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2019-20

ICAR-Central Institute of Temperate Horticulture
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EXECUTIVE SUMMARY

ICAR- Central Institute of Temperate Horticulture, Srinagar (J&K) has focused on generation of technologies in different temperate horticultural crops by carrying out research on various aspects like improvement, production, protection & post harvest management since its inception. Institute has emerged as an apex centre for generation of farmer friendly technologies during last few decades in various temperate horticultural crops. The Institute along with its two Regional Stations is continuously carrying out need based research on temperate horticultural crops to boost the productivity and quality of temperate horticultural crops. The number of technologies generated at ICAR-CITH 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 2019-20 are briefly summarized below:

CROP IMPROVEMENT AND BIOTECHNOLOGY

ICAR- CITH, Srinagar also acts as National Active Germplasm Site (NAGS) for temperate horticultural crops. The germplasm is the main wealth of any Institute, which can be used to breed a desirable new cultivar in future. The collection, evaluation and characterization of germplasm of horticultural crops is the major objective of the Institute. The Institute has added 60 new germplasm in its field gene bank and its number has reached to 2802 at main centre Srinagar, J&K while Regional Station Mukteshwar, Uttarakhand has added more than 210 germplasm lines of various fruit and vegetable crops.

Among earlier introductions which have started fruiting (sample fruiting) at Srinagar were genotypes of apple, pear, almond, plum, plumcot, cherry and hazelnut etc. and were evaluated further for fruit traits. In apple, twenty one genotypes of apple comprising of exotic, indigenous and wild cultivars were evaluated for total phenolic and flavanoid content. Phenolic acids analyzed were chlorogenic acid, vanillic acid, syringic acid, ferulic acid, caffeic acid, gallic acid, p-coumaric acid, o-coumaric acid, 2,4-dihydroxy benzoic acid, gentisic acid, proto catechuic acid, t-cinnamic acid, p-hydroxy benzoic acid, benzoic acid, 3-hydroxy benzoic acid, sinapic acid and ellagic acid. Chlorogenic acid was the major component found in all the apple cultivars with highest value of 526.0µg/g in Fuji. Flavonoids which were quantitatively analyzed and determined include catechin, umbelliferone, luteolin, rutin, hesperetin, myricetin, quercetin, apigenin, naringenin, kaempferol, epicatechin, epigallo-catechin, fisetin, eriodictyol and galangin. Among these quercetin content was found higher in Fuji (900 µg/g). In evaluation of thirty variants of Ambri apple for various traits, Ambri genotypes 36, 34 & 24 were found superior in respect of yield & quality related traits and can be promoted among the farmers of the valley for revival of Ambri in the valley and can be used in Ambri improvement programmes.

In evaluation of 27 cultivars of pear (European/ Asian) for fruit related attributes, maximum fruit weight (145.06 g), fruit length (78.89 mm) and maximum fruit diameter (62.59 mm) was recorded in cultivar Max Red Bartlett. Fruit firmness in pear cultivars ranged from 42.80 to 62.80 RI. The colour characteristics also varied from cultivar to cultivar.

In cherry, 28 genotypes were evaluated for different traits and maximum variability in term of dimension of fruit was observed. The lowest and highest geometric fruit diameter, Dg (13.4 & 20.69 mm) and fruit surface area, FSA (5.63 & 13.44 cm2) were observed in Awal No. and CITH-C-12, respectively. Fruit sphericity varied from 92.97 to 114.18 %. The minimum and maximum fruit weight was recorded in Awal No (2 g) and CITH-C-05 (7.06), respectively. CITH-C-20 recorded maximum flesh to stone ratio, FSR (15.09). The fruit TSS content varied from 9.6 to 18.53°B and a good number of genotypes (11) exhibited TSS higher than 15ºB. In apricot, 69 genotypes were evaluated and variation was recorded for various traits. Maximum yield per plant was recorded in CITH-AP-2 (88.42 kg). The top ten genotypes based on yield efficiency were CITH-AP-2, CITH-AP-7-A, Rival, CITH-AP-1, CITH-

AP-26-A, CITH-AP-32-A, Harcot, Turkey, Erani and CITH-AP-6. The heaviest fruits (90.66g) were produced by CITH-A-2. The taste of kernel was also recorded for 50 genotypes and out of which 36 produced sweet kernel. In peach, 14 genotypes were evaluated for various traits and maximum yield was recorded in Quetta followed by Crest Haven, Glo Haven and Red Globe. The yield efficiency was recorded maximum in Red Haven (2.55kg/cm^2) followed by Shan e Punjab (2.499kg/cm^2) and July Elberta (2.181 kg/cm^2). The heaviest fruits were produced by Crest Haven followed by CITH-P-5 and Early Red June. In evaluation of 10 nectarine cultivars, maximum numbers of fruits per plant and fruit weight (114.13g) were recorded in Fantasia. All cultivars were red in color while flesh color was towards yellow.

