screening based on fruit colour change or destructive monitoring of fruit firmness and total soluble solid content, which is often not very reliable. Easy and non-destructive determination of optimum ripening and harvesting stage of apples would greatly help farmers to quickly select optimum harvesting stage. In this project, identification of novel volatile markers for the prediction of ripening stage of apple has been done and highly sensitive E-nose sensor for the non-destructive prediction of ripening stages of apple using market volatiles has been developed. The developed sensor can also predict selected quality attributes, such as sugar, TSS and firmness content non-destructively. Furthermore, the sensor has been extensively fielding validated calibrated based on field trials at apple orchards of ICAR-CITH (Fig-20). In addition the VOC profiling done revealed VOC markers for postharvest shelf life prediction in apple**.** This sensor technology is expected to tremendously help farmers to select appropriate ripening stage for fruit harvesting which will ensure high fruit quality and shelf life. Consumers will be the second stakeholders who will get good quality nutritionally rich fruits to eat. Taken together, farmers will gain high economic returns by selling good quality fruits and consumers will get quality fruit to consume. Apple growers, in the current mobile phone generation could easily accept this sensor technology (e-nose sensor) for determining the correct harvesting time without the usage of difficult observation-based recognition. The proposed solution has economic significance.

Fig-20: E-nose for non-destructive determination of ripening and quality attributes of apple

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

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

During 2021 two hybrids have been registered through ICAR-NBPGR, New Delhi and INGR numbers were obtained. 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. Technologies developed by the Institute were compiled and communicated to ICAR-ATAARI for further compilation and publication at ICAR level. Technology demonstrations were laid in farmer's field for evaluation of different technologies including apple hybrids, rootstock multiplication under controlled conditions etc. Organized three training programmes for Horticulture Development Departments officials, supporting staff of horticulture and nursery growers of Himachal Pradesh state during 2021 to generate awareness about latest developments in temperate horticulture and to improve technical skill. First training programme was organized for supporting staff of Horticulture Department, Government of Himachal Pradesh on "Technical skill improvement for enhancing farm output" from 15-19th November, 2021 followed by seven days training programme to Horticulture Officers on "Enhancing productivity through advanced technological interventions in temperate fruit crops" from 1st to 7th, December, 2021 followed by five days training programme to Nursery Growers on "Quality planting

material production technologies in temperate fruit crops for enhancing farm income for nursery growers of Himachal Pradesh" from 13 to 17th December, 2021 at ICAR-Central Institute of Temperate Horticulture, Srinagar. During the training programmes participants from different districts of Himachal Pradesh were exposed to latest developments in temperate horticulture and were given hands on training on different techniques involved in plant propagation, multiplication, canopy management, layout method, vertical nursery production etc.

Walnut Propagation for Production of Quality Planting Material for Walnut Promotion in Uttrakhand

The non availability of quality planting material of standard cultivars is is major hindrance for promotion of walnut in India which is mainly grown in J&K, Uttarakhand, Himachal Pradesh and upto limited extent in Ladakh and Arunachal Pradesh. Due to health benefit of walnut, the demand of grafted /budded plants has increased much during last decade. Due to low propagation success in walnut as compared to other pome and stone fruits, the increase in acreage under this crop is not possible till sufficient availability of quality planting material. The propagation success depends upon many factors and success of different methods varies from region to region due to prevailing microclimate conditions. 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 it's planting in Uttarakhand was undertaken. The walnut propagation was done in polyhouse conditions at ICAR-CITH, Srinagar, Regional Station Mukteshwar and different nurseries of Deptt of Forest, Uttarakhand i.e. especially Magra and Sony.

Fruiting in walnut of Standard cultivar of walnut at ICAR-CITH, Srinagar

During December 2021, 3000 grafted plants of walnut were provided to UFRMP-JICA, Dehradun for further planting at different locations of Uttarakhand. About 1000 grafted plants were raised in different nurseries of Deptt of Forest, Uttarakhand mainly at Sony and Magra. Regional Station, Mukteshwar also produced about 1100 plants, out of which 700 were provided for UFRMP-JICA.

To see the success of chip budding and cleft grafting trial was conducted at ICAR-CITH, Srinagar. Besides this, trial was also conducted to see the best time of grafting of different Institute released varieties. Two methods of propagation *i.e.* chip and cleft were compared at different dates (5th Feb,12th Feb, 19th Feb, 26th Feb, 5th March and 15th March) in CITH-W-1 under polyhouse conditions. The overall success irrespective of dates was more in cleft grafting as compared to chip budding. Hence cleft grafting is recommended for walnut propagation under polyhouse conditions.

In comparative studies on success in cleft grafting performed on different dates among different walnut varieties, 10 Institute released varieties were compared for cleft grafting success performed on different dates i.e. 12th Feb.,19th Feb., 26th Feb., and 5th March, 2021. The CITH- W-1 gave maximum success when performed on 12th February followed by 19th February, 26th February and 5th March. This variety offered more time period to get success of 50 percent and more. Similarly, CITH W-2 gave maximum success on 12th February, CITH W-3 on 5th March and CITH W-4 on 26th February. CITH W-4 also offered more time span for grafting to get more success. CITH W-5 also gave better success on 26th February, CITH W-7 on 26th February, and CITH W-8 on 12th February. Similarly CITH W-9 gave maximum on 26th February and CITH-W-10 gave maximum success on 19th February. Among all varieties CITH W-2, 8 and 9 gave low value for maximum success as compared to other varieties. Among different varieties CITH W 1, 4, 7 and 10 offered wide time span for getting grafting success more than 50 percent, hence seems to be better for large scale multiplication.

In the walnut mother block of ICAR-CITH, RS Mukteshwar some additions were made and various growth parameters were recorded. Grafting was also practised at Mukteshwar with good success rate and maximum plant height was recorded in CITH Walnut-1 (309.32 cm) followed by CITH RS Selection-5 (292.29 cm) and CITH RS Selection-6 (246.26 cm) respectively.

Challenge programme on canopy Management and Canopy Architectural Engineering in Temperate Fruits

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) and four rootstocks (Seedling, MM 111, MM 106 & M 9) were evaluated for various fruit and yield traits. Due to climatic conditions prevailed especially dry spell & lockdown and Covid 19 restrictions full potential could not be harvested in this year and incidences of diseases and pests were more in this year due to failure of spray in earlier stages which lead to poor quality fruit yield. Among all systems, varieties and rootstocks, maximum yield was recorded in Oregon Spur (28.6 t/ha) on MM 106 rootstock trained on vertical axis system followed by Oregon Spur (22.5 t/ha) on MM 106 rootstock trained on modified central leader system, Oregon Spur on M 9 (21.9t/ha) and Red Delicious on MM 106 rootstock on vertical axis system. However number of fruits/ plant (57.3) were recorded highest in Oregon Spur on MM 106 rootstock trained on modified central leader system while fruit weight was highest (174 g) in Oregon Spur on seedling rootstock in vertical axis system. In pear, architectural engineering experiment, 4 varieties, 2 rootstocks and 4 training systems were used. In case of BA 29 C rootstock, average yield was highest in Red Bartlett (19.58 (t/ha) followed by William Bartlett (13.04 t/ha), Starkrimson (12.79 t/ha) and Kashmiri Nakh (12.42 t/ha) while in case of Q C rootstock, average yield was more in Red Bartlett (11.31 t/ha) followed by Starkrimson (10.02 t/ha), William Bartlett (8.65 t/ha) and Kashmiri Nakh (8.51 t/ha), respectively.In case of training systems, highest yield on B A 29 C rootstock was in Vertcal axis system (37.49 t/ha) followed by Tatura Trellies (8.93 (t/ha), Espalier (6.09 (t/ha) and MCLS (5.31 t/ha), respectively while on Q C rootstock, it was maximum in Vertical axis (26.54 t/ha) folloed by Espalier (5.08 t/ha), MCLS (3.58 t/ha) and Tatura Trellis (3.29 t/ha), respectively. In overall, Red Bartlett on BA 29 C rootstock trained on vertical axis gave maximum yield and found to be best combination followed by Starkrimson, William Bartlett and Kahmiri Nakh.

At ICAR-CITH, RS Mukteshwar, data on growth parameters in apple experiment was recorded and fruiting was observed in peach experiment in which highest fruit yield (6.5 kg) were recorded under open centre system in Red June cultivar.

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

The All India Network Research Project on Onion & Garlic is going on at ICAR-CITH, Srinagar and its Regional station Mukeshwar. The findings in this project are briefly presented below:

Crop improvement

In Germplasm collection, conservation and evaluation, no new collection was made during the year. However, 111previous collections and selections were maintained and conserved. In garlic, 81 previous collections were evaluated against 4 checks. There were statistically significant differences among genotypes for marketable yield that ranged from 109.00 to 455.00 q/ha. The mean marketable yield of germplasm was found to be 255.78 q/ha. CITH-G-5 expressed the highest yield.

Crop production

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

In this experiment two varieties and 6 treatments were tried including RDF for short day conditions as control. There were significant differences for marketable yield and related parameters with varying fertilizer dosage in Brown Spanish and Yellow Globe. In Brown Spanish, highest yield (60.72)was found in FYM: 15, N: 220, P: 80, K: 120 in treatment T6 followed by FYM: 15, N: 198, P: 72, K: 108 in T5 (54.45) while in Yellow Globe, it was observed 54.93 and 49.94 in in similar treatments.

Cumulative % loss by number

In Brown Spanish, lowest loss (6.31 & 9.81) was found in T6 (FYM: 15, N: 220, P: 80, K: 120) and T2 (FYM: 15, N: 132, P: 48, K: 72) while in Yellow Globe, it was 8.80&12.49 in T5 (FYM: 15, N: 198, P: 72, K: 108) and T6 (FYM: 15, N: 220, P: 80, K: 120), respectively.

Cumulative % loss by weight

In Brown Spanish, lowest % loss (15.11) was observed in treatment T6(FYM: 15, N: 220, P: 80, K: 120) while in Yellow Globe, it was 9.86 in T5 (FYM: 15, N: 198, P: 72, K: 108)

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

In this experiment two varieties and 6 treatments including RDF for short day conditions as check were used and there were no significant differences for marketable yield and related parameters with varying fertilizer dosage in CITH-G-1 and CITH-G-3. In CITH-G-1, highest (33.55) was found in T6 (FYM: 15, N: 200, P: 100, K: 100) and 31.92 in T5 (FYM: 15, N: 180, P: 90, K: 90) and in CITH-G-3, it was observed in 32.13 & 31.30 in T6 (FYM: 15, N: 200, P: 100, K: 100) and T4 (FYM: 15, N: 160, P: 80, K: 80).

Cumulative % loss by number

In CITH-G-1, lowest loss was found as 9.86 in T1 (FYM: 15, N: 100, P: 50, K: 50) and in CITH-G-3, it was observed as 8.42 in T4 (FYM: 15, N: 160, P: 80, K: 80).

Cumulative % loss by weight

In CITH-G-1, lowest % loss was observed as 5.60 in treatment T2 (FYM: 15, N: 120, P: 60, K: 60) and in Yellow Globe, it was 4.53 in T5 (FYM: 15, N: 180, P: 90, K: 90).

Crop protection

In this experiment, 8 treatments were evaluated for control of insect pests and diseases of garlic. Treatment T6 (Fipronil 5% SC @1 ml/L as control) was most effective for controlling thrips in terms of percent damage). The other treatments like T4 (Azoxystrobin 20 % + Difenconazole 12.5 % SC (1.25 ml/L)), T1 (Cyantraniliprole 10.26 OD @ 0.9 ml/L)and T3 (Metiram 55% + Pyraclostrobin 5 % WG (2g/L) + Cyantraniliprole (0.9 ml/L)) performed at par with T6.

For controlling Stemphylium blight that appears very late in the season, treatment T2(Metiram 55% + Pyraclostrobin 5 % WG @ 2 g/L) was most effective. However, similar control was seen with treatments T3 (Metiram 55% + Pyraclostrobin 5 % WG (2g/L) + Cyantraniliprole (0.9 ml/L), T5 (Azoxystrobin 20 % + Difenconazole 12.5 % SC (1.25 ml/L) + Cyantraniliprole (0.9 ml/L), T7 (Propiconazol 25% EC as Control) and T1 (Cyantraniliprole 10.26 OD @ 0.9 ml/L).

Seed Production

During the year, 12.30, 6.70, 8.0 and 1 kg seed of onion varieties Brown Spanish, Yellow Globe, CITH-O-1 and CITH-O-2, was produced, respectively while in garlic, 38.40& 33.60 kg seed of CITH-G 1 & CITH-G-3 was produced.

ICAR-CITH, RS Mukteshwar

In long day garlic, total seven genotypes including check cultivar *i.e.* CITH-MG-1 under IET long day garlic were evaluated for their growth, yield and its qualitative traits during *Rabi* extended summer 2020-2021. The maximum plant height was recorded in GN 20-17 (49.60 cm) while, the minimum height was observed in CITH-MG-1 (31.59 cm). The maximum TSS was recorded in GN 20-08 (38.50 °B) while, it was minimum in CITH-MG-1 (32.20 °B). The maximum yield was recorded in. CITH-MG-1 (195 q/ha) followed by GN 20-17 (137.20 q/ha yield), respectively.

In AVT- I, total thirteen genotypes including check cultivar *i.e.* CITH -MG-1 were evaluatedand maximum yield was recorded in GN 20-60 (192.35 q/ha) followed by CITH MG-1 (170q/ha) respectively.

In long day red onion**,** eight genotypes were evaluated under IET trial and maximum yield was recorded in RVA 20-18 (426.53 q/ha) followed by RVA 20-16 (344.50 q/ha), RVA 20-12 (231.67 q/ha) and RVA 20-14 (172.96 q/ha) respectively. However, maximum T.S.S. (°B) was recorded in RVA 20-09 (15.17 °B) followed by RVA 20-12 (13.47 °B), respectively.

In AVT-I on long day red onion yybrid, total seven genotypes were evaluated maximum yield was observed in RHB-20-48 (279.80 q/ha) followed by RHB-20-45 (226.52 q/ha) and RHB-20-51 (218.24 q/ha), respectively. The maximum total soluble solid were recorded in RHB-20-45 (14.2 °B) followed by RHB-20-49 (12.9 °B), RHB-20-51 (12.7 °B), RHB-20-41 (12.5 °B) and RHB-20-47 (12.5 °B), respectively.

In long day white onion (AVT- I) total five genotypes were evaluated highest yield was observed in WVB 20-57 (223.53 q/ha) followed by WVB 20-55 (182.04 q/ha) and WVB 20-59 (162.33 q/ha), respectively.

In AVT- II long day white onion, total five genotypes were evaluated maximum yield was observed in WVC 20-72 (191.16 q/ha) followed by WVC 20-68 (154.82 q/ha) and WVC 20-65 (127.82 q/ha), respectively. However, the highest TSS

was recorded in WVC 20-74 (16.0 °B) followed by WVC 20-65 (12.9°B), WVC 20-70 (12.7 °B) and WVC 20-68 (11.1 °B) respectively.

In Long Day White HTSS AVT- I, total seven genotypes were evaluated and highest yield was recorded in genotype WTB 20-79 (159.91 q/ha) followed by WTB 20-90 (159.47 q/ha) and WTB 20-77 (145.86 q/ha). The highest TSS was recorded in WTB 20-85 (17.05 °B) followed by WTB 20-83 (16.65 °B), WTB 20-81 (16.23 °B), WTB 20-88 (15.35 °B) and WTB 20-79 (12.20 °B), respectively.

All India Coordinated Research Project on Vegetable Crops (AICRP-VC)

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

Ten new collections in paprika, three in chilli and two in kale were made from different districts of Kashmir and details are presented in Table-25

Table-25: Collection of paprika, chilli and kale made during 2021

Crop	Collection name	Source
Paprika	CITH-Paprika-12 to CITH-Paprika-21	Nawakadal, Srinagar
Chilli	CITH-Chilli-7 CITH-Chilli-8 CITH-Chilli-9	Budgam
Kale	CITH-Kale-4	Tangmarg, Baramulla
	CITH-Kale-5	Tangmarg, Baramulla

CITH-Paprika-12

CITH-Paprika-14

CITH-Paprika-15

CITH-Paprika-16

CITH-Paprika-19

CITH-Paprika-21

New paprika collections (2021)

Evaluation and conservation

In kale 3 selections were evaluated and results are presented in Table-26

Table-26: Evaluation and conservation of leafy vegetable (kale) germplasm

Collection	Plant height (cm)	Plant spread (cm)	Leaf length (cm)	Leaf width (cm)	Leaf yield (q/ha)
CITH-Kale-1	Not survived				
CITH-Kale-2					
CITH-Kale-3 (Kawdari)	65.13	27.00	14.86	12.93	173.60

In chilli, 6 selections were evaluated and results are presented in Table-27

Table-27: Evaluation and conservation of chilli germplasm

Collection	Plant height (cm)	Plant spread (cm)	Fruit length (cm)	Fruit width (cm)	Mature fruit color	Mature fruit yield per plant (kg)
CITH-Chilli-1	40.55	32.57	9.35	1.25	Red	0.560
CITH-Chilli-2	42.36	28.17	5.42	0.48	Red	0.452
CITH-Chilli-3	39.57	25.36	5.13	0.87	Red	0.550
CITH-Chilli-4	35.86	29.68	5.24	0.81	Red	0.610
CITH-Chilli-5	40.12	31.25	6.56	0.64	Red	0.347
CITH-Chilli-6	42.25	30.58	4.35	1.26	Red	0.442

In Paprika, 11 selections were evaluated and results on various parameters are presented in Table-28

Table-28: Evaluation and conservation of paprika germplasm

Collection	Plant height (cm)	Plant Spread (cm)	Fruit length (cm)	Fruit width (cm)	Mature fruit color	Mature fruit yield per plant (kg)
CITH-Paprika-1	34.61	18.12	11.91	3.69	Red	1.025
CITH-Paprika-2	32.67	26.53	19.64	3.11	Red	0.531
CITH-Paprika-3	34.33	26.33	10.55	3.68	Red	0.850
CITH-Paprika-4	35.00	30.12	12.10	2.97	Red	0.713
CITH-Paprika-5	32.33	28.65	11.88	3.45	Red	0.516
CITH-Paprika-6	32.83	23.23	10.12	4.11	Red	0.630
CITH-Paprika-7	35.12	19.65	14.21	2.89	Red	0.300
CITH-Paprika-8	34.67	20.50	7.58	3.18	Red	0.465
CITH-Paprika-9	35.32	18.68	11.98	3.65	Red	0.458
CITH-Paprika-10	29.64	15.54	9.67	4.12	Red	0.320
CITH-Paprika-11	30.24	21.57	11.25	3.12	Red	0.856

Varietal and hybrid trials

During the year, the various varietal and hybrid trials were conducted and number of entries evaluated are presenyed in Table-29

Table-29 The number of entries tested in different crops under various trials

Crop	Trial	Number of entries tested
Chilli	IET hybrid	9
	AVT-I hybrid	5
	AVT-II hybrid	8
	IET variety	13
	AVT-I variety	8
	AVT-II variety	6
Determinate tomato	IET hybrid	6
	AVT-I hybrid	9
	AVT-I variety	9
	AVT-II variety	5
Indeterminate tomato	AVT-II variety	8
Cherry tomato	AVT-II variety	6
Capsicum	AVT-II variety	6
Long brinjal	AVT-II variety	11

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

Six-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. DUS test guidelines of UPOV and IBPGR were used in recording observations.

Brief technical programme

Number of genotypes : 62
Number of replications : 2
Spacing : 45cm x 30cm
Experimental design : RCBD
Time of sowing : July 2021
Time of transplanting : August 2021

Morphological traits observed

Plant traits			
Plant height	Plant diameter	Plant shape	Plant growth habit
Leaf traits			
Leaf blade shape	Leaf blade density of curling	Leaf blade recurvature of margin	Leaf anthocyanin coloration
Leaf blade length/diameter	Leaf blade number of lobes and incisions	Leaf colour	Leaf blade folding (transverse section)
Leaf blade curvature of mid rib	Leaf blade depth of incisions	Leaf blade undulation	Leaf pubesence
Leaf blade blistering	Leaf blade margin	Leaf apex shape	Leaf angle
Leaf blade thickness	Number of leaves	Number of pickings	Leaf yield
Midrib colour	Petiole length	Petiole diameter	Petiole colour
Stem traits			
Stem axis elongation and enlargement	Vegetative stem length/ width	Stem thickening	Stem colour

Metric traits observed

1.	Plant height (cm)	6.	Leaf blade thickness (mm)
2.	Plant diameter (cm)	7.	Petiole length (cm)
3.	Leaf blade length (cm)	8.	Petiole width (cm)
4.	Leaf blade width (cm)	9.	Number of lobes
5.	Leaf blade number of incisions	10.	Number of pickings

State Varietal Trial of Pea (Volunteer Center)

Under State Varietal Trial of Pea (Volunteer Center) at Mukteshwar, 10 genotypes of Garden pea were evaluated during *Kharif* 2021 for their growth and yield parameters. The highest plant height was recorded in VL-13 (38.09 cm) followed by Vivek Pea-11 (34.65 cm), PC-531 (33.51 cm), VL-7 (32.85 cm), PSM-3 (31.77 cm) and Arkel (30.67 cm) respectively. The maximum pod length was

recorded in VL-13 (9.50 cm) followed by VL-15 (8.98 cm), VP 1801 (8.34 cm) and VL 1803 (8.33 cm), respectively.