In plum, 20 cultivars (Japanese and European) were evaluated and maximum fruit weight (65.63g), fruit length (60.99mm), fruit diameter (48.13mm) and pedicle length (25.54mm) were recorded respectively in Santa Rosa, Kubio-26, Grand Duke and Stanley. Maximum TSS was recorded in Terrol (15.77°B) while maximum value of firmness was recorded in Satluj Purple (58.07RI). The vitamin C content ranged from 1.20 in Au Rosa to 5.10 in Beauty. In strawberry, 95 genotypes were evaluated for fruits and yield related traits. The fruit weight varied between 5.15g (IC 319115) to 24.52 g (IC 319093). Based on yield, Katrian Sweet, Shasta, Addie, Kimberley, Chandler, Jutogh Special and Brighton were found promising genotypes. In olive, 18 cultivars were evaluated and heaviest fruit weight was observed in Etnea (5.17g). Maximum average yield per plant was found in cv. Picholine (29.71 kg/plant) followed by Itrana (14.81 kg/plant), Zaituna (14.23 kg/plant), Frontoio (11.88 kg/plant), Pendolino (6.29 kg/plant), Coratina (5.91 kg/plant), Cerignola (5.03 kg/plant) and Messenese (4.71 kg/plant).

In almond, 10 cultivars were evaluated for various traits related to flowering, nut, kernel characteristics and yield. Among the evaluated almond cultivars Merced performed better in respect of physical attributes of nut and kernel. Further, highest yield was recorded in Waris followed by Pranyaj and Nonpareil. Further, in evaluation of 22 genotypes of almond collected from Kashmir valley, the considerable variation was observed for kernel recovery, kernel sphericity and nut length. CITH-Almond-2, CITH-Almond-4 and CITH-Almond-10 were found promising in respect of physical attributes of nut and kernel. The Ca content in different almond genotypes ranged from 174.73 (CITH-A-16) to 412.50 mg/100g (CITH-A-07). The Mg content varied from 224.60 (Drake) to 318.56 mg/100g (CITH-A-15). The Fe content varied 3 times, ranging 4.11 mg/100g in CITH-A-6 to 12.42 mg/100g in CITH-A-13. In four genotypes, Fe content was found more than 10 mg/100g. Likewise, the Zn content varied 5 times, ranging from 1.22 mg/100g in CITH-A-21 to 6.27 mg/100g in CITH-A-2. However, only three genotypes produced kernel having more than 4 mg/100g Zn. The highest content of Mn (3.45 mg/100g) was obtained in CITH-A-13. As far as Cu is concerned, it ranged from 0.68 mg/100g in Drake to 2.06 mg/100g in CITH-A-21.

In walnut, 239 genotypes were evaluated for various nut and kernel traits. The nut weight ranged from 6.03g (SHS-12) to 26.03g (BSS-8). Among all genotypes 105 genotypes produced nuts having weight more than 15g and 24 genotypes with nut weight more than 20g. Out of total, 106 genotypes produced nuts having kernel weight more than 7g and 17 genotypes with kernel more than10g. The kernel percentage was found more than 45 percent in 113 genotypes and more than 50 % in 52 genotypes. The different genotypes possess different degree of dichogamy ranging from 0 to 100% and among Institute released cultivars (CITH-W-1 to 10), lowest degree of dichogamy (31.25 %) was recorded in CITH-W-5.The genotypes were classified into four groups based on degree of dichogamy. CITH-W- 8 was found best pollinizer for CITH-W- 1, CITH-W-3 and CITH-W- 10 while CITH-W- 4 was found best for CITH-W- 2, CITH-W- 5, CITH-W- 6 and CITH-W- 9. Similarly CITH-W- 9 was found better pollinizer for CITH-W- 4 and CITH-W- 7 while CITH- W-2 proved better for CITH-W- 8. In case of Hamadan and Sulaiman, a combination of CITH-W- 4 & CITH-W- 9 can give better results based on synchronization of flowering.