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

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

Activities done during 2020 by ICAR-CITH, Srinagar

The main objective of the project was establishment of ripening and quality associated metabolites for apple that serve as potential biomarkers for sensing using e-nose sensor. During 2020, samples of three varieties of apple (Shireen, Red Delicious and Golden delicious) have been evaluated for various fruit quality traits like TSS, acidity, pH, firmness, ascorbic acid, color parameters, antioxidant activity, total phenols, flavonoids and flavanol content (Table-30). The samples of these three apple cultivars were collected at different pre and post-harvest stages and sent to IIT, Roorkee for further analysis. Electronic nose sensor was developed by IIT Roorkee with enhanced sensitivity of transducer using various combinations of a semiconducting thin film material to selectively sense ripening associated metabolites, also a mobile app was developed for easy application of sensor. Its validation in the field was done in ICAR-CITH, Srinagar and the data recorded was further re-evaluated by electronic nose under laboratory conditions (Table-31).

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

Table-30 Physicochemical parameters of apple cultivars at harvest stage

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

Demonstration of e-Nose to scientific staff in field

Demonstration of e-Nose to students staff in field

Working of e-Nose

Table -31: Comparison of Electronic Nose Sensor Values with refractometer reading

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

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

DUS centre for temperate fruits and nuts

Characterization of apple, walnut and almond reference varieties was performed as per the DUS descriptor developed by ICAR-CITH, Srinagar. The characterized data was converted into different notes which willserve as a data base for comparing candidate varieties with reference varieties at any time. Maintenance of reference varieties is being done and all traits/characters are being tested at nodal centre ICAR-CITH, Srinagar for their uniformity and stability. The new reference variety block of apple representing 250 apple cultivars has been developed for further evaluation and characterization. During the year PPV&FRA has awarded protection to farmer's varieties in apple, apricot and peach which were inspected and recommended by DUS Centre on temperate fruits and nuts, Srinagar. Walnut and almond genotypes were characterized with respect to DUS descriptor and other fruit quality traits.

In walnut, 27 genotypes were evaluated for nut and yield traits. Maximum nut diameter (42.57 mm) was observed in CITH-W-7 while maximum nut length (47.83 mm) was recorded in CITH-W-20. Nut weight (21.26 g) was recorded in CITH-W-3 while highest kernel weight (9.59g) was observed in CITH-W-1. Among 27 Genotypes 10 walnut genotypes have kernel percentage more than 40%. The highest kernel percentage was observed in CITH-W-1 (51.22 %) followed by CITH-W-9 (50.89 %), Turtle (50.57%), CITH-W-11 (49.61 %) and CITH-W-15 (49.21 %). Twenty seven walnuts were evaluated for their fat percent profiling. Among 27 genotypes of walnut, maximum fat percent was observed in CITH-W-9 (69.68 %) and was found significantly superior to all the genotypes except CITH-W-1 (68.74

%). The colour of walnut kernel was measured using colorimeter. L* is the lightness component which range from 0 to 100, and parameter a*(from green to red), and b (from blue to yellow). Hue value ranges from 75.85 to 53.12 while value of chroma ranges from 31.97 to 8.90. In terms of whiteness index, CITH-W-10 was found significantly superior as compared to all other varieties but was found significantly at par with CITH-W-8 and CITH-W-15 (Table. 32,33 & 34).

Table-32: Nut and kernel quality traits in different walnut genotypes

Name of variety	Nut dia. (mm)	Nut length (mm)	Nut weight (g)	Shell thickness (mm)	Kernel weight (g)	Kernel percentage
CITH-W-1	42.38^{a}	45.07^{bac}	18.72^{dc}	o.89^{i}	9.59^{a}	51.22^{a}
CITH-W-2	33.17^{gfhe}	35.84^{ed}	14.69^{e}	1.40^{g}	5.51^{ed}	37.50^{efdc}
CITH-W-3	34.75^{gdfe}	35.08^{ed}	21.26^{a}	1.77^{ecd}	5.08^{e}	23.90^{j}
CITH-W-4	35.90^{gdfce}	32.83^{e}	18.13^{d}	1.77^{ecd}	5.50^{ed}	30.40^{hjfig}
CITH-W-5	32.49^{gifh}	44.23^{bac}	14.24^{fe}	1.76^{ecd}	4.56^{e}	32.01^{hefig}
CITH-W-6	41.44 ^{ab}	44.14^{bac}	20.51^{bac}	1.48^{fg}	5.14^{e}	25.03^{ji}
CITH-W-7	42.57 ^{a}	45.32^{ba}	20.21^{bac}	1.59^{efg}	5.32^{e}	26.30^{hji}
CITH-W-8	32.49^{gifh}	28.14^{f}	11.43^{g}	1.87^{bc}	5.15^{e}	45.37^{bac}
CITH-W-9	32.39^{gih}	41.26^{c}	14.24^{fe}	1.71^{ecd}	7.26^{cb}	50.89^{a}
CITH-W-10	36.66 ^{dce}	36.66^{ed}	17.22^{d}	1.65^{efd}	6.66^{cbd}	39.77^{edc}
CITH-W-11	35.60^{gdfce}	46.27^{ba}	13.98^{fe}	1.86^{bc}	6.93^{cb}	49.61^{a}
CITH-W-12	34.17^{gfhe}	46.17^{ba}	19.24^{bdc}	1.81^{cd}	5.50^{ed}	28.58^{hjig}
CITH-W-13	34.36^{gdfhe}	45.69^{ba}	18.57^{dc}	1.59^{efg}	6.69^{cbd}	36.03^{efdg}
CITH-W-14	29.19^{ij}	34.53^{ed}	12.54^{fg}	2.11^{a}	4.53^{e}	36.02^{efdg}
CITH-W-15	35.46^{gdfce}	47.14^{ba}	14.50^{fe}	1.59^{efg}	7.15^{cb}	49.21^{a}
CITH-W-16	33.86^{gfhe}	43.19^{bc}	17.65^{d}	2.03^{ba}	6.86^{cb}	38.97^{edc}
CITH-W-17	35.46^{gdfce}	45.13^{ba}	18.86^{bdc}	o.96^{i}	6.80^{cbd}	36.15^{efdg}
CITH-W-18	39.01^{bc}	47.17^{ba}	20.76^{ba}	o.93^{i}	7.18^{cb}	34.55^{efdg}
CITH-W-19	31.08^{ihj}	43.75^{bc}	14.09^{fe}	1.24^{h}	5.08^{e}	36.02^{efdg}
CITH-W-20	33.56^{gfhe}	47.83^{a}	17.26^{d}	2.04^{ba}	7.83^{b}	45.31^{bac}
Hamdan	37.87^{dc}	43.33^{bc}	18.62^{dc}	o.90^{i}	7.67^{cb}	41.24^{bdc}
Turtle	36.01^{gdfce}	36.94^{d}	14.40^{fe}	o.91^{i}	7.27^{cb}	50.57^{a}
OpexCaulchery	28.63^{j}	34.96^{ed}	13.97^{fe}	o.94^{i}	4.63^{e}	33.22^{hefdg}
Cheinovo	36.10^{dfce}	37.70^{d}	14.03^{fe}	1.85^{bcd}	6.70^{cbd}	47.86^{ba}
Nugget	24.21^{k}	34.54^{ed}	13.35^{fe}	2.10^{a}	4.54^{e}	34.07^{hefdg}
Sulaiman	33.18^{gfhe}	36.84^{d}	18.79^{bdc}	1.87^{bc}	6.51^{cbd}	34.79^{efdg}
Franquette	36.62^{dce}	33.92^{ed}	14.35^{fe}	1.40^{g}	6.92^{cb}	48.21^{ba}

Table-33: Fat percentage of different walnut genotypes

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

Table-34:. Colour parameters of walnut kernels in different genotypes

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

CITH-W-19	42.37^{fg}	10.69^{gfe}	20.15^{i}	-53.24^{edgcf}	62.09^{ih}	22.81^{j}	37.96^{ed}
CITH-W-20	49.75^{c}	9.2^{jk}	24.6d^{e}	-41.72^{ebdac}	69.52^{cd}	26.26^{e}	43.29^{b}
Hamdan	24.46^{o}	5.34^{on}	7.11^{q}	-32.53b^{ac}	53.12^{l}	8.90^{p}	23.93^{n}
Tutle	44.03^{e}	11.44^{cfed}	26.61^{b}	-19.67^{a}	66.76^{ef}	28.96^{b}	36.97^{e}
OpexCaulchery	44.21^{e}	11.46^{cfed}	24.60^{de}	-59.3^{edc}	65.04^{ef}	27.14^{d}	37.95^{ed}
Cheinovo	43.67^{e}	9.14^{jk}	23.16^{f}	-50.15^{bdgc}	68.48^{ed}	24.90^{hg}	38.41^{d}
Nugget	32.39^{n}	9.67^{jhi}	15.64^{n}	-57.36^{edgc}	58.3^{jk}	18.39^{m}	29.93^{m}
Suleiman	38.40^{h}	10.69^{gfe}	21.99^{g}	-60.64^{edg}	64.10^{gh}	24.46^{hi}	33.72^{gih}
Franquette	35.55^{ml}	10.26^{ghi}	19.17^{j}	-58.71^{edc}	61.87^{ih}	21.74^{k}	31.97^{jk}

In Almond thirteen genotypes were evaluated for various traits related to nut and kernel characteristics. Maximum nut weight (3.50g) was observed in Ferragnes followed by Drake (3.43g), California Paper Shell (3.31g), Makhdoom (3.29g) and Nonpareil (3.22g). Highest kernel weight (1.64g) was recorded in California Paper Shell while lowest values were recorded in Waris (0.87g). Highest value of L (53.86) was recorded in Makhdoom followed by Pranyaj (46.44).Highest values of Hue (63.51), chroma (37.25) and whiteness index (50.62) was observed in Makhdoom while lowest values were recorded in Ferralise (Table -35 & 36) .

Table- 35 : Nut and kernel traits in different almond cultivars

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

Table-36: Colour parameters of almond kernels in different genotypes

Variety	L	a*	b*	Tint	Hue	Chroma	Whiteness index
Shalimar	37.20^{g}	17.53^{ba}	25.26^{f}	-89.81^{l}	55.27^{f}	30.75d	34.61^{h}
Drake	42.64^{d}	16.15^{de}	27.28^{e}	-81.25^{i}	59.3^{cd}	31.71c	40.17^{d}
Merced	42.55^{d}	16.15^{de}	28.03 de	-81.09^{h}	60.0^{cb}	32.34c	40.08^{d}
Nonpareil	41.49^{e}	16.15^{de}	25.23^{f}	-79.45^{g}	57.41^{e}	29.96d	39.09^{e}
Pranyaj	46.44^{b}	15.5^{e}	28.37 dc	-72.87^{f}	61.391^{b}	32.33c	43.99^{b}
Primorskij	40.02^{f}	17.67^{a}	29^{c}	-91.21^{m}	58.65^{e} d	33.96b	37.23^{f}
IXL	41.44^{e}	13.63^{f}	23.73^{g}	-69.64^{b}	60.16^{cb}	27.37e	39.67^{ed}
Waris	44.80^{c}	16.94^{bc}	30.30^{b}	-82.97^{j}	60.82^{b}	34.71b	42.00^{c}
Makhdoom	53.86^{a}	16.63^{dc}	33.33^{a}	-71.8^{e}	63.51^{a}	37.25^{a}	50.62^{a}
CPS	35.41^{h}	15.74^{e}	23.34^{g}	-84.54^{k}	56.02^{f}	28.15e	33.34^{i}
Tardy Nonpareil	37.77^{g}	12.76^{g}	18.64 h	-64.52^{a}	55.62^{f}	22.59f	36.32^{g}
Ferralise	32.36^{j}	12.33^{g}	15.70^{i}	-70.72^{c}	51.89^{g}	19.97g	31.12^{k}
Ferragnes	33.27^{i}	11.22^{h}	16.26^{i}	-71.02^{d}	55.42^{f}	19.76g	32.22^{j}

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

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

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

Validation and Development of DUS guidelines in olive

During 2020 data was recorded on various tree, leaf, fruit and stone characters) in 18 olive varieties as per the UPOV descriptor. The aim of the study is to validate the VPOU guidelines of olive under Indian conditions and develop DUS guidelines of olive as per the validated data recorded from UPOV guidelines. All reference varieties of olive are maintained at ICAR-CITH, Srinagar farm. To know the stability of traits data was also recorded on some varieties available at Ramban.

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

Canopy management and plant architectural engineering in temperate fruit crops at ICAR-CITH, Srinagar to develop efficient plant architectural systems using different rootstocks and scion cultivars to harvest solar energy through increased light interception and improve sink source relationship, to utilize maximum vertical space & energy and to maximize production and improve color and quality of produce. Project was implemented in seven centres during 2019& 20 with different temperate fruit crops of their regional importance. The summary of results from different centres during is presented in Table-37.

Table- 37. Summary of results at different centers on canopy management and plant architectural engineering in temperate fruit crops

Centre	*Crops*	*Findings*
ICAR-CITH, Srinagar	Apple & Pear	In apple, Oregon Spur on MM 111 and MM 106 gave highest productivity on Vertical Axis training system. Light interception was found more in Cordon System. In Pear, Red Bartlett on Q C and Starkrimson on BA-29C rootstock on Vertical Axis system excelled other in productivity.
ICAR-CITH, Regional Station, Mukteshwar	Apple & Peach	In apple,, the highest plant height was recorded in Modified Leader System, highest plant diameter was recorded in cordon System. Maximum number of branches/ plant were recorded in CITH Lodh Apple 1 on Modified Central leader system on M 9 rootstock In peach trial, the highest plant diameter & plant height was recorded in open centre System.
Dr YSP UH&F, Solan (H P)	Peach	In Snow Queen Nectarine, maximum yield was recorded in Espalier system. In peach, Red haven gave better yield in Espalier system closely followed by Tatura Trellis system
Dr YSP UH&F,	Apple	Maximum productivity was recorded in cv

Solan , RHRS, Bajaura, Kullu (HP)		Jeromine on M-9 rootsock followed by Red Velox on M-9, Scarlett Spur II on M-7 and Super Chief on M-7 in Vertical Axis system. Gale Gala on M-9 rootstock gave production of 36.37 t/ha Vertical Axis and Head and Spread systems were found better for fruit weight
Panjab Agriculture University, Ludhiana	Pear &Plum	In Pear, vegetative growth of pear plants on Kainthrootstock is substantially higher than grafted on the Quince C rootstock. Maximum number of fruit were recorded on kainth rootstock in Tatura Trellis System . All pear varieties grafted on Quince C rootstock exhibited overgrowth on the union as evidenced by greater union diameter values as compared to either stock or stem diameter. Due to incompatibility the mortality rate was approximately 80 % in Punjab Beauty/Quince C combination while it was approximately 15 % in both Nijisseiki/Quince C and Punjab Soft/Quince C combinations. In Plum, fruit number per plant was maximum in Tatura Trellis system of planting.
ICAR Research Complex for NEH Region, Shillong, Meghalaya and Arunachal Pradesh Center, Basar& Sikkim Centre), Tadong, Gangtok, Sikkim	Peach and Kiwifruit	Highest fruit weight , yield and TSS was obtained in Y shaped trellis at both the centers In Kiwifruit at Sikkim, Maximum yield of 9.41 kg/plant was recorded in cv Hayward in Duble Circle System followed by Allison on Paragola system (9.3kg) and Hayward on Tatura Trellis System (9.12 kg

Espalier system in peach in Shillong

Y Shape trellis system in peach in Shillong

Extended T Bar System in Sikkim

Pergola System in Sikkim

Tatura Trellis

Gale Gala under Espalier System of Training at Bajuara

Espalier System of Training at Bajaura

Jeromine under Espalier system of training at Bajuara

Fruiting under Spindle Bush system of training at

Fruiting under Head & Spread system of Training

Red Velox cv. of apple under Vertical Axis of Training at Bajuara

Walnut propagation for production of quality planting material

This project was initiated with an aim to promote walnut cultivation in Uttarakhand for improving the livelihood and socioeconomic status of farmers. But to ahead further the availability of quality planting material was main problem. Due to low propagation success in walnut as compared to other pome and stone fruits, the increase in acreage under this crop is going at a slow pace. The propagation success depends upon many factors. The walnut propagation is done in polyhouse conditions due to low temperature outside unsuitable for better success at ICAR-CITH, Srinagar. So ICAR-CITH, Srinagar along with its Regional station, Mukteshwar started producing vegetative propagated walnut plants as well as human resource development of staff and farmers of Uttarakhand along with standardization of propagation method and time.

To study the best method and time of propagation in walnut, a small trial was carried out under polyhouse conditions during 2020. Five propagation methods *i.e.* chip budding, tongue grafting, wedge (manual), wedge (machine) and cleft grafting were performed in 6th, 15th, 24th February, 4th and 13th March in CITH-W-1. During the comparison, maximum success rate (90%) was recorded in cleft grafting performed on 15th and 24th February, 2020. As compared to previous year, other methods gave very less success in this year which may be due to newly planted rootstock. In another trial, twenty four walnut genotypes were compared for cleft grafting success under different conditions. Maximum grafting success (62.25%) was recorded in CITH-W-9 followed by CITH-W-7 (57.85%), CITH-W-3 (54.37%) and WBPH (53.27%) while minimum was recorded in KHS-9(9.41%). The varied success rate in different genotypes may be growing conditions, genetic response and condition of rootstock (especially planting time of rootstock, establishment time) and difference in grafting dates along with temperature and humidity.The overall results indicates that the grafting success is a complex phenomenon and depends upon many factors like climatic conditions i.e temperature & humidity condition and planting of rootstock, condition of scion wood time and grafting skill. The well established rootstock gave better success as compared to newly planted rootstock.

During December, 2020, eleven thousand grafted/budded plants of elite varieties /genotypes were provided to UFRMP-Dehradum and planted in Garhwal and Kumaon region covering approximately 70 hectare area. ICAR-Regional Station, Mukteshwar also started production of walnut plants. Durong 2020, one 10

days, one 3 days and 4 one day training programmes were organized for officers, staff from forest, horticulture and progressive farmers (Table-38). Excellent impact of human resource development was noticed as more than 1000 plants were produced by the Forest Department nurseries

Table-38: Training/ demonstration programmes organized at various locations

S. No	Date	Duration	Venue	Training / demonstration	No. of partici-pants	Category of trainees
1	18th to 27th Feb, 20209	10 days	ICAR-CITH, Srinagar	Walnut Propagation	9	Gardeners from Deptt of Forest, Uttarakhand
2	5th Feb,2020	1 day	Magra	Walnut Propagation	44	Officers from Deptt of Forest, line Deptt and farmers from Uttarakhand
3	7th Feb, 2020	1 day	Sony	Walnut Propagation	32	Officers from Deptt of Forest and farmers from Uttarakhand
4	9th Feb, 2020	1day	Silalekh	Walnut Propagation	68	Officers from Deptt of Forest and farmers from Uttarakhand
5	10th Feb, 2020	1 day	Muktes hwar	Walnut propagation for quality planting material production	41	Officers from Deptt of Forest, Deptt of Horticulture and farmers from Uttarakhand
6	3rd to 5th Dec,2020	3 days	ICAR-CITH, Srinagar	Handling , packaging and transportation of grafted plants	4	Officers/ staff from Deptt of Forest, Deptt



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


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


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






Packing and supply of walnut plants to Uttarakhand

All India network research project on onion and garlic

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

ICAR-CITH, Srinagar (J&K)

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

Germplasm collection, conservation and evaluation

Onion

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

Garlic

No new collections were made during 2020. Eighty-one previous collections were evaluated against 4 checks. There were statistically significant differences among genotypes for marketable yield that ranged from 152.81 to 399.77 q/ha. The mean marketable yield of germplasm was found to be 270.55 q/ha. CITH-G-60 (399.76), CITH-G-5 (387.01), CITH-G-21 (377.90), CITH-G-7 (369.59), CITH-G-32 (366.88), CITH-G-73 (365.96) and CITH-G-1 (361.57) exhibited the highest yields, which were at par with each other.

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

Significant differences exist among tested hybrids and varieties of long day adaptation (Table-39). Highest marketable yield was observed in CITH-O-2 (47.37),Brown Spanish (46.80), Super Ex (45.77), Red Coral**(**20-20**)** (37.86) and Red Coral (37.48) which were at par with each other and significantly superior to all other entries. Total soluble solids varied significantly among different genotypes. Highest TSS was found in Brown Spanish (13.20) followed by CITH-O-2 (11.80).

Table-39. Data on yield, yield related and biotic stress resistance parameters in long day onion varieties for cultivation in Kashmir valley

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

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

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

Table-40: Yield and storage attributes in Brown Spanish and Yellow Globe in response to fertilizer dosage

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

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

The different treatments compared are T1: FYM: 15, N: 100, P: 50, K: 50 (RDF for short day conditions as check),T2: FYM: 15, N: 120, P: 60, K: 60,T3: FYM: 15, N: 140, P: 70, K: 70,T4: FYM: 15, N: 160, P: 80, K: 80,T5: FYM: 15, N: 180, P: 90, K: 90,T6: FYM: 15, N: 200, P: 100, K: 100.There were no significant differences for marketable yield and related parameters with different fertilizer doses except % B grade bulbs by weight in CITH-G-1 and CITH-G-3 and % C grade bulbs by weight. Per cent D grade bulbs by weight: Lowest % of D grade bulbs by weight was observed at lowest and highest fertilizer dosage in CITH-G-1. Significant differences were observed for cumulative storage losses after 4 months.Lowest storage losses were observed at lower fertilizer doses in both genotypes. Treatment T2 showed lowest storage loss of 4.32 and 5.55 respectively.Lowest weight loss was observed in T2 i.e. 5.78 and 4.67 in CITH-G-1 and CITH-G-3 (Table-41).

Table-41: Yield and storage attributes in CITH-G-1 and CITH-G-3 in response to fertilizer dosage

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

ICAR-CITH, RS Mukteshwar (Uttarakhand).

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

Long Day Garlic: Among the Twelve genotypes under IET long day garlic, GN-19-30 was found top ranking in term of bulb yield of 3.24 Kg/plot and 324.0 q/ha followed by GN-19-35 and GN-19-12 with 2.09 Kg and 1.07 Kg bulb yield/plot and 209.7 q/ha and 107.0 q/ha, respectively. In AVT-II, total seven genotypes were evaluated. Among the genotypes, GN-19-50 was found best in term of bulb yield of 2.78 Kg/plot and 278.2 q/ha followed by GN-19-52 and GN-19-44 with 2.55 Kg and 1.06 Kg bulb yield/plot and 255.3 q/ha and 106.7 q/ha, respectively. Apart from this two hybrids were also tested, Bhima Purple reported highest bulb yield 0.75 kg/plot and 75.0 q/h. followed by Bhima Omkar 74.4 q/h.

Long Day Red Onion: Among the IET nine lines, LORVA-19-09 was recorded highest bulb yield of 5.49 Kg/plot and 244.0 q/ha. Highest plant height of 60.2 cm was recorded in genotype LORVA-19-06 followed by 50.6 cm in LORVA-19-16 and 50.3 cm in LORVA-19-18. However, highest TSS (^{0}B) was recorded in LORVA-19-18 (12.8) followed by in LORVA-19-14 (11.2). In AVT-I, total seven genotypes were evaluated, among the genotypes, LORVB-19-30 was found best in term of yield 6.03 kg/plot and 268 q/h. Likewise AVT-II, among the seven genotypes, LORVC-19-44 was recorded highest yield 4.96 kg/plot and 220.0 q/h. In long day red hybrids, total seven genotypes were tested for growth and yield, the genotype LORAH-19-65 recorded highest yield 1.28 kg/plot and 56.8 q/h.

Long Day White Onion: Among the IET five lines, LOWA-19-66 was recorded highest bulb yield of 0.24 Kg/plot and 10.6 q/h followed by in LOWVA-19-68 0.211 kg/plot and 9.4 q/h. In AVT-I, total five genotypes were evaluated, among the genotypes, LOWVB-19-77 was found best in term of yield 0.98 kg/plot and 43.5 q/h.. In long day white-HTSS-IET, total seven genotypes were tested for growth and yield, the genotype LOWTA-19-89 recorded highest yield 1.5 kg/plot and 66.7 q/h.

All India Coordinated Research Project (Vegetable Crops)

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

ICAR-CITH, Srinagar

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

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

No new collections in chilli, capsicum and pepper were made. However, in kale, Kawdari was collected from farmer's field and evaluated in field conditions (Table 42 & 43).

Table-42: Evaluation of Kawdari for yield traits

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

Table-43: Evaluation of chilli collections made in 2019-20

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

Varietal and hybrid trials

The following varietal and hybrid trials were conducted during the year 2020 (Table-44)

Table-44 Number of entries under different varietal and hybrid trials

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

ICAR-CITH, Mukteshwar

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

Garden Pea Early (AVT-II): Seven genotypes of Garden pea were evaluated during Kharif 2020 at ICAR-CITH Regional Station, Mukteshwar, Nainital (UK) for their growth and yield parameters. The maximum plant height (67.1 cm) recorded in 2018/PEVAR-5, whereas maximum pod length (10.7 cm) and number of pods/Kg (380.0) were recorded in 2018/PEVAR-6.

Garden Pea Mid (AVT-II): Seven genotypes of Garden pea were evaluated during Kharif 2020 for their growth and yield parameters. The maximum plant heights (63.3

cm), number of pods/Kg (310.0) were recorded in genotypes 2018/PMVAR-3. however maximum pod length (10.8 cm) was recorded in 2018/PMVAR-6.

Garden Pea Edible Pod: Eight genotypes of Garden pea were evaluated, among the genotypes, the highest plant height (69.6 cm) was recorded in genotype 2018/PEDVAR-8, whereas lowest (44.7 cm) in genotype 2018/PEDVAR-1. However, maximum pod length (10.6 cm) was recorded in genotypes 2018/PEDAVR-5.

Radish: Total seven genotypes were evaluated during kharif 2020 for their growth, yield and quality parameters. Among the genotypes, 2018/RADVAR-3 was recorded maximum plant height of 45.2 cm, leaf length 43.4 cm. however, the highest root length (31.2) and number of leaves per plant (7.7) was recorded in 2018/RADVAR-2.

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

State Varietal Trial of Pea and Bean (Volunteer Center)

Garden Pea: Ten genotypes of Garden pea were evaluated during Kharif 2020 for their growth and yield parameters. VP-1228 recorded was highest plant height 62.2 cm followed by VSM-14 (58.2) and highest pod length (11.5 cm) was recorded in VP-1436 followed by VP-1332, VSM-14 (10.4cm) whereas, highest number of pods/Kg (237.0) was recorded in VP-1511 followed by Arkel (232.0).

French bean: Nine genotypes of French bean were evaluated during Kharif 2020 for their growth and yield traits. The highest plant height (73.5 cm), pod length (18.3 cm), weight of ten fruits (105.0 g) and lowest pod number (99.5 pod/kg) were recorded in genotype CITH-FB-1 as compared to other genotypes.

Meetings and Events

During 2021, efforts were made to organize various meetings and events through virtual as well as physical mode by following the proper COVID 19 guidelines issued time to time, keeping in consideration the restrictions and lockdown. Institute has organized number of programmes and participants were restricted as per Covid-19 guidelines during the programmes. The events and meetings organized by ICAR-

CITH, Srinagar and its regional stations *viz*. Mukteshwar & Dirang are presented below and summarized in the Table-45 .

Apple Day

ICAR-Central Institute of Temperate Horticulture Celebrated Apple Day on 9th September 2021 as part of *Azadi Ka Amrit Mahotasav*. Shri Narendra Singh Tomar, Hon'ble Union Minister for Agriculture and Farmers Welfare, Government of India was Chief Guest of the function. Sh. Kailash Choudhary & Ms. Shobha Kalandrale (Minister of State for Agriculture and Farmers Welfare), Dr Farooq Khan, Advisor to Hon'ble LG of J&K graced the occasion as Guest of Honour. Dr. A K Singh, Deputy Director General, ICAR, welcomed the guests and highlighted about salient achievements of the institute. Dr. O C Sharma, Director, ICAR- CITH, senior Officers from Department of Agriculture and Cooperation, Govt. of India and Department of Agriculture and Farmers Welfare UT of J&K and other line departments were also present. About 80 farmers and rural youths participated in the programme.

The Minister in the presence of Guests Dedicated the Automatic Agro Weather Station established at KVK Baramulla under GKMS Scheme to the farming community for issuing agro advisory services with increased accuracy. The minister in his address said that government under the dynamic leadership of Hon'ble Prime Minister Sh. Narendra Modi is committed to double farmer's income by 2022 and described development strategies to achieve that goal. He appealed to the farmers for better application of technology towards enhanced farm productivity and to make agriculture as more profitable enterprise. He also visited the experimental farm and inspected technology park of institute to make him acquaint with technologies and planting material generated by the Institute. A exhibition of more than 100 apple varieties was also displayed by the Institute.

Glimpses of Apple Day at ICAR-CITH, Srinagar

Table 45. List of various events organized during the year 2021

S. No	Event	Date	Organizers/ Coordinators
1	Apple Day	9th September, 2021	All staff
2	Parliamentary official language committee inspection	16th July,2021	O C Sharma, J I Mir, Manoj Kumar, Vishal Dinkar & F A Dar
3	17th Institute Research Council Meeting	20th &21st April, 2021	O C Sharma
4	17th RAC Meeting	28th April, 2021	O C Sharma
5	IMC Meeting	27th April, 2021	J I Mir
6	World No Tobacco Day	31st May, 2021	S U Nabi
7	International Women Day	8th March 2021	Smt . Mubeena
8	World Water Day	22nd March, 2021	Sudhakar N R
9	Hindi Week	14 to 21st September, 2021	Vishal Dinkar
10	Nutritional garden Mega Campaign	17th September,2021	Madhu G S, Geetika Malik, Puneet Kumar & J I Mir
11	Har Med Par Ped	16th July, 2021	Madhu GS, Mohd. Abbas Shah, W H Raja & S U Nabi
12	Farmers Scientist Interaction on climate resilient Agriculture	28th Sep, 2021	Geetika Malik, JI Mir and Madhu GS
13	Mahila Kisan Diwas	15 October, 2021	Geetika Malik, Madhu GS, J I Mir & Sudhaka N R
14	World Food Day	16th October, 2021	Mohd. Abas Shah & Dr Geetika Malik,
15	Vigilance Awareness Week	26th October to 1st November, 2021	Geetika Malik
16	National Unity Day/	31st October, 2021	Mohd. Abas Shah &

	Rashtriya Ekta Diwas		O C sharma
17	Communal Harmony Compaign week / Flag day	19th to 25th November, 2021/ 22nd Nov,2021	Puneet Kumar, Geetika Malik & Mohd. Abas Shah
18	World Soil Day	5th December, 2021	Sudhakra N R
19	Swachhata Pakhwara	16th to 31st December, 2021	Puneet Kumar
20	Special National Swachhata Compaign	12th October, 2021	Puneet Kumar
21	Constitution Day	26th November, 2021	Puneet Kumar
22	Kisan Diwas	23th December, 2021	S U Nabi, Geetika Malik & W H Raja
23	Farmers Awareness Campaign on Balanced Use of Fertilizers	18th June, 2021	Sudhakara N R
24	Kale Day	23th December, 2021	Geetika Malik
25	International Yoga Day	21st June, 2021	Madhu G S and Manoj Kumar
26	Fit India-Freedom Run 2.0	10th September to 2nd Oct, 2021	Arun Kishore

Second sub-committee of the Parliamentary Official Language Committee inspection

The second sub-committee of the Parliamentary Official Language inspected the progress of work being done in Hindi in the Institute on 16th July, 2021. This inspection program was organized by the convener of the second sub-committee, Hon'ble Prof. Rita Bahuguna Joshi, in which Hon'ble Shri Sushil Kumar Gupta (Member of Parliament), Smt. Ranjanben Dhananjay Bhat, (Member of Parliament) and Shri Durga Prasad Uike, (Member of Parliament) besides Secretary of Parliamentary Committee on Official Language Smt. Manjula Saxena, Under Secretary, Dr. Rameshwar Lal Meena, Section Officer Shri Kamal Swarup, Senior translator Shri Kiran Pal Singh, translator Ms. Geeta and Stenographer Shri Anil Kumar were present. Dr. Om Chand Sharma, Director, while welcoming the Honourable members and officers of the committee, briefed on the mandates and achievements of the institute and introduced all the officers who participated on

behalf of the Institute and Council Headquarters. The questions asked by the Hon'ble members were answered satisfactorily and committee expressed satisfaction over the answers given by the institute. The committee showed great interest in knowing about research activities being carried out by the institute. The members of the committee appreciated the research/ extension work being carried out by the institute in the field of temperate horticulture and emphasized on desseminating these achievements to the farmers in mother tongue or Hindi medium. One bulletin written by Institute in Hindi *"Akhrot Mein Gunvatta Rooan Samrgri Ka Utpadan"* was also released by the dignitaries.

Glimpses of Inspection programme by Parliamentary official language committee and release of Bulletin in Hindi

17th Research Advisory Committee Meeting

The 17th RAC meeting of ICAR-CITH, Srinagar was held on 28th April, 2021 in virtual 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. Bhardendu Vatsya, Dr. V K Baranwal, Dr. B K Pandey, Sh. Desh Kumar Nehru, Dr. Desh Beer Singh and Dr. O. C. Sharma.

Besides, the Scientists of ICAR- CITH, Srinagar Dr. J I Mir; Dr. W H Raja; Dr. Sajad Un Nabi & Dr. Mohd Abas Shah and P C & Head, KVK Baramulla, Dr. Manoj Kumar and I/C RS Mukteshwar, Dr. Arun Kishore also attended the meeting. The meeting started with welcome address by Dr. D. B. Singh, Director ICAR-CITH, Srinagar which was followed by presentation of Action Taken report of 16th RAC and also on various research achievements made during last two years. After the presentations there was a detailed discussion on various research aspects and chairman & committee members appreciated the work done by the Institute. The committee members also gave important inputs for ongoing research projects and future line of work. The members also held discussion with the scientific staff and framed various recommendations for future line of action for further submission to council.

17th Institute Research Council Meeting

The 17th IRC Meeting was held on 20th to 21st April, 2021 under the chairmanship of Dr D B Singh, Director ICAR-CITH, Srinagar. All the scientists participated in the meeting by following proper social distance keeping in view the COVID-19 pandemic. Project wise presentations were made by PIs and results/outcomes along with the activities to be taken up next year were discussed in detail. The presentation on Research Projects from Regional Station, Mukteshwar and new scientists who were on proposed training, attended the meeting in virtual mode. The meeting started with the welcome address by Member secretary followed by the Director's address in which he highlighted the importance of IRC before the house and emphasized on the project to be taken in collaboration as well as inter- institutional mode. The Chairman gave critical inputs on experimentation for obtaining realistic and reproducible results. More time was also given to complete some projects, so as to obtain reproducible results. Some new projects were approved in the house after through discussion.

Presentations and discussion during IRC meeting

Institute Management Committee (IMC)

The IMC meeting of ICAR-CITH, Srinagar was held on 27th April, 2021 under the Chairmanship of Dr D B Singh, Director ICAR-CITH, Srinagar. The other members who attended the meeting were Dr B K Pandey, Dr S K Singh, Dr S M Sultan, Sh Desh Kumar Nehru, Dr J I Mir, Dr O C Sharma, Dr Manoj Kumar and Sh Fayaz Ahmad Dar. The detailed discussions were held on various agendas and many agendas were approved.

Hindi Week

Hindi Week was organized at ICAR-CITH, Srinagar from 14th to 21st September, 2021 after observing Hindi Diwas on 14th September. During the inaugural programme Dr O C Sharma (Director, Act) highlighted the history and importance of official language and emphasized one more work to be done officially in Hindi. Sh Vishal Dinkar (Hindi Officer) also highlighted the programmes to be organized during the week for promotion and creation of interest in Hindi language among the staff. The pledge to use and promote Hindi was also administered by Director to whole staff members of the institute. During the week, essay writing, translation, poster making, ex tempore and Antakshari were organized in which staff members along with their children participated fervently. Certificates and cash prizes were awarded to winners of the various competitions on 21st September, 2021.

Hindi Week was also celebrated at at ICAR-CITH, RS Mukteshwar *w.e.f.* 14th Septemberto 20th September, 2021. The inauguration of Hindi week was done on 14th Sep, 2021 in which all staff member participated. Three competitions namely *ex tempore*, essay writing and debate competition were organized in which permanent

and contractual staff of station participated. The winners of various competitions were awarded with cash prizes/ certificates.









Glimpses of different programmes and prize distribution during Hindi Week at ICAR-CITH Srinagar

Glimpses of different programmes during Hindi Week at ICAR-CITH, R S Mukteshwar

World No Tobacco Day

World No Tobacco Day was celebrated at ICAR-Central Institute of Temperate Horticulture Srinagar on 31st May, 2021 in which Director Dr O.C Sharma highlighted the health and other risks associated with tobacco use and advocated for effective policies for reducing the consumption of tobacco. Dr Sajad Un Nabi organizer of the programme highlighted the aim and history of the programme. He said that the day's history goes to 1987, when member states of WHO thought to create global attention to the tobacco epidemic and decided to Celebrate, No Tobacco Day, around the globe every year on 31st May. This yearly celebrations was aimed to raise awareness among the global citizens about the dangers of using tobacco under the theme "Commit to Quit". Finally No Tobacco pledge was administered by Director to whole staff of the institute.

Pledge and discussion on World No Tobacco Day

World Water Day

The World Water Day was celebrated at ICAR-CITH, Srinagar on 22nd March, 2021. During the programme Dr Sudhakara N R, Scientist, Soil Science delivered a presentation on importance of water in agriculture and rural livelihood. During his presentation, he briefed about the water resources available across the globe and India. He also provided information on technological interventions available in country and Government sponsored schemes on water management and its effects on rural livelihood, ground water recharge and conservation practices for better use of water. After the presentation Dr. D B Singh, Director, ICAR- CITH interacted with the farming community and staff and advised water conservation and management aspects, technological interventions need to be dissipated to farmer's fields for better utilization and conservation of water resources. Total 42 participants including staff, students and farmers were present in the programme.


Participation and Lecture during World Water Day

International Women's Day

ICAR-CITH, Srinagar celebrated International Women's Day on 8th March 2021 in which 250 participants participated. Besides the staff of ICAR-CITH, Srinagar other distinguished women participants were from S P College, Srinagar (students & staff) and women farmers from Handalbagh & Kralpora villages (neighboring villages of the Institute). During the programme, a short movie on success stories of women's empowerment was shown to the participants. During the programme various speakers who expressed their views were Dr BD B Singh, Director, Dr O C Sharma, Dr. J. I. Mir, Smt Mubeena, Dr. Danish Bashir, Dr.Lubna Masoodi, Dr. Salwee Yasmeen , Dr. Saima Farooq & Smt. Iqra Qurashi who

highlighted the importance of International Women's Day and women empowerment in their speeches. Besides this a training and farm visit was also organized to the participants. A kit of vegetable seeds for kitchen gardening was also provided to the women farmers. The programmed was coordinated by Smt. Mubeena Technical Assistant (IT). At last participants thanks the Institute for organizing the programme and stressed that such programmes should be organized on regular basis for the benefit of farm women.




<u>Glimpses of International Women Day Celebrated at ICAR-CITH, Srinagar</u>

International Yoga Day

ICAR-Central Institute of Temperate Horticulture has celebrated International Yoga Day on 21st June, 2021. During this year, the theme of the day was Yoga For Wellness. Dr. Manoj Kumar, Head KVK, Baramulla, Dr. J I Mir, Sr Scientist and I/C Fruit Science and Sh. Madhu G S, Scientist gave brief talk about the importance, and need of yoga for invigorating overall mental and physical status of a person. All scientific, administrative, technical and supporting staff of ICAR-CITH, Srinagar, and scientific staff of ICAR-NBPGR-RS, Srinagar and ICAR-IGFRI-RS, Srinagar has performed different

asanas of yoga under the guidance of Dr. Manoj Kumar and Sh. Madhu G S. All the staff members showed extra zeal and enthusiasm while performing and participating this great event.

Glimpses of International Yoga day at ICAR-CITH, Srinagar

Nutritional Garden Mega Campaign and Plantation Drive

In connection to International Year of Millet 2023 (Antrashtiy poshak Anaj barsh 2023 ke paripekshay mein) compaign on Nutri- Garden and Tree Plantation (Poshan Vatika Mahahiyan evam Vriksharopan) programme was organized at ICAR-CITH, Srinagar on 17th September, 2021. In this programme first the live telecast of programme organized at Hydreabad was shown followed by address of

dignitaries, Sh Kailash Choudhary Ji, MoS Ministery of Agriculture and Farmers Welfare and Sh Narinder Singh Tomar Ji Honb'le Union Minister of Agriculture, Ministery of Agriculture and Farmers Welfare who highlighted the importance of the Day vis-a-vis millets. At ICAR-CITH, Srinagar, about 70 women farmers and 80 men farmers participated in the programme besides the permanent staff of ICAR-CITH, NBPGR and IGFRI, regional stations Srinagar. During this programme, the importance of various cereals for nutrition was highlighted by Dr S M Sultan, I/C NBPGR RS Station Srinagar. Dr O C Sharma also highlighted the importance of nutri- garden and plantation drive on this day. Later on plantations of 132 saplings of apple, apricot, cherry, peach and cherry plum were also planted in the campus premises by the farmers and the staff. Later on seed packets of vegetables and saplings of quince were distributed among the farmers. The NBPGR and IGFRI also distributed the seed packets of other crops.

Glimpses of Nutritional Garden Mega Compaign and Plantation Drive at ICAR-CITH, Srinagar

Farmers Scientist interaction on Climate Resilient Agriculture

A programme on Climate Resilient Agriculture was organized at ICAR-CITH, Srinagar on 28th September, 2021 in which total 162 participants participated (80 farmers from Kargil, 32 from Srinagar & staff working at Institute). During the programme interaction was held between farmers and scientists on various aspects of climate change. During the interaction, it stressed that role of different climate

resilient varieties is of prime importance. After the programme live telecast of address from Union Minister of Agriculture and Hon'ble Prime Minister of India was also shown to farmers in which climate resilient varieties were released for the benefits of the farmers.

Glimpses of Farmers Scientist interaction on Climate Resilient Agriculture

Har Med Par Ped (ICAR Foundation day)

ICAR-Central Institute of Temperate Horticulture organized tree plantation campaign on the occasion of ICAR foundation day on 16th July, 2021with the theme of *Har Med Par Ped*. All the scientific, administrative, technical and supporting staff of ICAR-CITH, Srinagar attended and campaigned for tree plantation. All the staff members showed enthusiasm in planting olive trees on the bunds of vegetable fields. Dr. W H Raja, Scientist SS (Fruit Science) highlighted the importance of tree planation in the bunds of cropping systems to boost the farmers income. Dr. Mohd. Abas Shah and Dr. Sajad Un Nabi also highlighted the importance of Agroforestry in agriculture.

Celebration of ICAR Foundation day (Har Med Par Ped)

Mahila Kisan Diwas

To celebrate the Mahila Kisan Diwas at ICAR-CITH, Srinagar, a training programme was organized for women farmers on, "Advanced production technologies in vegetable crops" on 15th October, 2021. During the programme Dr J I Mir highlighted the importance of the Mahila Kisan Diwas and role of ICAR-CITH, Srinagar for the upliftment of women farmers. Dr O C Sharma, highlighted the great role of women especially in hill agriculture and for socio economic upliftment of their family. Dr Geetika Malik explained the advanced cultivation technologies of different vegetables for enhancing the income of farmers as well as their contribution towards nutritunal security. Dr Geetika Malik and Sh Madhu G S also arranged visit of the farm in which importance and demonstration on various technologies were explained in detail. In this programme 30 women farmers participated and assured to adopt advanced production technologies in their farm.

Discusstion during Mahila Kisan Diwas

World Food day

ICAR-Central Central Institute of Temperate Horticulture, Srinagar celebrated World Food Day on 16th October, 2021. On this occasion, one seminar on the importance of world food day with current year's theme entitled "Our Actions are our Future"was organized. In the seminar, 20 scientists and technical officers and research scholars participated. Dr. Geetika Malik introduced the relevance of the seminar. Dr. Md. Abas Shah delivered a lecture on the current year's theme wherein the various aspects of food and nutritional security were brought to the attention of the attendees. Besides this, a training programme was also organized for farmers. The program ended with formal vote of thanks by Dr. Geetika Malik.

Glimpses of Seminar and training programme on World Food Day

Vigilance Awareness Week

ICAR- Central Institute of Temperate Horticulture, Srinagar observed Vigilance Awareness Week from 26th October to 1st November, 2021. The theme of the Vigilance Week was **Independent India @75: Self Reliance with Integrity (□□□□□□□□ □□□□ @ 75: □□□□□□□□□□ □□ □□□□□□□□□□□□□□). Various programmes were organized to make the staff aware of various practices and measures to fight against the corruption. The programme was started with welcome address and importance of vigilance week by Vigilance Officer on 26th October 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. The posters were displayed in different areas of campus for creation of awareness for making vigilant and prosperous India. The staff members assured to remain vigilant to make the country prosperous. Pledge and awareness programmes were also organized at Regional Station, Mukteshwar (Uttarakhand).

Pledge and discussion during Vigilance Awareness Week

National Unity Day/ *Rashtriya Ekta Diwas*

The National Unity Day/ Rashtriya Ekta Diwas was celebrated at ICAR-CITH, Srinagar on 31st October, 2021. Staff of ICAR-CITH attended the programme on physical as well as virtual mode. During the programme Dr Manoj Kumar highlighted the commitment of the Sardar Vallabhbhai Patel towards work and about his life. Dr O C Sharma, 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 Balbhbhai Patel will always be remembered. The major reforms made in his life were also discussed. Lastly, Director urged the staff to work for integration and development of the Nation. To commemorate the Unity Day a run for unity was also organized at village institute road. National Unity Day/ Rashtriya Ekta Diwas was also celebrated at Regional Station, Mukteshwar (Uttarakhand).

Pledge taking ceremony during National Unity Day

Communal Harmony Campaign Week

The communal harmony campaign week was observed w.e.f. 19th to 25th November, 2021 at ICAR-CITH, Srinagar. The week was celebrated with great zeal and zest and all staff members participated with enthusiasm. On 22nd November, volunteer fund raise campaign was also organized for making contribution to "National Foundation for Communal Harmony" in which our staff members come

forward for this cause and made their contribution. On 25th November, *Sadbhavana* pledge was also taken and Flag Day was celebrated with participation of staff members.

Sadbhavana Pledge at ICAR-CITH, Srinagar

Flag Day observance at ICAR_-CITH, Srinagar

Constitution Day

The constitution Day was celebrated on 26 November at ICAR-CITH, Srinagar. The Ministry of Parliamentary Affairs has developed dedicated portals for reading "Preamble of Constitution of India" and "online quiz on Constitution Democracy". The staff members assembled in conference hall at 11:00 am and they were enthusiastic about the ceremony and participated with great zeal and zest in both the activities. During the program, the staff member read the Preamble of Constitution of India and participated in the quiz organized by Ministry of Parliamentary Affairs on dedicated portal. The programme was also organized at ICAR-CITH, RS Mukteshwar.

Preamble of Constitution of India on Occasion of Constitution Day (26th Nov, 2021) at ICAR-CITH, Srinagar and R S Mukteshwar

World Soil Day

ICAR-Central Institute of Temperate Horticulture, Srinagar celebrated the World Soil Day on 5th December, 2021 with theme *"Half Soil Salinization, Enhance Soil Production"* in which 35 participants participated. During the programme, the Director, ICAR-CITH, Srinagar highlighted the importance of the day and role of soil in human life. After that a lecture regarding the theme was delivered by Dr. Sudhakara, Scientist (Soil Science), ICAR-CITH, Srinagar in which he lighted the present status of soil in the country. Besides these, lecture on management of soil, balanced use of fertilizer for higher productivity in temperate horticulture crops were also organized. The participants also put their view regarding soil health management.

Lecture and Discussion during World Soil Day

Participation in Valedictory Address of Hon'ble Prime Minister during Natural farming- Pre vibrant Gujarat Summit, 2021

ICAR-CITH, Srinagar participated in the Valedictory Address of Hon'ble Prime Minister during Natural farming- Pre vibrant Gujarat Summit, 2021 held on 16th December, 2021 on virtual mode. In this programme total 52 participants including staff and 24 farmers participated in the programme and heard the views of various dignitaries in the programme followed by the address of Hon'ble Prime Minister of India.

Farmers & Staff Participation at ICAR-CITH Srinagar on Valedictory Address of Hon'ble Prime Minister during Natural farming- Pre vibrant Gujarat Summit, 2021

Kisan Diwas

Kisan Diwas was organized at ICAR-CITH, Srinagar on 23rd December, 2021 under *National Campaign on Jai Jawan Jai Kisan.* In this programme a training cum exposure visit of 120 farmers from Sub Division Khansahib was conducted under the Soil health card scheme (NMSA) from Department of Agriculture, J&K. Lectures covering the of soil health, importance of soil health card, ways and means of improving soil health and importance of soil testing were conducted. During the visit Director ICAR-CITH, Srinagar highlighted the contribution of farmers towards nation prosperity and praised their efforts. He also highlighted the importance of various technologies for getting best output.


Celebration of Kisan Diwas at ICAR-CITH, Srinagar

Fit India Freedom Run 2.0

ICAR-CITH, RS Mukteshwar organized Fit India Freedom Run 2.0 in which all staff member participated in Fit India Freedom Run 2.0 to commemorate *Azadi Ka Amrit Mahotsav* from 10th September to 2nd October, 2021.


Glimpses of Fit India Freedom Run 2.0 at ICAR-CITH, RS Mukteshwar

Gandhi Jayanti

ICAR-CITH, RS Mukteshwar along with staff Celebrated 151th birth anniversary of our father of the nation Mahatama Gandhi Ji on 2nd Oct. 2021.


Glimpses of Gandhi Jayanti at ICAR-CITH, RS Mukteshwar

Special Swachhta campaign

Special Swachhta campaign was organized at ICAR-CITH, RS Mukteshwar from 2nd Oct to 31st Oct 2021. Four programmes under Special Swachhta campaign were organized at weekly intervals in Mukteshwar, Sunkiya and Naveen Sunkiya villages.



Glimpses of Special Swachhta campaign organized by ICAR- CITH, RS Mukteshwar (2nd Oct to 31st Oct 2021)

Swachhta Pakhwada

ICAR-CITH, RS Mukteshwar organized Swachhta Pakhwada from 16th December to 31st December, 2021**.** Farmer awareness programme on cleanliness and sanitation was organized in the village Sunkiya adopted under MGMG scheme. Cleaning of the station premises was done during all the working days in which roads, channels, water bodies as well as office, chambers, laboratories, farm office, surrounding the residential quarters of the premises were cleaned. Besides, we created awareness on Swachchta, harmful effect of plastic and single use plastic, garbage, and dirtiness in the new villages Dutkanidhar and Kasiyalekh. Also organized farmer awareness programme on Swachchta and not use single use plastic on the occasion of Kisan Diwas at the station in which total 44 farmers ware participated, during the campaign farmers were also provided sanitizer, soap, mask and hand wash for curtailment of COVID-19 pandemic.

Swachhta Pakhwada at ICAR-CITH, RS Mukteshwar (16th December, 2021)

Swachh Bharat Abhiyan

During 2021, number of programmes were organised under the Swachh Bharat Abhiyan at ICAR-CITH, Srinagar. The aim of all the programmes was to

spread the message of Mahatma Gandhi Ji to take initiative at individual level in promoting cleaning drives and devote personal time in nation cleaning. On occasion of 152nd birth anniversary of Mahatma Gandhi Ji, office cleaning drive was organised at institute in which staff members took part and cleaned their respective chambers as well as common places like conference room, committee hall, institute main lawn, streets etc. On 12th October, 2021, Waste to wealth under "Special National Swachhta Campaign" was observed at the institute. In this program message was conveyed about utilization of farm or kitchen waste into natural resources for farm input. The emphasis was given on converting farm or kitchen waste into compost by Family net vessel compost technique and *in-situ* decomposition of rice-wheat waste using EKCEL decomposer developed by ICAR-IISS, Bhopal. In this program 20 farmers and 5 staff members actively participated. During Swachhta Pakhwada i.e., from 16th to 31st December, 2021, various date wise activities were organized at the institute. Main activities during Swachhta Pakhwada were Swachhta Pledge, Swachhta audit, Kisan Diwas, swachhta quiz, weeding and cleaning of orchards, and cleaning of street, labs, greenhouse etc. On 17th December, the Swachhta Pledge was taken by all staff members. A three members committee was constituted to conduct swachhta audit in the institute. The audit panel visited the institute buildings, laboratories, guesthouse and various orchards to know about the status of cleanliness and working atmosphere inside the institute. The *Kisan Diwas* was observed on 23rd December, for which officials from state agricultural department along with farmers Badgam district were present. In this program, total 120 participants participated in the program including farmers and officials. During the program, the farmers were demonstrated about the various technologies and products developed at the Institute. Awareness about the soil health card and the importance of the soil health to get the higher yield created among the farmers.

Pledge and cleaning drive on occasion of 152nd birth anniversary of Mahatma Gandhi ji

Special National Swachhta Campaign

Swachhta Pledge during Swachhta Pakhwada

Swachhta audit of labs

Kisan Diwas celebration

Extension and other programs

Extension Activities

Besides the the need based quality research on different aspects in different horticultural crop, Institute has emerged as a hub for generating farmer-friendly technologies which in turn will boost the productivity of quality produce and benefit the farmers with higher returns. There is a lot of scope for the increasing productivity of quality produce of temperate horticultural crops in different regions of the country having temperate climatic conditions. The technologies generated need to be popularized among the stakeholders through various extension agencies/ means for uplifting the socio-economic status of farmers. The Central Institute of Temperate Horticulture, Srinagar and its regional stations are putting continuous efforts to make the farmers/ officers of line departments and other stakeholders apprised about various new technologies generated in temperate horticultural crops for improving the productivity of quality produce. The Institute has always strived to disseminate various technologies through various means of extension. Despite of Covid 19 pandemic/ lockdowns Institute and its Regional stations have actively worked for the benefits of farmers. Several programmes were organized through awareness awareness and advisories have also been done via print, electronic and social media. The details of various programmes organized by ICAR-CITH during 2021 are presented under various heads.

ICAR-CITH, Srinagar

Training programmes for officers

Seven days programme organized for officer

A seven days training programme was organized on Enhancing productivity through advanced technical interventions in temperate fruit crops at ICAR-CITH, Srinagar for officers from Department of Horticulture, Himachal Pradesh from 1st to 7th December, 2021. Total 30 subject matter specialist (SMS), horticulture development officers (HDO), horticulture extension officers(HEO) etc participated in the programme. During the programme various lectures on various technologies for enhancing productivity in temperate fruits were delivered followed by practical demonstrations. All aspects like research and development needs in temperate fruits, nursery and rootstock production, high and medium density plantation, pollination management, training & pruning, orchard floor 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 training programme. The participants were highly satisfied with the training and assured to implement in their state to boost the productivity of temperate fruits in future.

Glimpses of Seven days programme organized for Officer

Five days programme organized for departmental personnel

A five days training programme was organized on, "Technical skill improvement for enhancing farm output in temperate fruits" for supporting staff of Department of Horticulture, Himachal Pradesh at ICAR-CITH, Srinagar from 15th to 19th November, 2021. Total 20 participants/ officers participated in the training programme. During the training programme, emphasis was given for improving skill of the staff on nursery production, high & medium density plantation in temperate fruits especially apple, pollination management, layout of orchard, water and soil management, pest & diseases management, post harvest handling and orchard management of temperate fruits crops. Besides the lectures, participants were also exposed to various technologies through practical demonstration in the field. Some visits to different organizations were also organized during the training programme. The participants were highly satisfied

with the training and assured to implement in their farms to enhance the farm out in future.



Glimpses of five days training programme organized for supporting staff

Five Days training programme organized for Nursery growers

A five days training programme on, "Quality planting material production technologies in temperate fruit crops for enhancing farm income was organized at ICAR-CITH for nursery growers of Himachal Pradesh, w.e.f. 13th to 17th December, 2021. Total 20 participants from different districts of Himachal Pradesh participated in the programme. During the training, participants were made aware on advances in quality planting material production in temperate fruit crops. The lecture and practical were organized for the participants on various aspects like importance & components of nursery, rootstock multiplication, vegetative propagation, mother orchard management, varietal diversity, nursery management, media and growth regulators in nursery, pest and diseases management in nursery, important rootstocks in temperate fruit crops and their suitability for various soil conditions and high density plantation. The nursery growers assured to adopt the technologies for enhancing their farm income from nursery and supply of quality planting material to the growers.

Glimpses of Five Days training programme organized for Nursery growers

Table 46. List of training programmes organized for officers/ staff of line department by ICAR-CITH, Srinagar

Sr No.	Name of Programme	Venue	Duration (Days)	Date	No. of Participants	Organizers/ coordinators
1.	Enhancing Productivity through Advanced Technical Interventions in Temperate Fruit Crops	ICAR-CITH, Srinagar	7	1st to 7th December, 2021	30	Md Abas, Madu GS & Vishal Dinkar
2.	Technical Skill Improvement for Enhancing Farm	ICAR-CITH, Srinagar	5	15th to 19th November, 2021	20	Geetika Malik, Sajad Un Nabi &

	Output in Temperate fruits					Sudhakara N R
3	Quality Planting Material Production Technologies in Temperate Fruit Crops for Enhancing Farm Income	ICAR-CITH, Srinagar	5	13th to 17th December, 2021	20	J I Mir, W H Raja & Puneet Kumar

One day training programmes organized for staff of UFRMP & Department of Forest, Uttarakhand

During 2021, total six one day training programmes were organized in different nurseries and officials/ staff of Deptt of Forest, Uttarakhand. Some farmers and participants from Deptt of Horticulture also participated. These programmes were on mother orchard management and grafting techniques in walnut. The location of the programmes was at Magra, Sony, Riya, Ladiyakata, Lamahanga and Silalekh in Uttrakhand. The details of programme are presented in Table-47.

Table-47: One Day training programmes organized for Staff of UFRMP & Department of Forest, Uttarakhand

Sr No	Date	Venue	Training/ demonstration	No. of participants	Category of trainees	Organizer/Coordinator
1	16th Feb.,2021	Magra	Mother orchard management and grafting in walnut	28	Staff from Deptt of Forest / UFRMP and farmers of Uttarakhand	O C Sharma
2	18th Feb.,2021	Sony	Mother orchard management	44	Staff of Forest / UFRMP, Horticulture	O C Sharma

			and grafting in walnut		and farmers from Uttarakhand	
3	20th Feb.,2021	Riya	Mother orchard management	31	Staff of Forest / UFRMP, Uttarakhand	O CSharma
4	20th Feb.,2021	Ladiya kata	Grafting in walnut	48	Staff of Forest / UFRMP and farmers from Uttarakhand	O C Sharma & Arun Kishore
5	20th Feb.,2021	Lamaha nga	Mother orchard management	4	Staff of Forest / UFRMP and farmers of Uttarakhand	O C Sharma
6	21st Feb.,2021	Silalekh	Mother orchard management and grafting in walnut	32	Staff of Forest / UFRMP and farmers of Uttarakhand	O C Sharma & Arun Kishore
	Total			187		



Glimpses of training programmes at Magra, Sony,Riya, Ladiyakata, Lamahanga and Silalekh in Uttarakhand

Training programmes/ visits for students

The well-equipped labs of various disciplines and experimental orchard blocks of different crops had made the Institute as center of learning for students from various schools, colleges and universities. During the year, 6 visits/ training were organized for students. The details of students visit/ training from different organizations are presented in **Table-48**

Table-48 List of schools/colleges/ institutes who visited the ICAR-CITH during the year 2021

Date	Name of School/ University	No. of Students / particiants	Facilitated By
22nd August,2021	SKUAST-J, Jammu	55	O C Sharma, Madhu G S & Eshan Ahad
20th October,2021	Govt Degree College Baramulla	50	Md. Abas, Sajad Un Nabi and Geetika Malik
28th to 29th October, 2021	Govt College for Womem, M A road, Srinagar (Two days hands on training in Biotechnology	16	Sajad Un Nabi, Md. Abas and J I Mir
6th November, 2021	Govt Degree College, Tral district Pulwama	25	Md Abas, Sajad Un Nabi & Geetika Malik
18th December, 2021	S P College Srinagar	31	JI Mir, Md Abas & S U Nabi
29th December, 2021	SKUAST-K (B.Tec. Agriculture Engineering)	22	Geetika, Malik, Puneet Kumar & O C Sharma

Training cum exposure visit for students from SKUAS-J

One day training programme cum exposure visit was organized for the students of BSc. Agriculture from SKUAST-Jammu on 22nd August, 2021 in which 55 students participated. The students were made aware of various aspects of temperate horticulture and research activities going on various crops at the Institute. During field visit different varieties of various crops were shown to students and the students felt happy after knowing various R&D activities.

Glimpses of Students visit from SKUAST -J

Training cum exposure visit for students from Govt Degree College Baramulla

One Day training programme cum exposure visit was organized for the Students of BSc., Govt Degree College Baramulla to make them aware about various crops and research & development activities going on at ICAR-CITH, Srinagar on 20th October, 2021. Total 46 students along with 2 faculty members in the programme. During the visit detailed discussion on various aspects like fruit production, propagation, varietal wealth, pollination, biotechnological approaches,

vegetables, diseases & pest management were held with the scientists. After that various labs were also shown and equipments along with their function were demonstrated in detail. All question raised by students were addressed by the scientists.

Training Programme for students from Govt. Degree College Baramulla

Two days hands on training in Biotechnology for students from Govt Women College Srinagar

A two days programme "Hands on biotechnology" was organized for the students of Bsc. Biotechnology from Govt Women College, M A Road, Srinagar from 28th & 29th October, 2021 at ICAR-CITH, Srinagar and 16 students participated in the programme. During the programme, Biotechnology labs were shown and equipments along with their function were demonstrated in detail. Visit of various other labs and field were also organized for the students.

Glimpses of two days programme on hands on training in Biotechnology

One day Training cum exposure visit for students from Govt Degree College Tral

One Day training programme cum exposure visit was organized for the students of Govt Degree college Tral district Pulwama on 6th November, 2021 at ICAR-CITH, Srinagar to make them aware about various crops and research & development activities going on at ICAR-CITH, Srinagar. Total 25 students along with two staff participated in the programme. During the visit detailed discussion on various aspects like fruit production like propagation, varietal wealth,

pollination, biotechnological approaches, vegetables, diseases, pest & management were held with the scientists. All question raised by students were addressed by the scientists.

Training cum visit of Students from Govt. Degree College, Tral

One day Training cum exposure visit for students from S P College Srinagr

One Day training programme cum exposure visit was organized for the students of Department of Botany, 5th Semester SP College, Srinagar on 18th December , 2021 at ICAR-CITH, Srinagar to make them aware about various Plant breeding techniques and methods used at ICAR-CITH, Srinagar for development of various varieties. Twenty-five students (10 male and 15 female) accompanied by 6 teachers including Head of Department, Dr. Wilayat Rizvi visited the institute to get first hand exposure of the various R&D activities being carried out. Dr. Om Chand Sharma (Director) welcomed the students and faculty members and informed them about the activities of the Institute. Dr. Javid Iqbal (I/C HoD Fruit Science) apprised the students about the various breeding techniques used for development of new varieties of fruit crops. During field visits, various advanced techniques pertaining to establishment and maintenance of high-density apple

orchards, pruning and training and development of regular orchards of walnut, scientific nursery production and germplasm collection and breeding in vegetable crops were discussed and demonstrated by Dr. Javid Iqbal, Dr. Sajad un-Nabi and Dr. M Abas Shah. The students were also exposed to various advanced equipments in biotechnology laboratory by Dr. J I Mir. All the questions raised by students were satisfactorily answered by the scientists and they were highly satisfied with with the programme.

Glimpses of training cum visit of students from, S P College Srinagar

One day Training cum exposure visit for students from SKUAST-K, Srinagar

One Day training programme cum exposure visit was organized for the students of B. Tech (Agr. Engineering) 2nd year of SKUAST-K on 29th December, 2021 at ICAR-CITH, Srinagar to make them aware about precision farming techniques. Total 22 students participated in the programme. During the visit, detailed discussion on various aspects of precision farming in different crops like

fruits, vegetables and ornamentals were discussed with the students. The protected cultivation of vegetables and ornamentals, propagation of fruit crops and irrigation, planting methods and canopy architectural engineering for precision farming were discussed.




Visit of B Tech Students for various precision farming techniques

Training Programmes for Farmers

For Ladakh Region

One day training/ visit organized for farmers from Kargil district of Ladakh

One day training/farm visit was organized for the farmers of district Kargil on 28th September, 2021 in which 80 farmers participated and majority of them were farm women. The farmers were apprised about various technologies by the scientist related to fruit & vegetable production, propagation, protected cultivation etc. The farmers were also apprised with the germplasm wealth in the Institute in various

crops suitable for various regions. The farmers took keen interest on various technologies generated by the Institute.

Training and visit of farmers from kargil district of Ladakh

Table-49. Training programme organized for the farmers of Ladakh

Date	Training/ visit/Topic	Department / Organization	Zone/ Area	No of participants			Facilitator/ Coordinator
				Male	Female	Total	

28th September, 2021	Horticulture production in Ladakh	Department of Agriculture, UT of Ladakh	Kargil	8 Male	72	80	Geetika Malik & Madhu G S, J I Mir

For Himachal Pradesh

One day Training/ visit organized to farmers of Himachal Pradesh

A one day training programme/ farm visit was organized for the progressive farmers from Shimla, Chamba and Mandi districts of Himachal Pradesh. Tewnty five (men & women) farmers along with two officers participated in the programme. The programme was sponsored by Deptt of Horticulture, Himachal Pradesh. During the training / visits, the farmers were made aware about various technologies like nursery production, canopy management, plant protection and pollination management etc. generated at ICAR-CITH, Srinagar for enhancing the productivity and doubling farmer's income. The farmers were highly satisfied with the research activities going on in the Institute for the benefit of the farmers.

Glimpses of programme organized for Progressive Farmers of Himachal Pradesh

Table-50: Training programme organized for the farmers of Himachal Pradesh

Date	Training / visit /Topic	Department /Organization	Zone/ Area	No of parti-cipants	Facilitator/ Coordinator

26th April, 2021	Temperate Fruit Production	Deptt of Horticulture, Himachal Pradesh	Shimla, Chamba and Mandi	25	O C Sharma & J I Mir

For Meghalaya

As per the demand for North eastern states especially from Meghalaya, ICAR-CITH, Srinagar organized two training programmes for the officer/ staff from Deptt of Horticulture, Meghalaya. One programme was organized on virtual mode and other on physical mode regarding cultivation of strawberry in Meghalaya. Demonstration on planting of strawberry and runner production was also given during the training. The detail of the programmes is presented in Table-51.

Table-51:. List of Training for officers of line Deptt

Date	**Topic**	**Department**	**No. of parti-cipants**	**Organizer**
26th October	Strawberry production in Meghalaya- Package and Practices (Virtual Mode)	Deptt. of Horticulture, Meghalaya	16	W H Raja & Sudhakara N R
30th October, 21	Strawberry runner production (Physical Mode)	Deptt. of Horticulture, Meghalaya	20	Sudhakara N R & Puneet Kumar

Training programme on Strawberry production in Meghalaya- Package and Practices (Virtual Mode)

Training programme on Strawberry production in Meghalaya- Package and Practices (Virtual Mode)

Training and Demonstration on Strawberry cultivation in Meghalaya

Diagnostic Visit to Meghalaya

As per the demand of Meghalaya regarding decline in production of some temperate fruits, a team of Scientists comprising of Mr Madhu G S, Scientist (Plant Pathologist) and Dr Sudhakara N R (Soil Scientist) visited various orchards

at various locations at Meghalaya during March and submitted a detail report for the concerned Department regarding reasons and remedial measures to be carried out in these orchards of different crops.

Glimpses of Diagnostic visit of Meghalaya by scientists of ICAR-CITH, Srinagar

For Air Force Families

Three days Training Programme organized on Value added products of Fruits and Vegetables for Air Force Women Welfare Association (AFWWA)

A three days training programme was organized on, "Value added products of fruits and vegetables" for Air Force Women Welfare Association (AFWWA), Srinagar from 4th to 6th October, 2021 at ICAR-CITH, Srinagar. In this programme 20 women members participated. In the programme participants were first made aware about various fruit and vegetable crops being grown in Kashmir and the various processes adopted for making various value added products of different crops. The products of various fruits and vegetables were prepared by the participants and trainers. The participants assured to prepare the products at home scale in future for their domestic use and dissemination of methodologies to others also for more adoption. The detail of programme is presented in Table-52

Table-52. List of Training programme organized for AFWWA

Date	Topic	Department	No. of participants	Organizer
4 to 6th Oct, 2021	Value added products of Fruits and Vegetables	Air Force Women Welfare Association	16	Dr Puneet, Geetika Malik, and Madhu G S

Glimpses of Three days training programme organized for AFWWA

For Jammu & Kashmir

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

During the year, eight farmer groups sponsored by various agencies visited the Institute for a day training/ farm visit. The farmers were apprised about various technologies generated at ICAR-CITH in various horticultural crops. The details of various programmes are presented in Table-53

Table- 53: List of visits/ trainings organized for farmers at ICAR-Central Institute of Temperate Horticulture during the year 2021

Date	Training / visit / Topic	Department / Organization	Zone / Area	No of participants			Facilitator / Coordinator
				Male	Fe-male	Total	
1st March, 2021	Management of nursery for production of quality planting material	ICAR-CITH Srinagar	Kulgam	10	0	10	W H Raja
18th June, 2021	Balanced use of fertilizers	Virtual mode (ICAR-CITH Srinagar)	Baramulla, Pulwama, Bandipoa & Budgam of J&K and Bomdilla of Arunachal Pradesh	35	0	35	W H Raja & Sudhakara N R
15th October,2021	Vegetable and Fruit production in Jammu & Kashmir	ICAR-CITH Srinagar	Budgam	0	30	30	Geetika Malik, Madhu G S, J I Mir and Sudhakar N R

16th October, 2021	Market oriented vegetable cultivation with special focus on organic farming	KVK, Srinagar	Srinagar	11	7	18	Geetika Malik, Mohd Abas & S U Nabi
25th October,21	Temperate Horticulture Production in Jammu & Kashmir	Kisan Biotech hub/ KVK Baramulla	Baramulla	21	0	21	W H Raja, Geetika Malik & SN Kirmani
28th October, 2021	Scientist – Farmer Connect Meet	ICAR-CITH, Srinagar & KVK Baramulla (Kisan Biotech Hub)	Palhallan-Hyderbaugh (Pattan)-Baramulla	10	160	170	W H Raja & Sajad Un Nabi, Manoj Kumar & S N Kirmani
2nd November,2021	Training cum farm visit on Temperate horticulture production	KVK Baramulla (Kisan Biotech Hub)	Yadipora-Pattan Malgan, Kunzer	13	6	19	Geetika, Madhu, W H raja & S N Kirmani
23rd December,2021	Training cum farm visit on Temperate horticulture production & soil health management	Deptt of Agriculture, Budgam	Bugroo, Khansahib, Yasi Kale,Anzal	30 30 30 30	- - - -	120	S U Nabi, Geetika Malik & W H Raja
27th December,2021	Training cum farm visit on Temperate horticulture production & soil health management	Deptt of Agriculture, Budgam	Bugroo, Khansahib, Yasi Kale,Anzal	30 30 30 30	- - - -	120	S U Nabi, W H Raja & J I Mir
29th December,2021	Training and pruning in temperate fruits	ICAR-CITH, Srinagar (Kisan Biotech Hub)	Pulwama	12	-	12	W H Raja

One day programme on Market oriented vegetable cultivation with special focus on organic farming

A training cum awareness program was organized on the occasion of World Food day on "Market oriented vegetable cultivation with special focus on organic farming' in which 18 youth farmers brought by KVK, Srinagar participated. Dr. Om Chand Sharma welcomed the farmers and informed them about the activities of the Institute. Dr. Geetika explained the importance of organic vegetable cultivation and how this practice can be remunerative for the farmers. During field visit, various advanced cultivation practices pertaining to scientific nursery production and organic plant protection strategies in vegetable crops were discussed and demonstrated by Dr. Geetika Malik and Dr. Sajad un-Nabi and Dr. M Abas Shah. Participants were also appraised about various programs run by government for the benefit of entrepreneurial farmers. The training programme was concluded with remarks by the Director.

Glimpses of training programme on Market oriented vegetable cultivation with special focus on organic farming

Scientist- Farmer Connect Meet

ICAR-CITH, Srinagar with KVK Baramulla organized Scientist- Farmer Connect Meet at Palhallan-Hyderbaugh (Pattan)- Baramulla on 28th October, 2021. This programme was organized under Kisan Biotch Hub and total 170 farmers (160 women & 10 men) participated in the programme. In this programme, scientists from ICAR-CITH & KVK Baramulla interacted with the farmers and their questions on various aspects were satisfactorily addressed.

Scientist- Farmer Connect Meet at Palhallan-Hyderbaugh (Pattan)- Baramulla

Training cum Exposure visit for farmers from district Budgam

Two training cum exposure visit were organized for farmers from Sub Division Khansahib under the Soil health card scheme (NMSA) from Department of Agriculture, J&K. These programmes were organized on 23rd and 27th December, 2021 and 120 farmers participated in each programme. Lectures covering the soil health, importance of soil health card, ways and means of improving soil health and importance of soil testing were delivered by scientists. During the visit Director ICAR-CITH, Srinagar highlighted the contribution of farmers towards nation prosperity and praised their efforts. He also highlighted the importance of various technologies for increasing productivity & getting best output in their farms.


Training cum Exposure visit for farmers Budgam


Training/ visit of farmers under Kisan Biotech hub

Training programme on Training and Pruning



Scientist- Farmer Connect Meet at Palhallan-Hyderbaugh (Pattan)- Baramulla



Training programmes organized under Kisan Biotech Hub at ICAR-CITH Srinagar



Training programmes organized under Kisan Biotech Hub at ICAR-CITH Srinagar

ICAR-CITH Regional Station Mukteshwar

During 2021, ICAR-CITH, Regional Station, Mukteshwar has also continuously disseminated the technologies through various extension means on regular basis. Many training programmes for officer & farmers were organized, besides the exhibitions on various occasions, visits, demonstrations etc for the benefit of farming community. The various programmes organized by ICAR-CITH, RS Mukteshwar are presented below:

Programmes for officers

Two programmes were organized on various aspects for the officers and details are presented in Table-54

Table-54: Training programmes/ visits organized for officers at ICAR-CITH, Mukteshwar

Sr No.	Name of programme	Venue	Date	Parti-cipants	Co-ordinators	Organizer/
1	Management and after care of walnut plant in mother block and nursery plant in polyhouse	ICAR-CITH RS, Mukteshwar	7th October, 2021	06	Dr Arun Kishor	Dr Arun Kishor
2	Exposure visit of SMSs of KVKs of ICAR-ATARI Zone VII Umiam, NEH Region	ICAR-CITH RS, Mukteshwar	23rd March, 2021	11	Dr Arun Kishor	Dr N.K. Hedau, ICAR-VPKAS, Almora & Dr Arun Kisho



Glimpses of training/farm visit at ICAR-CITH, RS Mukteshwar



Glimpses of training/farm visit at ICAR-CITH, RS Mukteshwar

Visits

During 2021, three visits were organized for the farmers and presented in Table-55

Table-55: Visits organized for farmers at ICAR-Central Institute of Temperate Horticulture during the year 2021

Date	Department/ Organization	Zone / District	Number	Facilitator/ Coordinator
9th March, 2021	Exposure visit-cum training on propagation and pruning in Kiwifruit and walnut	Thalisain Block, Pauri garwal	27	Dr Arun Kishor
22nd March, 2021	Exposure visit-cum FAP on in situ/ex-situ rain water harvesting and its management for crops on the occasion of water day	Someshwar, Almora	22	Dr Arun Kishor
24th March, 2021	Exposure visit-cum FAP/training on management and maintenance of temperate horticultural crops	Dhari block, Nainital	34	Dr Arun Kishor

One day training/ demonstration and awareness programmes for farmers

During the year, many one day training programme, demonstration, technology demonstration, awareness programmes & lectures delivered by scientists of ICAR-CITH RS, Mukteshwar and are presented in Table-56.

Table-56: Training, Demonstration, Technology demonstration, awareness programmes, lectures performed by CITH RS, Mukteshwar:

Training / Demonstration / Day etc.	Date & Venue	No of Parti-cipants	Coordinators / organizers
Training on pruning and propagation of apple crop.	21st January,2021. Government Garden, Satbunga, Nainital	10	Dr Arun Kishor
Field visit cum FAP/ Training and pruning of kiwifruit, walnut plantation and other temperate fruits	26th February, 2021. Naveen Sunkiya, Nainital	10	Dr Arun Kishor Dr Sovan Debnath
Technology demonstration/FAP on Proper and safe disposal of farm wastes and inorganic wastes under ATMA, Dept. of Agriculture, Uttarakhand	9th March,2021. ICAR-CITH RS, Mukteshwar	27	Dr Arun Kishor Dr Sovan Debnath
Technology demonstration/FAP on Nutrient management in temperate fruit crops	22nd March,2021. ICAR-CITH RS, Mukteshwar	22	Dr Arun Kishor Dr Sovan Debnath
Training cum FAP Soil health management through soil testing	24th March,2021. ICAR-CITH RS, Mukteshwar	34	Dr Arun Kishor Dr Sovan Debnath
FAP cum Virtual Kisan Gosthi on 'Management of fruit trees and nursery after hail storm'	25th April,2021. ICAR-CITH RS, Mukteshwar	12	Dr Arun Kishor
FAP cum Virtual Kisan Gosthi on 'Management and maintenance of fruit crops during summer season'	30th May,2021. ICAR-CITH RS, Mukteshwar	07	Dr Arun Kishor
Field day on the occasion of World Environment Day	5th June,2021. ICAR-CITH RS,	10	Dr Arun Kishor Dr Sovan Debnath

	Mukteshwar		
Outreach of existing technologies on temperate horticulture developed by ICAR-CITH, RS, Mukteshwar	29th July,2021. TERI, Supi	06	Dr Arun Kishor Dr Sovan Debnath
FAP cum Virtual Kisan Gosthi on 'Management of fruit trees and nursery in rainy season'	31st July,2021. ICAR-CITH RS, Mukteshwar	15	Dr Arun Kishor Dr Sovan Debnath
Field demonstration cum FAP on Maintenance of temperate fruit trees and up-keeping soil health in monsoon	3rd August 2021. Dutkanidhar, Nainital	15	Dr Arun Kishor Dr Sovan Debnath
FAP-Demonstration on scientific pea cultivation for seed production	29th September,2021. Sunkiya Naveen	32	Dr Arun Kishor
Special swachhata campaign cum waste decomposition awareness programme	22nd October,2021 Sunkiya Naveen	11	Dr Arun Kishor
Special swachhata campaign cum waste decomposition awareness programme	27October,2021, Sunkiya Naveen	19	Dr Arun Kishor
Swachhata campaign cum waste decomposition awareness programme	18th December 2021. Sunkiya	10	Dr Arun Kishor
Swachhata campaign cum kisan gosthi on scientific way of planting winter vegetables and waste decomposition awareness programme	22nd December,2021. Odlohar/Simsyari, Bageshwar	40	Dr Arun Kishor
Swachhata campaign cum training-demostration on scientific way of planting and cultivation of apple, plum and apricot on the occasion of Kisan Diwas	23rd December,2021 ICAR-CITH RS, Mukteshwar	44	Dr Arun Kishor

Swachhata campaign cum training-demostration on pruning in stone fruits	24th December,2021. Dutkanidhar, Nainital	28	Dr Arun Kishor
Swachhata campaign cum kisan gosthi on safe use of pesticides/fertilizers and maintaining the hygiene in the orchards	30th December,2021, Kasiyalekh, Nainital	08	Dr Arun Kishor
Delivered invited lecture to the farmers on Phalo Ka Rakh Rakhav organized by KVK Saraiya Muzaffarpur, Bihar	30th May,2021 Virtual mode	40	Dr Arun Kishor

Exhibitions

During the year ICAR-CITH RS Mukteshwar organized three exhibition during different Kisan Melas organized by various organizations and details of which are presented in Table-57.

Table-57: Exhibitions in different farmer fair by the ICAR-CITH-RS, Mukteshwar

Date	Department/ Organization	Vanue	Facilitated By
17th March,2021	Kisan Mela at ICAR-DCFR, Bhimtal	Bhimtal	Dr Arun Kishor Dr Sovan Debnath
9th October, 2021	Kisan Mela at ICAR-VPKAS, Almora	Almora	Dr Arun Kishor
24th to 26th September, 2021	International Apple Festival, Dept. of Hort. & Food Process., Govt. of Uttarakhand	Ranger's Ground Dehradun	Dr Arun Kishor Dr Sovan Debnath

Exhibition stall of ICAR-CITH RS Mukteshwar during Kisan Mela at ICAR-DCFR, Bhimtal

Exposure visit-cum training on propagation and pruning in Kiwifruit and walnut












<u>Field demonstration cum FAP on Maintenance of temperate fruit trees and up-keeping soil health in monsoon</u>


FAP-Demonstration on scientific pea cultivation for seed production


Swachhata campaign cum training-demostration on scientific way of planting and cultivation of apple, plum and apricot on the occasion of Kisan Diwas


Swachhata campaign cum training-demonstration on pruning in stone fruits


Swachhata campaign cum kisan gosthi on safe use of pesticides/fertilizers and maintaining the hygiene in the orchards

ICAR-CITH, Regional Station, Dirang

ICAR-CITH is continuously working for the benefit of farmers of the NEH Region through the 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 details of training programs conducted during the year 2020-21 along with the planting material/ tool kits distribution among the beneficiaries of NEH region are briefly presented in Table-58, 58a &58b.

Programmes organized for officers

Three days training programme organized for officials at Bomdila

ICAR-Central Institute of Temperate Horticulture, RS Dirang in collaboration with Department of Horticulture, Government of Arunachal Pradesh organised three days training programme on "Technological interventions for higher productivity and quality of temperate fruits in Arunachal Pradesh" at Bomdila, West Kameng District *w.e.f* 20th to 22nd March, 2021 for the officials/officers from departments including Horticulture, Agriculture and allied sectors. Total 20 officials/officers participated in the 3 days training programme. On 20th March, the programme was inaugurated by ADC Headquarters Sh. Sang Khandu and he stressed upon the exploitation of vast potential of district for growing important temperate fruits including apple, kiwi, walnut etc. During the programme lectures covering important aspects of temperate fruit production and protection were delivered by experts (Dr Wasim H Raja, Dr Sajad Un Nabi and Dr Muneer Ahmad Sheikh) from ICAR-CITH, Srinagar, Dr N.D.Singh, Dr T Mishra and Dr Divya Pandey from KVK Dirang and Mr. N. Lobsang from State horticulture Department . The participants were made well acquainted with different aspects of temperate fruit production including canopy management, production of quality planting material, management of physiological and micronutrient deficiencies, disease/pest management in fruits and vegetables, profitable kiwi production, vegetable production, value addition of fruits and vegetables.

Glimpses of three days programme and media coverage by local newspapers

Table-58: List of training programmes organized for officers/ staff of line department by ICAR-CITH, Regional Station Dirang

Sr No.	Name of Programme	Venue	Date	No. of Parti-cipants	Organizers / coordinators
1.	Technological interventions for higher productivity and quality of temperate fruits in Arunachal Pradesh from 20-22nd March, 2021 at Bomdila, West Kameng District	Bomdilla	20-22nd March, 2021	20	W.H.Raja Sajad Un Nabi and Muneer A Sheikh

Training programmes for farmers

Training programme and distribution of planting material and kits for farmers

For the benefit of farmers of NEH Region, five training programmes were organized at various locations and distribution of planting material and tool kits were also undertaken at three different locations. The brief of the programmes is presented below:

Table-58a. List of training programmes organized for farmers of Arunachal Pradesh

Sr No.	Name of Programme	Venue	Date	No. of Parti-cipants	Organizers/ coordinators
1.	Scope and prospects of temperate fruits in Arunachal Pradesh	ICAR-CITH Dirang	9th February, 2021	50	Dr J.I.Mir, Dr W.H.Raja and Dr Sajad Un Nabi
2.	Protection of of Plant varieties and Farmers Right (PPV&FRA) Act	ICAR-CITH Dirang	10th February, 2021	20	Dr J.I.Mir, Dr W.H.Raja and Dr Sajad Un Nabi
3.	Scientific cultivation of apple and stone fruits	ICAR-NRC Yak	24th March,2021	80	W.H.Raja, Sajad Un Nabi & Muneer Ahmad Sheikh
4.	Orchard establishment and intercultural operations in Kiwi fruit and walnut in west Kameng district of Arunachal Pradesh	Bomdilla	25th March,2021	40	W.H.Raja, Sajad Un Nabi & Muneer Ahmad Sheikh
5.	Training and pruning in apple	CITH RS, Dirang	4th October,2021	80	W H Raja & S U Nabi

Table-58b: Material/ demonstrations supplied to the farmers of NEH region

Sr No.	Date	Venue	Material distributed	No. of bene-ficiaries	Organizers/ coordinators
1.	9th February, 2021	ICAR-CITH Dirang	Planting material (apple, apricot, walnut, almond & peach	50	J I Mir, W H Raja and S U Nabi
2.	24th March,2021	ICAR-NRC Yak	Agriculture implement kit	80	WH Raja, S U Nabi & M A Sheikh
3.	25th March,2021	Bomdilla	Fertilizer kits (NPK)	40	WH Raja, S U Nabi & M A Sheikh
4.	4th October, 2021	Dirang	Grafting Tools	80	W H Raja & S U Nabi

One day training programme at ICAR-CITH RS Dirang

One day training programme on, "Scope and prospects of temperate fruits in Arunachal Pradesh" was organized at ICAR-CITH Regional Station, Dirang on 9th February,2021 in which 50 farmers participated. In this programme, the importance and scope of various aspects of fruit production were discussed and its benefits/ role for raising the socio economic status of the farmers. In this programme, planting material of various fruit crops like apple, apricot, walnut, almond & peach was distributed among the NEH beneficiaries from state Arunachal Pradesh. The planting material was distributed among the 50 farmers and three walnut demonstrations were also given to progressive farmers of the region.

Planting material distribution during the training programme

Awareness cum training programme on PPV &FRA Act

One day awareness cum training programme was organized at ICAR-CITH, Regional Station, Dirang on 10th February, 2021 to make farmers acquainted with the rights and protection of farmers and varieties respectively. The farmers were made aware regarding importance of the indigenous material and its protection and right of farmers. The process of registration of farmer's varieties was discussed in detail.

Glimpses of training programme on PPV&FRA Act

One day training programme organized at Dirang

One day training programme on scientific cultivation of apple and stone fruits was organized at ICAR-NRC Yak Dirang on 24th March, 2021 in which 80 farmers of the area participated. The chief guest of the function was ADC Dirang and guest of honour was Director ICAR-NRC Yak. In the programme, the cultivation practices of various fruit crops were discussed in detail. The kit consisting of various farm implements used in daily farm operation were distributed among 80 farmers from different villages.

Glimpses of training programme and distribution of implement kit

Training programme organized at Bomdilla

One day training programme on orchard establishment and intercultural operations in Kiwi fruit and walnut in west Kameng district of Arunachal Pradesh was organized on 25th March, 2021 at Bomdilla in which 40 farmers from different villages of Bomdilla participated. In this programme the scientific cultivation of walnut and kiwifruit was discussed in details along with its returns to farmers. The NPK fertilizer was distributed among the 40 farmers and was made acquainted with use and benefits of the fertilizers to increase the productivity of crops. The farmers appreciated the efforts made by ICAR-CITH for the benefit of the farmers.

Glimpses of training cum fertilized distribution at Bonmdilla

Kisan Diwas celebration at at ICAR-CITH, Regional Station, Dirang

On 23rd Dec 2021 ICAR-CITH Regional Station, Dirang celebrated *Kisan Diwas* to commemorate the birth anniversary of the fifth Prime Minister of India, Shri Chaudhary Charan Singh Ji. The farmers were invited to the celebration to extend awareness and to honour and appreciate all the responsible farmers for their

contribution to society. Young Professional-II Ms. Toko Manna and Mr. Dorjee Drakpa delivered an oration to recognize the significance of the occasion. The programme concluded with thanks giving to all the participants.




Kisan Diwas at Dirang

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

For the benefit of tribal farmers, Tribal sub plan was also executed by ICAR-CITH, Srinagar in notified districts and areas under execution in early years. Various programme like trainings, interaction, demonstrations and planting material distribution for enhancing their farm income. The programmes carried out are summarized in Table- 59 and detail is presented below:

Table-59:. Details of trainings and kit distributed in different districts under TSP

Sr No	Date	Place	Dis-trict	No. of training / inter-action	No. of parti-cipants	N. of farmers to which Kits / planting material distributed	Co ordinators/ faciltators
1	27.2.21	KVK, Poonch	Poonch	1	120	100	O C Sharma, Madhu G S, M A Sheikh , Istiyaq Ahmad Showkat Ahmad Dar
2	28.2.21	Mohra-Kotranka	Rajouri	1	60	50	O C Sharma, Madhu G S, M A Sheikh , Istiyaq Ahmad, Showkat Ahmad Dar
3	20th March, 2021	Babanagri	Gand-erbal	1	178	100	Madhu G S, Sudhakara N R, Istiyaq Ahmd & Zubare Ahmad Swathi

Tribal Sub Plan

One day training Programme cum interaction meeting organized at Poonch

ICAR-Central Institute of Temperate Horticulture organized a programme in collaboration with KrishiVigyan Kendra, Poonch of SKUAST-J for the tribal farmers of district poonch, Jammu & Kashmir on 27th February, 2021 in which more than 120 farmers participated. The programme started with the address of Dr Ajay Gupta, Sr Scientist & Head, KVK Poonch who welcomed Dr. O.C Sharma and other scientists from ICAR-CITH and informed the farmers that ICAR-CITH is a premier Institute in the field of horticulture and has generated number of technologies/ varieties for boosting the horticulture production in the country. He explained that the programme was organized by ICAR-CITH under Tribal Sub Plan for the tribal farmers of Poonch district of Jammu and Kashmir. Dr. O.C Sharma, Principal Scientist, CITH explained the broad objectives of the programme and also explained the production techniques of temperate horticultural crops especially fruits and vegetable crops. He also explained about the mandate of ICAR-CITH and informed

the farmers that institute has collection of more than 2500 varieties of horticultural crops. He stressed the need for quality planting material and timely management viz. pruning in fruit crops for maximum production and returns. He also explained the role of pollinizers in orchards. Dr Madhu G S, Scientist ICAR-CITH explained the diseases management in horticultural crops. Dr Muzaffar Mir, SMS Fruit Science (KVK Poonch) deliberated on the importance of pecan crop in Poonch district. He elaborated that climatic conditions of Poonch are favourable for cultivation of variety of fruits. Dr Muneer Ahmed Sheikh (Technical officer) from CITH emphasized the role of implement kit to be distributed kit and its use in their farm. A Farmer Scientist Interaction was also organized on this occasion in which the scientists from ICAR-CITH and KVK Poonch replied to various problems faced by the farmers in Horticulture and Agriculture crops. On this occasion, planting material of apple, almond, nectarine and plum, seed kit of vegetables, tool kit consisting of spade, sickle, scissor, rake etc was also distributed among 100 tribal farmers of the district. The Sarpanches and farmers from remote thanked ICAR-CITH, Srinagar and Krishi Vigyan Kendra Poonch for organizing such a programme and working for the welfare of farmers.

Glimpses of TSP Programme (Training & Planting material/ kit distribution) at Poonch

One day training programme cum interaction meeting organized for tribal farmers of district Rajouri

ICAR-Central Institute of Temperate Horticulture organized one day training cum intraction meeting was organized on 28th February, 2021 at Mohar village of Kotranka area in district Rajouri in which about 60 farmers participated. Dr Madhu G S (Scientist) highlighted various aspects of the TSP programme organized for the tribal farmers of the village. Dr O C Sharma, Principal Scientist, ICAR-CITH emphasized on growing of horticultural crops for enhancing the income of tribal farmers. He also stressed that ICAR-CITH, Srinagar has generated many technologies which should be used by the farmers for enhancing their farm income and improve their livelihood. Dr Muneer Ahmad Sheikh (Technical Officer) highlighted regarding planting and management of plants and use of tool kit for their daily work given under this scheme. During the programme various problems faced by the tribal farmers were discussed and addressed. On this occasion, planting material of fruit crops like apple almond etc and a farm tool kit was provided to 50 participating tribal farmers. The Sarpanches and farmers from remote thanked CITH, Srinagar for organizing such a programme and working for the welfare of farmers. They also stressed that such programmes should be continued in future also.

Glimpses of TSP Programme (Training & Planting material/ kit distribution) at Rajauri

One Day Training Programme cum interaction meeting rganized for tribal farmers of district Ganderbal

For implementation of Tribal Sub Plan Scheme in Ganderbal district, ICAR-Central Institute of Temperate Horticulture, Srinagar distributed planting material and seeds of elite varieties of temperate fruits and vegetables among 178 tribal farmers of Babanagri, Ganderbal on 20th March, 2021. Grafted and budded plants of apple, almond, cherry & peach including seeds of onion, carrot, cabbage, beet root and Swiss chard were distributed for promoting horticulture and improving livelihood of the tribal farmers in the region. Training programme was also organized on Soil Health Management and Plant Protection by Dr G. S. Madhu and Dr Sudhakara N R, Scientists in which 100 tribal farmers of Babanagri, Ganderbal participated. During the year, experts from ICAR-CITH, Srinagar visited Babanagri; Ganderbal during fruiting season to check the performance of different crops distributed under TSP scheme and on spot advisories were provided to the farmers for improving the performance of the plants.

Schedule Caste Sub Plan (SCSP)

Schedule Caste Sub Plan (SCSP) was also executed by ICAR-CITH, Srinagar at RS Pura area of Jammu Kashmir. The programmes carried out are summarized in Table-60 and detail is presented below:

One Day programme organized under SCSP in Jammu

ICAR-Central Institute of Temperate Horticulture organized one day programme for SC farmers of Jinder Melhu - RS Pura, Jammu on 2nd March, 2021 in collaboration with Directorate of Extension and KVK Jammu under SKUAST-Jammu. In this programme about 125 farmers including women farmers participated. Dr S K Gupta, Director Extension from SKUAST – Jammu was Chief Guest on this occasion. During the programme Sh Sham Gorkha briefed about the village and motivated the farmers for taking benefits of various schemes for the benefits of SC farmers. After that many retired officer of the village and various sarpanches expressed their views and thanked ICAR-CITH for organizing the programme in their village. Dr O C Sharma, Principal Scientist welcomed the Director Extension and others. He highlighted about the scheme as well as about Institute and stressed for self employment of the youth. He told that ICAR-CITH, Srinagar is providing them a kit consisting of tools used in day to day life. After that Dr Puneet Choudhary, Head KVK Jammu expressed his views and role of KVK

for self employment generation. He also thanked ICAR-CITH for conducting the programme in their collaboration. Later Chief Guest, Dr S K Gupta interacted with the farmers and praised the steps taken by ICAR-CITH for the benefit of the SC farmers of the village. Lastly tool kits were distributed among 110 SC farmers. Lastly all sarpanches and others thanked ICAR-CITH for organizing the programme and hoped for conducting more programmes in future in other villages for upliftment of socio economic status of SC farmers.

Table-60: Details of trainings and kit distributed in Jammu district under SCSP

Sr No	Date	Place	Dis-trict	No.of training / inter-action	No.of parti-cipants	No.of farmers to which Kits distri-buted	Co or-dinators / faciltators
1	2nd March,2021	Jinder Melhu - RS Pura,	Jammu	1	125	110	O C Sharma, Madhu G S, M A Sheikh , Istiyaq Ahmad, Showkat Ah. Dar






Glimpses of training programme and kit distribution for SC farmers

Schedule Caste Sub Plan (SCSP)
Uttarakhand

Odlohar-Simsyari village was selected in the Bageshwar district under SCSP and the scheme was implemented in the village during 2021. The basic data/document were collected and verified and total 100 farming families are selected for the benefit. In the village, Swachhata campaign cum kisan gosthi on scientific way of planting winter vegetables and waste decomposition awareness programme was organized on 22nd December,2021 in which total 40 farmers were participated.

Glimpses of TSP Programme (Training & Planting material/ kit distribution) at Poonch

Glimpses of SCSP programme in Uttarakhand

Implementation of Mera Gaon Mera Gaurau Programme
Mera Gaon Mera Gaurav

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. Six trainings, six diagnostic/field visits and four demonstrations in which total more than 100 farmers participated. The farmers of the village were also supported with different technological literatures on temperate fruits and vegetables. Further, 20 mobile based advisory; five FAPs; four swachhata campaign and waste decomposition awareness programme were organized beside providing the technical support to the farmers of the village as and when approached.

Glimpses of MGMG programme by ICAR-CITH, Mukteshwar

Radio/ TV Talks

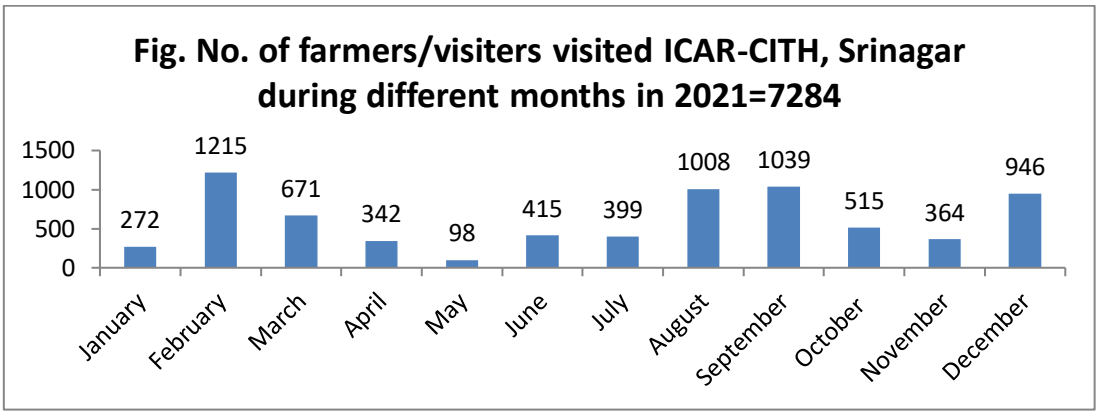
During thr year less number of physical programme could have been possible due to COVD-19 restrictions. But to cater to the need of farmers time to time advisories were issued through various media. To disseminate the technologies through mass media for their adoption on a larger scale, scientists of ICAR-CITH, Srinagar continuously delivered need-based talks on various topics beneficial for farmers and line departments. A total of **24** TV/Radio talks were delivered by various scientists during the year is presented in Table-61.

Table-61: Radio/ TV talks delivered by scientist of ICAR-CITH during 2020

Sr No	Name of Scientist	No. of talks
1.	Dr O C Sharma	1
2.	Dr J I Mir	3
3.	Dr Geetika Malik	2
4.	Dr Abas	1
5.	Dr W H Raja	2+6=8
6.	Sh Sajad Un Nabi	5+4=9
	Total	**24**

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 2021, total 7284 farmers/ visitors visited ICAR-CITH, Srinagar and month wise detail is presented in Fig below:.



Visitors at ICAR-CITH, Srinagar

Farmers taking quality planting material of fruit crops from ICAR-CITH, Srinagar

Trainings and Capacity Building

The up gradation of knowledge and skill of the staff of ICAR-CITH is a continuous phenomenon and Institute is deputing its staff regularly for various need based training programmes organized time to time by various organizations. During 2021, following officers were deputed for below mentioned trainings (online/offline) and have successfully completed the trainings.

Trainings attended by Scientific Staff

- ***Dr J I Mir, Sr Scientist (Agricultural Biotechnology)***
  - Implementation and Use of Agricultural Research Management System (ARMS) organized by IASRI, New Delhi held on 8th June, 2021
  - Implementation and Use of Agricultural Research Management System (ARMS) organized by IASRI, New Delhi to be held on 11th November, 2021 (online)
  - Plant Quarantine Procedures for Imports and Exports organized by National Institute of Plant Health Management, Hyderabad from 26th to 30th April, 2021 (online)
- ***Dr Arun Kishore, Scientist SS (Fruit Science)***
  - A 21 days training on Entrepreneurship Strategies in Agriculture, Horticulture, Animal Husbandry & Allied Sectors for Economic Development of India organized by Directorate of Extension Education Uttar Banga Krishi Vishwavidyalaya, Pundibari, West Bengal and Agro Environmental Development Society, Rampur, Uttar Pradesh from 1st to 21st December, 2021 (online)
- ***Dr Geetika Malik, Scientist SS (Vegetable Science)***
  - A 21 days training on Agricultural Research Methodologies Practices and their Management organized by Samagra Vikas Welfare Society (SVWS) & College of Horticulture & Forestry, Central Agricultural University Pasighat, Arunachal Pradesh, India from 4th October to 24th October, 2021(online)
- ***Dr Sajad Un Nabi, Scientist (Plant Pathology)***
  - A five days training programme on Plant Quarantine Procedures for Import and Export organized by NIPHM Hyderabad from 26th to 30th April, 2021 (online)
  - A three days training programme on Transcriptomic Data Analysis organized by Centre for Agricultural Bioinformatics (CABin), ICAR-Indian Agricultural Statistics Research Institute, New Delhi from 28th to 30th September, 2021 (online)
- ***Sh Vishal Dinkar, Scientist (Plant Breeding and Genetics)***

- A 10 days training program on "Biosecurity and Biosafety: Policies, Diagnostics, Phytosanitary Treatments and Issues" organised by NBPGR, New Delhi from 15th to 24th September, 2021.
- A 3 days training programme on "Transcriptomic Data Analysis" organised by Centre for Agricultural Bioinformatics, ICAR-IASRI, New Delhi from 28th to 30th September, 2021.

➢ ***Dr Sudhakara N R, Scientist (Soil Science)***

- A five days training programme on Strategies for Climate Risk Management and Resilient Farming organised jointly by ICAR-Central Research Institute Dryland Agriculture, Hyderabad (Telangana) and National Institute of Agricultural Extension Management, Hyderabad (Telangana) from 20th to 24th September, 2021 (online)
- A one day training programme on Soil Survey and Land Use Planning Using Remote Sensing and GIS organised by NBSSLUP, Regional centre, Hebbal, Bengaluru from 27th September to 1st October 2021(online)

➢ ***Sh Puneet Kumar Scientist (ASP&E)***

- A three days workshop on Statistical Modelling and Forecasting Techniques in Agriculture organised by Division of Forecasting and Agricultural System Modelling, ICAR-IASRI, New Delhi from 24th to 26th June, 2021 (online).
- A one day training programme on Packaging Standards for Fruits and Vegetables organised by Department of Food Packaging and System Development, Indian Institute of Food Processing Technology (IIFPT) on 31st August, 2021 (online).
- A five days training programme on Recent Trends in Nonthermal Processing: Prospects and Challenges organised by Indian Institute of Food Processing Technology (IIFPT) in collaboration with AICTE Training and Learning Academy from 4th to 8th October, 2021(online).
- A five days training on Technologies for Increasing the Shelf-life of Perishable Foods organised by Department of Food Process Engineering, National Institute of Technology, Rourkela, Odisha from 13th to 17th December, 2021 (online).

Awards/ Rewards/ Recognition

- ***Dr. Arun Kishor, Scientist-SS (Fruit Science)***
  - Received Young Scientist Award in the 4th International Conference on Current Approaches in Agricultural, Animal Husbandry & Allied Sciences for Successful Entrepreneurship (CAAAAHASSE-2021) held from 13th to 15th March, 2021 (virtual) organized by Agro Environmental Development Society (AEDS) Majhra Ghat, Rampur, Uttar Pradesh-244922 India in collaboration with RVSKVV, Gwalior, M.P.

- ***Dr. Sovan Debnath, Scientist-SS(Soil Science)***
  - Received Best poster presentation for paper Assessing Zn induced Fe depletion in processed foods made up of Zn fortified cereal grains' in the National Webinar on "Stewardship of Agrochmicals for upkeeping Environment" organized by the Society for Fertilizers and Environment in collaboration with Bidhan Chandra Krishi Viswavidyalaya from 30th to 31st March, 2021.
  - Recieved Best oral paper presentation for paper 'Is temperate fruit-based farming implicating soil mining of nutrients in fragile lands of mid-Himalayan ecosystem? in the World Environment Summit 2021 organized by Environment and Social Development Association, New Delhi from 1st to 3rd October, 2021.

- ***Dr WH Raja, Scientist SS (Fruit Science)***
  - Received Best poster paper award for the research paper entitled "Morpho-molecular characterization and genetic diversity analysis across a wild apple (*Malus baccata*) accessions using simple sequence repeat markers" in the 9th Indian Horticulture Congress 2021, held at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh from 18th to 21st November, 2021.

- ***Dr. Mohd. Abas Shah, Scientist SS (Agricultural Entomology)***
  - Received Best Presentation Award for paper "Evaluation of chlorine dioxide for the management of common scab of potato" in International Potato e-conference, New Paradigms in Food Security and Industrial Applications

organized by ICAR-Central Potato Research Institute, Shimla (HP) from 23rd to 26th November, 2021.

- ***Dr. S U Nabi, Scientist (Plant Pathology)***
  - Received M.J. Narasimhan Academic Merit Award Commendation Certificate for Presentation of paper entitled "Comparative virome analysis in mosaic infected and asymptomatic apple cultivars using RNA sequencing: development of multiplex RT-PCR and evaluation of rootstocks for sensitivity to mosaic disease" in the 73rd Annual Meeting (Virtual) of the Indian Phytopahological Society during National Symposium on "Plant Health and Food Security: Challenges and Opportunities" held at ICAR-IARI, New Delhi, from 25th to 27th March, 2021.

Patents

- ***Dr Mohd Abas Shah, Scientist SS (Agricultural Entomology)***
  - A Process for Culturing and Hardening of Potato Microplants Yielding Vigorous Plants. Kaur R P, Singh A K, Kumar R, Devi S, Shah M A and Minhas J S. Application No. 202111047004, dt. 14-10-2021. Controller General of Patents, Designs and Trade Marks, India.

Publications

Research Papers (International / National)

- Debnath S, Mandal B, Saha S, Sarkar, Batabyal K, Murmu S, Patra B C, Mukherjee D and Biswas T 2021. Are the modern-bred rice and wheat cultivars in India inefficient in zinc and iron sequestration? *Environmental and Experimental Botany* 189: 1-7.
- Fayaz H, Mir A H, Tyagi S, Wani A A, Jan N, Yasin M, Mir J I, Mondal B, Khan M A, and Mir R R 2021. Assessment of molecular genetic diversity of 384 chickpea genotypes and development of core set of 192 genotypes for chickpea improvement programs. *Genetic Resources and Crop Evolution 69:1193-1205.*
- Indrabi S A , Malik A A, Malik G, Hussain K , Narayan S, Nabi A, Akhter A , Sultan A and Javeed I 2021. Genetic divergence among chilli (*Capsicum annuum* L.) genotypes based on quantitative and qualitative traits. *The Pharma Innovation Journal* 10(10): 1033-1038.
- Kumar P, Chakraborty S K and Kate A 2022. Influence of infrared (IR) heating parameters upon the hull adherence and cotyledon integrity of whole pigeon pea (*Cajanus cajan* L.) grain. *LWT Food Science and Technology* 154 : 112792.
- Kumar R, Tiwari R K, Jeevalatha A, Sunderaresha S, Shah M A, Sharma S, Sagar V, Kunar M and Chakarabarti S K 2021. Potato apical leaf curl disease: current status and perspectives on a disease caused by tomato leaf curl New Delhi virus. *Journal of Plant Diseases Protection* 128: 897–911.(https://doi.org/10.1007/s41348-021-00463-w)
- Malik G, Yousuf S, Wani S H, Shabir A, Shah R A., Nabi S U, and Sharma A 2021. Effect of sulphur supplementation on yield and quality enhancement of bolting garlic (*Allium sativum* L. spp. *ophioscorodon*) in Indian Himalayan long day temperate climate. *Chemical Science Review and Letters* 10 (39): 295-298.
- Mohiddin F A, Majid R, Bhat A H, Dar M S, Shikari A B, Sofi N R, Nabi S U ***et al.*** 2021. Molecular phylogeny pathogenic variability and phytohormone production of Fusarium species associated with bakanae disease of rice in temperate agro-ecosystems. *Mol Biol Rep* 48: 3173–3184.
- Mohiddin F A, Padder S A, Bhat A H, Ahanger M A, Shikari A B, Wani S H, Bhat F A, Nabi SU, Hamid A, Bhat N A, Sofi N R, Waza S A, Hamid B, Parveen S, Hussain A, Bhat A N, Ali O M, Dar M S, **Abdel Latef AAH** 2021.Phylogeny and optimization of *Trichoderma harzianum* for chitinase production: Evaluation of their antifungal behaviour against the prominent soil borne

phytopathogens of temperate India. *Microorganisms* 9(9):1962. (https://doi.org/10.3390/microorganisms9091962).

- Mushtaq R, Sharma M K, Mir J I, Mansoor S , Mushtaq K, Popescu S M, Malik A R, El-Serehy H A, Hefft D I, Bhat S A and Narayan S 2021. Physiological activity, nutritional composition and gene expression in apple (*Malus* x *domestica* Borkh) influenced by different ETc levels of irrigation at distinct development stages. *Water* 13:3208
- Nabi S U, Madhu G, Rao G P and Baranwal V K 2021. Development of multiplex RT-PCR assay for simultaneous detection of four viruses infecting apple (*Malus domestica*). *Letters in Applied Microbiology*. https://doi.org/10.1111/lam.13643
- Narayan R, Debnath S, Kumar A, Kishore A and Sharma O C 2021. Effect of organic growing media for cost effective production of quality tomato seedlings in portrays under natural ventilated polyhouse. *Progressive Horticulture* 53(2):176-182.
- Raja W H, Yousuf N, Qureshi I, Sharma O C, Singh D B, Kumawat K L, Nabi S U, Mir J I, Sheikh M A, Kirmani S N and Sheikh M 2021. Morpho-molecular characterization and genetic diversity analysis across wild apple (*Malus baccata*) accessions using simple sequence repeat markers. *South African Journal of Botany* ((https://doi.org/10.1016/j.sajb.2021.08.020).
- Sadawarti M, Katare S, Singh S P, Shah M A, Samadhiya R K, Sharma S and Singh R K 2021. Efficacy of mineral and non-edible seed oils against aphids and whitefly in potato. *Indian Journal of Entomology*,(https://doi.org/10.5958/IJE.2021.97).
- Shah M A, Katare S, Bhatngar A, Sharma S, Sadawarthi M J and Singh S P 2021. Efficacy of soil insecticides against sucking pests of potato. *Indian Journal of Entomology* https://doi.org/10.5958/0974-8172.2021.00154.1
- Shah M A, Kaur R P, Devi S, Kumar R and Sharma S 2021. Efficacy of rice straw mulch for the control of vector and virus incidence in potato. *Potato Journal* 48(1): 76-80.
- Shah M A, Naga K C, Subhash S, Sharma S and Kumar R *2021*. Use of petroleum-derived spray oils for the management of vector-virus complex in Potato. *Potato Res.* 65: 1–19. (https://doi.org/10.1007/s11540-021-09505-0).
- Shah M A, Sharma S and Kumar R 2021. Seasonal population dynamics and flight activity of sweet potato whitefly, *Bemisia tabaci* on potato in the sub-

tropical plains of India. *Arthropod-Plant Interactions* 15: 605–613. (https://doi.org/10.1007/s11829-021-09835-3)

- Sharma A, Kumar S, Khan S A, Kumar A, Mir J I, Sharma O C, Singh D B and Arora S 2021. Plummeting anthropogenic environmental degradation by amending nutrient-N input method in saffron growing soils of north-west Himalayas. *Scientific Reports* 11:2488
- Sharma A, Kumar S,, Mir J I, Kumar R, Sharma O C, Lal S, Kumawat K L, Ahmed N, Singh D B, Ganie M A and Razvi S 2021. Restricting depletion of soil organic carbon by amending nutrient-N input to soils. *Land Degradation & Development* 32(11): 3204-3219
- Sheikh Z N, Sharma V, Shah R A, Raina S, Aljabri M, Mir J I, Kenani N A and Hakeem K R 2021. Elucidating genetic diversity in apricot (*Prunus armeniaca* L.) cultivated in the north-western Himalayan provinces of India using SSR markers. *Plants* 10 (12): 2668
- Sheikh Z N, Sharma V, Shah R A, Sharma N, Summuna B, Al-Misned F A, El-Serehy H A and Mir J I 2021. Genetic diversity analysis and population structure in apricot *(Prunus armeniaca* L.) grown under north-western himalayas using ISSR markers. *Saudi Journal of Biological Sciences* 28(10): 5986-92
- Sudhakara N R and Krishnamurthy R 2021. Sulphur status and effect of different sources and levels of sulphur application on performance of aerobic rice (*Oryza Sativa* L.). *Mysore Journal of Agricultural Sciences* 55(3):75-82
- Tiwari J K, Mandadi N, Sridhar J, Mandal V, Ghosh A, Kardile H B, Naga K C, Shah M A, Kumar M, Rao A R and Rai A 2021. Draft genome sequencing of the foxglove aphid (*Aulacorthum solani* Kaltenbach), a vector of potato viruses, provides insights on virulence genes. *Journal of Asia-Pacific Entomology* 24(2): 93-102.
- Waghmode B, Masoodi L, Kushwaha K, Mir J I and Sircar D. 2021. Volatile components are non-invasive biomarkers to track shelf-life and nutritional changes in apple cv. 'Golden Delicious' during low-temperature postharvest storage. *Journal of Food Composition and Analysis* 102: 104075
- Wani S, Saleem S, Nabi S U, Ali G, Paddar B A, Hamid A 2021. Distribution and molecular characterization of potato virus Y (PVY) strains infecting potato (*Solanum tuberosum*) crop in Kashmir (India). *Virus Disease.* 32(4):784-788

- Wani T A, Masoodi F A, Dar M M, Akhter R and Sharma O C 2021. Subcritical treatment of olive oil: minor phenolics composition and antioxidant properties of solvent extracts. LWT- Food Science and Technology 147:111584

Review Papers

- Khan M and Mir J I 2021. Potential of Biotechnology in Phytoremediation. *Current World Environment* 16(1):1-6
- Malik A A, Malik G, Narayan S, Hussain K, Mufti S, Kumar A, Khan F A, Kumar H and Lone S 2021. Grafting technique in vegetable crops: A Review. *SKUAST Journal of Research* 23(2): 104-115
- Raja W H, Noomphy M, Bam G, Nabi S U, Sharma O C, Mir J I, Shah M A and Madhu G S 2021. Potential and prospects of Kiwifruit production in the state of Arunachal Pradesh *The Pharma Innovation* 10(12): 1749-1751

Books

- **Shahid Ali Akbar, D. B. Singh, J. I. Mir et al 2021. Pests of Fruit Crops in Kashmir. An illustrated colour handbook. Published by Astral New Delhi. (Incomplete Reference)**

Book chapters:

- Abdel R M A, Ezz A R, Muhammad A, Ceman S, Abdel R A, Yousaf M A, Mohammad AL, Menir T, Rouf A Shah M A *et al* 2021. Plant-microbe interaction under climate change. *In*: Developing Climate-Resilient Crops: Improving Global Food Security and Safety edited by Fahad S *et al*., CRC Press, pp. 159-173
- Abdel R M A, Ezz A R, Muhammad A, Ceman S, Abdel R A, Yousaf M A, Mohammad AL, Menir T, Rouf A Shah M A *et al* 2021. Biological nitrogen fixation in a changing climate. *In:* Sustainable Soil and Land Management and Climate Change edited by Fahad S *et al*. CRC Press, pp. 17-26
- Baranwal V K, Nabi S U and Yadav M K 2021. Plant virus diagnostics: Traditional to recent and emerging advances. *In:* Emerging Trends in Plant Pathology edited by Singh K P, Jahagirdar S and Sharma B.K. Springer, Singapore. (https://doi.org/10.1007/978-981-15-6275-4_5).
- Hussain K, Ahmed N, Narayan S, Malik A A, Dar Z A, Hussaini A A B, Khan F A, Qayoom S, Bhat K and Malik G 202. Human health and organic farming. *In*: Organic Vegetable Production edited by Sumati Narayan, Khursheed

Hussain, Ajaz Ahmed Malik and Faheema Mushtaq. Delhi, Jaya Publishing House, India, pp 30-36.

- Kumar P, Lamo C, Naik R and Murthy G R K 2021. Scope of Bioplastics in Agricultural Processing. *In:* Agricultural Research, Technology and Policy: Innovations and Advances. Edited by Srinivasarao Ch. *et al,* ICAR-National Academy of Agricultural Research Management (NAARM), Hyderabad, Telangana, India, pp. 349-368.
- Malik A A, Narayan S, Hussain K. Mufti S, Masoodi U. Magaray M and Malik G 2021. Organic agriculture - A potential way for combating climate change. *In:* Organic Vegetable Production edited by Sumati Narayan, Khursheed Hussain, Ajaz Ahmed Malik and Faheema Mushtaq. Delhi, Jaya Publishing House, India, pp 37-45.
- Malik G, Singh D B, Malik A A and Gulzar A 2021). Underutilized vegetable species of Himalayas. *In*: Neglected and underutilized crops-towards nutritional security and sustainability edited by Sajad Majeed Zargar, Antonio Masi and Ramesh Kumar Salgotra. Singapore, Springer Nature Pvt. Ltd, pp 237(https://doi.org/10.1007/978-981-16-3876-3)
- Malik K, Shah M A and Naga K 2021. Aphid-vector surveillance. *In :* Potato in sub-tropics: A saga of success edited by Chakrabarti SK *et al.* New Delhi, International Books & Periodical Supply Service, pp. 61-68.
- N Sumati, Hussain K, Malik A A, Khan F A and Malik G 2021. Production of organic inputs for organic agriculture. *In*: Organic Vegetable Production edited by Sumati Narayan, Khursheed Hussain, Ajaz Ahmed Malik and Faheema Mushtaq. Delhi, Jaya Publishing House, India, pp 89-93.
- Nabi S U, Yousuf N, Yadav M K, Choudhary D K, Ahmad D, Kirmani S N, Sheikh P and Ahmed, I 2021. Recent insights in detection and diagnosis of plant viruses using next-generation sequencing technologies. *In:* Innovative Approaches in Diagnosis and Management of Crop Diseases edited by Gopala & Singh R K, CRC Press, pp16
- Narayan S, Chakrabarty S, Hussain K. Malik A A, Khan F A and Malik G 2021. Organic and biodynamic vegetable farming. *In:* Organic Vegetable Production edited by Sumati Narayan, Khursheed Hussain, Ajaz Ahmed Malik and Faheema Mushtaq. Delhi, Jaya Publishing House, pp 55-61.
- Rana M., Kaldate R., Nabi S U, Wani S H and Khan H 2021. Marker-Assisted Breeding for Resistance Against Wheat Rusts. *In*: Physiological, Molecular, and Genetic Perspectives of Wheat Improvement edited by Wani S.H.,

Mohan A., Singh G.P. Springer, Cham. (https://doi.org/10.1007/978-3-030-59577-7_11)

- Shah M A, Al-Tawaha A R, Naga K C and Sharma S 2021. Insect pest management in the era of climate change. *In:* Climate Change and Plants Biodiversity, Growth and Interactions edited by. Fahad S *et al*. CRC Press, pp. 133-146.
- Sharma S.K, Sharma D, Meena R P, Yadav M K, Rajashekra H, Dubey A K, Sharma P, Kumar S, Pramesh D, Nabi SU *et al*. 2021. Recent insights in rice blast disease resistance. *In*: Blast Disease of Cereal Crops : Fungal Biology edited by Nayaka S C, Hosahatti R, Prakash G, Satyavathi C T and Sharma R. Springer, Cham. (https://doi.org/10.1007/978-3-030-60585-8_7)
- Singhal P, Yadav M K, Nabi S U 2021. Techniques for detection of viroids. *In*: Innovative approaches in diagnosis and management of crop diseases edited by Gopal & Singh R K. CRC Press, pp24
- Sudhakara N R, Yadav B, Mohanty M, Pratibha G, and Ch. Srinivasa Rao. 2021. Soil management for mitigating greenhouse gas emissions in agricultural sectors. *In*: Agricultural Research, Technology and Policy: Innovations and Advances, ICAR-National Academy of Agricultural Research Management (NAARM), Hyderabad, Telangana, India, pp. 229-270.

Technical bulletins/ Popular articles/pamphlet/folders

- Kaur R P, Devi S, Shah M A, Kumar R, Singh S, Pandey N K, Arora R K, and Singh R K 2021. Potato production scenario in Punjab with special emphasis on potato seed production. Technical Bulletin. ICAR-Central Potato Research Institute, Shimla-171001, (HP), India, pp. 37.
- Malik G 2021. Garlic: A mysterious wonder plant. In newspaper: *Rising Kashmir* (21st August, p 9: Viewpoint)
- Mir J I, Sharma O C, Raja W H, Sami-Ullah S and Raja R H S. High density plantation in apple – A highly remunerative enterprise. Indian Horticulture, September–October 2021 : 24-26.
- Sudhakara N R, Kumar P and Sunil B H 2021. Post-harvest management of apple. *Agrobios Newsletter*: 20(05): 34-36.
- Sudhakara N R, Sharma O C, Raja W H, Kumar P , Dinkar V, Malik G, Shah M A, Nabi S U, Madhu G S and Mir J I 2021. Scientific Production Practices of Strawberry Cultivation. ICAR-Central Institute of Temperate Horticulture, Srinagar, J&K, India.

- Sunil B H, Malav L C and Sudhakara N R 2021. Land degradation: Causes and management. *Agrobios Newsletter* 20(2): 19-20.
- Sunil B H, Malav L C, and Sudhakara N R 2021. Metals Contamination in India. *Agrobios Newsletter* 20(06): 69-70.
- Sunil B H, Malav L C, and Sudhakara N R 2021. Potential use of urea briquettes -diammonium phosphate for rice crop. *Biotica Research Today* 3(6):528-530
- Venkata Shiva Reddy J S, Sudhakara N R, and Uday Kumar S N. 2022. Producing food globaly without destroying the planet. *Agrobios Newsletter* 20(08): 21-22.
- Venkata Shiva Reddy,J S, Sudhakara N R, and Uday Kumar S N .2021. Pesticides usage and its lon-term effects on human health in India. *Agrobios Newsletter* 20(07): 44-46.
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Participation in Workshops/ Conference/ Meeting

- ***Dr. O.C. Sharma, Director (Act.)***
  - Attended and presented the progress on use of official language before the Parliamentary Committee on Official language- second Sub Committee during the inspection of ICAR-CITH, Srinagar on 16th July, 2021
  - Attended Director's Conference chaired by DG, ICAR and Secretary, DARE on 2nd July, 2021
  - Attended Mid term Review Meeting of 24th RCM (Zone III) on 10th April, 2021
  - Attended 25th Regional Committee Meeting of Zone III on 11th December, 2021 Chaired by Secretary DARE, & DG ICAR .
  - Attended Mid Term Review Meeting of XXVI meeting of ICAR Regional Committee 1 held on 12th April, 2021.
  - Attended Preliminary Meeting (virtual mode) of Prime Minister Task Force Committee ACZ-1 (Western Himalaya) held on 16th September, 2021
  - Attended meeting as expert for Development of International Certificate Course on Temperate Horticulture during workshop organized by Deptt of Fruit Science, Dr YSPUH&F, Solan under Institute Development Plan, National Higher Education Project on 8th April, 2021
  - Attended 50th Research & Extension Advisory Committee Meeting (REAC-Rabi-2021) of SKUAST K, Srinagar on 20th November 2021.
  - Attended 49th Research and Extension Advisory Committee Meeting (Kharif-2021) of SKUAST-K in 17th June, 2021 on virtual mode
  - Attended and chaired the meeting of subcommittee for RWBCI for apple held on 30th June,2021.
  - Attended IMC meeting of ICAR-CITH, Srinagar on 27th April,2021 held at ICAR-CITH, Srinagar
  - Attended & presented the EFC of ICAR-CITH, Srinagar in the meeting regarding EFC chaired by DDG Horticulture on 9th June,2021
  - Attended Review meeting on Special Campaign and Pending matters on 27th October, 2021 on virtual mode organized by ICAR, New Delhi.

- ***Dr. J. I. Mir, Sr Scientist (Plant Biotechnology)***
  - Attended workshop on EFC presentation and preparation on 4th June, 2021 organized by ICAR (HQ), New Delhi.
  - Attended online workshop on Effective utilization and product presentation J GATE@CeRA" organized by team CeRA, New Delhi on 28th June, 2021
  - Attended 9th Indian Horticulture Congress and presented oral paper on "Tall Spindle System in Apple – A remunerative enterprise" held at CSAUAT, Kanpur, UP from 18th to 21st , November, 2021.
  - Delivered a lead lecture on "Saffron apocarotenoids biosynthesis and their role in human health" in International conference on saffron and seed spices organized by SKUAST-K, Srinagar on 7th November, 2021.
  - Presented ITMU achievements during 2019-20 and 2020-21 by ICAR-CITH, Srinagar during the sensitization and review workshop organized by ABI-Unit and ZTMU on 6th October, 2021.
  - Attended AgIn, Techno-Commercial Assessment and Expert Committee Meeting to assess the technical & commercial feasibility, handholding requirement, preferred modes of commercialization and to develop standard terms for potential technologies of ICAR Institutes. Technology disclosure forms and technology valuation forms in respect of two technologies 1. PPA (Predictor and Planner for Almond) and 2. LCP (Land Use and Contingency Planner for apple and walnut) from ICAR-CITH, Srinagar was presented on 8th January, 2021
  - Attended various meetings regarding Horticulture Planting Material held under the Chairmanship of Secretary (A&FW) on various dates.
  - Attended meetings with members of Apple Crop Specific Technical Sub-Committee regarding standardization of Term sheet under RWBCIS held on 25th and 29th May, 2021 under the Chairmanship of Director, ICAR-CITH, Srinagar.
  - Attended virtual meeting and progress of Indo-Uzbek Project: INT/Uzbek/P-06 – on 31st May, 2021 organized by ICAR-NBPGR, New Delhi.
  - Attended virtual meeting and progress of Indo-Uzbek Project: INT/Uzbek/P-06 – on 25th October, 2021 organized by ICAR-NBPGR, New Delhi.

- Attended Mid-Term Review Meeting of ICAR - Regional Committee – Zone I on 12th April, 2021
- Attended and organized meeting on Development of strategy document for management of codling moth and promotion of hi-tech horticulture in Ladakh on 5th April, 2021
- Attended and presented the project during the Meeting for Horticulture Planting Material under the chairmanship of Secretary (A&FW) on 17th May,2021
- Attended meeting under chairmanship of DDG (HS) on Ladakh Horticulture and codling moth management –a strategy document and gave presentation on 10th May, 2021.
- Attended meeting on "The details of apricot scenario in UT of Ladakh, its threats and opportunities with special reference to codling moth and other aspects of hi-tech horticulture promotion in UT of Ladakh" under the chairmanship of Sh. Ravinder Kumar, IAS, Secretary (PDD / Animal & Sheep / Coop / Labour & Emp / Horticulture on) on 10th April, 2021
- Attended meeting on "The details of apricot scenario in UT of Ladakh, its threats and opportunities with special reference to codling moth and other aspects of hi-tech horticulture promotion in UT of Ladakh under the chairmanship of CEC, LAHDC, Leh on 10th April, 2021
- Attended meeting on The details of apricot scenario in UT of Ladakh, its threats and opportunities with special reference to codling moth and other aspects of hi-tech horticulture promotion in UT of Ladakh under the chairmanship of CEC, LAHDC, Kargil on 12th April, 2021
- Attended meeting on The details of apricot scenario in UT of Ladakh, its threats and opportunities with special reference to codling moth and other aspects of hi-tech horticulture promotion in UT of Ladakh under the chairmanship of Advisor to LG, UT of Ladakh on 13th April, 2021
- Attended 7th meeting of Faculty of Horticulture at SKUAST-K, Shalimar on 9th August, 2021
- Attended virtual meeting on Review of activities under NAIF project on 6th to 7th October, 2021
- Attended online meeting related to EFC (2021-2026) organized by ICAR-IIHR, Bangalore on 30th December, 2021.

- ***Dr. Arun Kishore, Scientist (Fruit Science)***
  - Attended & presented paper on "ffect of Different Plant Bio-Regulator Treatments on the Semi-Hardwood Cuttings of Kiwifruit Cultivars" in 4th International Conference on Current Approaches in Agricultural, Animal Husbandry & Allied Sciences for Successful Entrepreneurship (CAAAAHASSE-2021) organized by Agro Environmental Development Society (AEDS) Majhra Ghat, Rampur, Uttar Pradesh in collaboration with RVSKVV, Gwalior, M.P. from 13th to 15th March,2021in virtual mode.
  - Attended Preliminary meeting of ICAR institutes at Uttarakhand on 19th June, 2021 though virtual mode organized by Director IISWC, Dehradun.
  - Attended SAC meeting of ICAR-VPKAS-KVK, Kafligair on 21st June, 2021 though virtual mode organized by KVK, Bageshwar.
  - Attended webinar workshop on effective use of J-Gate @ CeRA on 28th June, 2021 though virtual mode organized by CITH, Srinagar.
  - Attended Group Meeting of All India Network Research Project on Onion and Garlic held from 12th to 13th October, 2021 on Virtual Mode.
  - Attended interaction meeting of Secretary DARE & DG ICAR on 23rd October, 2021 through virtual mode.
  - Attended 39th Group Meeting of All India Coordinated Research Project on Vegetable Crops held from 7 to 9th September, 2021 on Virtual Mode.
  - Attended zoom meeting on RWBCIS 24th May, 2021 though virtual mode organized by Director CITH, Srinagar.
  - Attended in house workshop on functioning and operation of ARMS portal on 2nd August, 2021 though virtual mode organized by Director CITH, Srinagar

- ***Dr. Sovan Debnath, Scientist-SS(Soil Science)***
  - Presented oral paper (Virtual) entitled 'Is temperate fruit-based farming implicating soil mining of nutrients in fragile lands of mid-Himalayan ecosystem? during the World Environment Summit 2021 organized by Environment and Social Development Association, New Delhi from 1st to 3rd October, 2021.
  - Presented poster (Virtual) entitled Zinc and iron profiling in some commonly consumed food crops uncovers inter- and intra-crop variation' during the 8th Annual Convention and a Webinar on Stewardship to Agrochemicals for upkeeping Environment organized by Society for

Fertilizers and Environment in collaboration with Bidhan Chandra Krishi Viswavidyalaya from 30th to 31st March, 2021.

- ***Dr. Geetika Malik, Scientist (Vegetable Science)***
  - Attended one day workshop for KRISHI Nodal Officers on 17th July, 2021 (online)
  - Attended one day panel discussion on 'Enriching diet with nutria-dense vegetables for better health and wellness' on 31st Foundation day of ICAR-IIVR, Varanasi on 28th September, 2021 (online)
  - Attended Interaction meeting of Hon'ble Secretary DARE & DG ICAR with ICAR scientists on 28th October, 2021
  - Attended one day online National conference on International Year of Fruits and Vegetables on 29th October, 2021 (online)
  - Attended one day Brainstorming session on *Allium* breeding on 20th November, 2021 (online)
  - Attended three days International conference on 'Vegetable Research and Innovations for Nutrition, Entrepreneurship and Environment (ICVEG-21)' organized by ISVS, IIVR-Varanasi and ICAR at IIVR, Varanasi from 14th to 16th December, 2021
  - Attended two days International webinar on Exchange on Biochemical and Molecular Techniques (BMT) Guidelines and Implementation of BMT in DUS from 16th to 17th December, 2021 (online)
- ***Dr. W H Raja, Scientist SS (Fruit Science)***
  - Attended & presented paper entitled "Vertical expansion nursery for enhancing the multiplication rate of clonal rootstocks of apple under protected conditions in 9th Indian Horticulture Congress 2021: Horticulture for Health, Livelihoods and Economy held at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh from 18th to 21st November 2021, organized by Indian Academy of Horticulture Sciences, New Delhi.
  - Attended & presented poster on "Understanding the genetic diversity and population structure of wild apple (*Malus baccata* L.) accessions using microsatellite markers in National Seminar on Technological options and market intelligence for enhancing profitability in horticulture organised by Biotech KISAN Hub, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir in virtual mode from 27th to 28th March, 2021.

- Attended two days workshop for Deputy Commissioners of AP for sustainable goals at Namsai, Arunachal Pradesh along with DDG Horticulture from 25th to 26th Sept, 2021.
- Attended 6th National Review Conference on *Pradhan Mantri Fasal Bima Yojana*- celebrating fifth year of the scheme on 24th July 2021.

➢ ***Dr. Sajad Un Nabi, Scientist (Plant Pathology)***

- Attended online webinar on "Next generation sequencing on deciphering host pathogen interaction" organized by Indian Phytopathological Society in collaboration with Bionivid technology PVT Ltd, from 4th & 5th February, 2021
- Attended National Symposium (Virtual) on Plant Health and Food Security: Challenges and Opportunities organised by Indian Phytopathological Society at ICAR-IARI, New Delhi from 25th to 27th March, 2021.
- Attended International-e-Conference on post harvest disease management and value addition of Horticultural crops from 18th to 20th August, 2021 at ICAR-IARI, New Delhi.
- Attended strategy online workshop on, "Certification of quality planting material of clonally propagated fruit crops for promoting diversification" organised by National Academy of Agricultural Sciences (NAAS) on 20th September, 2021 at New Delhi

➢ ***Dr. Md Abas Shah, Scientist SS (Agricultural Entomology)***

- Attended International Potato e-conference, New Paradigms in Food Security and Industrial Applications organized by ICAR-Central Potato Research Institute, Shimla (HP) from 23rd to 26th November, 2021.

➢ ***Sh. Vishal Dinkar, Scientist (Plant Breeding and Genetics)***

- Attended National Conference on "Integrated Farming Systems: A Tool for Enhancing Income and Nutritional Security" organised by ICAR-Research Complex for Eastern region, Patna, Bihar from 5th to 7th October, 2021.

List of Ongoing Projects

I. Institute Research Projects

A. Project: Crop improvement and Biotechnology
Sub projects

1. Survey, collection, characterization and documentation of temperate horticultural crops
2. Breeding for development of superior varieties/hybrids in solanaceous vegetables
3. Development of superior cultivars/ hybrids in temperate fruits through conventional and non conventional methods
4. Characterization and diversity analysis of flowering related gene/ genes in almond
5. Development of CMS lines in long day onion [Allium cepa L]
6. Breeding of nutrarich varieties or hybrids in root vegetable crops.
7. Rootstock improvement in temperate fruits

B. Project: Crop Production and Propagation
Sub projects

1. Management of pre harvest fruit drop in apple by fruit load management
2. Enhancement in multiplication rate of clonal rootstocks for production of quality planting material under protected conditions
3. Standardization of integrated nutrient management of vegetables as intercrop in apple orchard
4. Development of almond based saffron inter cropping system

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. Elucidating the diversity, species spectrum and screening of germplasm

against Alternaria spp. infecting temperate fruits

4. Bionomics, modeling and management of sucking pest complex of temperate fruits

D. Project: Post Harvest Management

Sub projects:

1. Effect of various post harvest treatments on storage in pear

E. Ongoing externally funded projects

Sub projects

1. Network project on onion and garlic (co-operation centre)
2. All India Coordinated Research Project (Vegetable Crops)
3. Intellectual property management and transfer/ commercialization of agricultural technology scheme (NAIF)
4. Challenge programme on canopy management and plant architectural engineering in temperate fruits
5. DUS testing centre for temperate fruits
6. Development of an electronic nose sensor to determine the optimum harvesting time for apple and papaya
7. Walnut propagation for production of quality planting material
8. Validation and development of DUS testing guidelines for olive
9. Development and validation of DUS guidelines in Kale under Indian conditions
10. Augmentation of plant genetic resources and capacity building of researchers in India and Uzbekistan
11. Production of Quality Planting Material of Elite Walnut Cultivars and Demonstration of Improved Agro Technology for Walnut Orchards in Kashmir and Arunachal Pradesh
12. Characterizing diversity, genome profile and development of robust diagnostics for Diplodia spp. associated with Canker disease of Apple (*Malus domestica* Borkh.) in North Western Himalayan Region of India
13. 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 January, 2021 to 8th January, 2024)

1.	**Dr T A More** Ex -Vice Chancellor, MPK, 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, Maharastra 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.	**Dr B K Pandey** ADG(HS II),ICAR, New Delhi	**Member**
7	**Dr. Hina Shafi** D/o Sh. M. S. Bhat M.P. Lane, Kursu Rajbagh , Srinagar	**Member**
8.	**Shri Desh Kumar Nehru** Village Panjla, The Rohama, Distt Baramulla (J&K)	**Member**
9	**Dr Desh Beer Singh** Director, ICAR-CITH, Srinagar	**Member**
10	**Dr O C Sharma** Principal Scientist, ICAR-CITH, Srinagar	**Member Secretary**

Institute Management Committee (IMC)

1.	**Dr. Desh Beer Singh** Director, ICAR-CITH, Srinagar	Chairman
2.	**Director Horticulture** Govt. of J&K, Raj Bagh, Srinagar	Member
3.	**Director** Horticulture & Food Processing, Deharadun, Uttarakhand	Member
4.	**Dr. Hina Shafi Bhat** D/O Sh. M.S. Bhat R/O M.P. Lane Kursoo, Rajbagh, Srinagar -190008	Member / Progressive Farmer
5.	**Sh. Desh Kumar Nehru** S/O Sh. Shyam Lal R/O Rohama, District Baramulla, J&K	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, Regional Station, Srinagar (J&K)	Member
9.	**Dr. Javid Iqbal Mir** Senior Scientist (Biotechnology), ICAR-CITH, Srinagar (J&K)	Member
10.	**Dr B K Pandey** 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

- Shri Narendra Singh Tomar, Hon'ble Union Minister for Agriculture and Farmers Welfare, Government of India visited ICAR-CITH, Srinagar on 9th September, 2021 on the occasion of Apple Day. He was briefed about various technologies generated by the institute for the benefit of the farmers. He appealed to the farmers for better application of technology towards enhanced farm productivity and to make agriculture more profitable enterprise for better living standards.

- Sh. Kailash Choudhary, Hon'ble Minister of State for Agriculture and Farmers Welfare, Government of India visited ICAR-CITH, Srinagar on 9th September, 2021 on the occasion of Apple Day.

- Ms. Shobha Kalandrale, Hon'ble Minister of State for Agriculture and Farmers Welfare, Government of India visited ICAR-CITH, Srinagar on 9th September, 2021 on the occasion of Apple Day.

- Sh Farook Khan, Advisor to Hon'ble LG of J&K visited ICAR-CITH, Srinagar on 9th September, 2021 on the occasion of Apple Day.

- Dr A K Singh, DDG (Horticulture) visited the Institute on 8th to 9th September, 2021 and interacted with scientists and staff regarding various research and other works going on at the Institute.

- Dr B K Pandey, Additional Director General (HS II) visited ICAR-CITH, Srinagar on 15th July, 2021 and was made aware of various research activities going on at our institute. He also interacted with the staff of ICAR and was made aware of various problems.


Visit of Shri Narendra Singh Tomar, (Hon'ble Union Minister for Agriculture and Farmers Welfare), Sh. Kailash Choudhary. (Minister of State for Agriculture and Farmers Welfare) & Ms. Shobha Kalandrale, (Minister of State for Agriculture and Farmers Welfare) to ICAR-CITH, Srinagar on 9th September, 2021


Visit of DDG Horticulture and ADG Horticulture during their visit to ICAR-CITH, Srinagar

Personnel (As on 31st December, 2021)

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)
- Sh. Madhu G S, 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**,** (UDC)
- Sh. Mohd. Muzafer Lone,(LDC)
- Sh. Rouf Ahmad Sheikh,(LDC)

Technical

- Sh. Eshan Ahad**,** Sr.Technical Officer (T-6)
- Dr. Muneer Ahmad Sheikh, Technical Officer (T-5)
- Sh. Mehraj-ud-Din Bhat, Sr. Technical Assistant (T-4)/Driver
- Sh. Farman Ali, Technical Officer (T-5)/ Driver)
- Sh. Mohammad Ramzan Wani, Technical Assistant (T-1-3)
- 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, (LDC)

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)

Administrative

- Sh. Khushi Ram, (LDC)

Transfers / Superannuation /Promotions

New Joining

- Dr Om Chand Sharma, Principal Scientist, ICAR-CITH, Srinagar joined as Director (Act.) on 1st May, 2021 (F/ N).
- Dr. Mohd. Abas Shah, Scientist (Agricultur**e** Entomology) joined ICAR-CITH, Srinagar on 11th February, 2021 (F/N) after his transfer from ICAR-CPRI, Regional Station, Jalandhar (Punjab).
- Dr Sudhakara N R joined ICAR-CITH, Srinagar as Scientist (Soil Science) on 12th January, 2021 after completing training at NAARM, Hyderabad.
- Sh Vishal Dinkar joined ICAR-CITH, Srinagar as Scientist (Plant Breeding and Genetics) on 12th January, 2021after completing training at NAARM, Hyderabad.
- Sh Puneet Kumar joined ICAR-CITH, Srinagar as Scientist (AS&PE) on 12th January, 2021after completing training at NAARM, Hyderabad.
- Shri Jawahar Lal Koul joined ICAR-CITH, Srinagar as Assistant on deputation from ICAR-IVRI, Izatnagar, Bareilly (U.P.) on 15th November, 2021 (F/N).
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Superannuation/ Volunteer Retirement

- Dr Desh Beer Singh, Director superannuated from Council's Service on 30th April, 2021(A/N).
- Shri Mohd. Ramzan Wani, Technical Assistant (T-I-3) superannuated from Council's Service on 31st December, 2021(A/N).
- Shri Mukhtar Ahmad, Assistant took Voluntary Retirement from Council's Service on 30th September, 2021 (A/N)

Transfers

- Dr. Sovan Debnath, Scientist-SS (Soil Science) transferred from ICAR-CITH, Regional Station Mukteshwar to ICAR-CAFRI, Jhansi (U.P) on 6th October, 2021(A/N).
- Shri Akhil Thukral, Assistant Administrative Officer transferred from ICAR-CITH, Regional Station Mukteshwar to ICAR-NRC on Camel, Bikaner (Rajasthan) on 8th November, 2021

Promotions

- Dr Mohd Abas Shah, Scientist (Agricultural Entomology) promoted under CAS from Scientist (Level 10) to Scientist SS (Level 11) on 14th October,2021 w.e.f 1st July, 2019.
- Shri Diwan Chandra, Assistant, ICAR-CITH, Regional Station Mukteshwar promoted as Assistant Administrative Officer w.e.f. 24th July, 2021(A/N).
- Shri Showkat Ahmad Mir, Assistant, ICAR-CITH, Srinagar promoted as Assistant Administrative Officer w.e.f. 24th July, 2021(A/N).
- Smt. Shahida Rafiq, Personal Assistant ICAR-CITH, Srinagar promoted as Private Secretary w.e.f. 30th June, 2021(F/N).
- Shri Reyaz Ahmad Mir, Assistant, ICAR-CITH, Srinagar promoted as Assistant Administrative Officer w.e.f. 18th September, 2021(A/N).
- Shri Tariq Ahmad Mir, Stenographer (Gr-III) ICAR-CITH, Srinagar promoted as Personal Assistant on 30th June, 2021(F/N).
- Shri Farman Ali, Senior Technical Assistant (T-4)/ Driver ICAR-CITH, Srinagar promoted as Technical Officer(T-5)/Driver w.e.f. 1st January, 2021(F/N).
- Shri Vinod Chandra, Technical Officer (T-5), ICAR-CITH, Regional Station, Mukteshwar was promoted on 6th March, 2021 as Sr.Technical Officer (T-6) *w.e.f.* 21st March, 2019.
- Shri Eshan Ahad, Technical Officer (T-5), ICAR-CITH, Srinagar was promoted on 6th March, 2021 as Sr.Technical Officer (T-6) *w.e.f.* 21st March, 2019.
- Dr Shoaib Nissar Kirmani, Sr Technical Officer (T-6), ICAR-CITH, Srinagar was promoted on 22nd April, 2021 as Assistant Chief Technical officer (T-7/8) *w.e.f.* 13th April, 2020.