In Pistachio, eight selections were evaluated for floral and nut traits. Out of 8 selections, two were found to be male and six were female. The heaviest nut weight (1.02 g) and kernel weight (0.42 g) was produced by CITH-Pistachio- Selection-4 while highest kernel percentage (67.36 %) was recorded in CITH- Pistachio-Selection-3. The flowering in male plants initiated from 14th to 20th April, while in female plant from 18th to 25th April. Based on nut weight & kernel weight CITH-Pistachio

-Selection -4 was found best, while on the basis of kernel recovery, CITH- Pistachio-Selection-3 was found promising.

Evaluation work was also carried out in peach, plum, apple and kiwi fruit for various physio chemical traits including antioxidant potential at Regional Station Mukteshwar, Uttarakhand. In peach seven cultivars (Red June, FLA-16-33, Flordasun, Flordaking, Red Nectarine & Golden Monarch) were evaluated and on the basis of the physico-chemical characteristics of fruits, Red June was found superior as compared to other peach cultivars. In plum, 5 cultivars (Santa Rosa, Green Gage, Kalegi, Satsuma & Late Plum) were evaluated and based on the physico-chemical characteristics of fruits, Satsuma was found superior as compared to other plum cultivars. In apple, 27 apple cultivars belonging to Delicious group, spur type and colour strains were evaluated for various traits and the cultivar Red Delicious, Rich-a-Red, Bright-N-Early, Starkrimson, Red Chief and Skyline Supreme performed better in the region under prevailing climatic conditions. In evaluation of four kiwifruit cultivars, most of the physico-chemical characteristics of fruits was found superior in Hayward and Allison as compared to other cultivars. Besides this , a survey was conducted in Kumaon hills of Uttarakhand and twenty five plum genotypes were evaluated.

In vegetable crops, the germplasm of kale, pea, exotic Allium species, pran, lettuce, Swiss chard, Chinese cabbage, broccoli and other exotic vegetable was maintained and evaluation was done on some hybrids made by breeding some Brassica crops. The evaluation work was also carried out in root crops like radish, turnip and carrot. Thirty four kale genotypes were evaluated and yield ranged from 9.49 to 36.45 t/ha with an average of 20.24 t/ha. The highest yielders CITH-KC-28 (36.45) and CITH-KC-26 (33.33) were significantly better than checks i.e Khanyari (19.67) and GM Dari (18.37) and rest of the germplasm. In evaluation of Chinese cabbage, Swiss Chard Green and Swiss Chard Red , a yield of 87.36t/ha , 23.69 t/ha & 52.16 t/ha and TSS of 5.760B, 10.680B & 10.62 0B were recorded on in CITH- Chinese Cabbage 1, CITH- SC - Green and CITH- SC-Red, respectively.In evaluation of cabbage hybrid (*Brassica oleracea* var. *capitata* and *Brassica oleracea* var. *capitata f. rubra*), However, with respect to head polar diameter (PD), the hybrid had significantly larger value (18.00 cm) compared to male parent Golden Acre. The plant height and plant spread of hybrid were also significantly more than the Golden Acre. In evaluation of hybrid attempted between Brussels' Sprouts and Broccoli, the hybrid produced large succulent leaves in very large number with excellent taste.

Thirty genotypes (10 each in carrot, radish and turnip) have been documented with NBPGR, New Delhi and IC numbers were obtained. In carrot, 31 collections were evaluated for structural and economic traits and yield of the germplasm ranged from 13.95 to 33.30 t/ha, root length from 11.21cm to 25.35cm, root diameter from 1.38 cm to 4.03cm, core diameter from 0.84 cm to 0.90cm and average weight from 0.025 kg to 0.300 kg. All these selections were selected for hybridization and backcrossing of carrots for root colour and shape. In radish, 25 collections were evaluated and yield of the germplasm ranged from 17.25 t/ha to 54.40 t/ha, root length from 8.65 cm to 40.40cm, root diameter from 23.24 mm to 100.91mm, and average weight from 0.323 kg to 3.27kg. All these selections were selected for hybridization and backcrossing for root colour and shape. In turnip, 30 genotypes were evaluated for economic yield traits and root yield of the different germplasm ranged from 20.82 t/ha to 84.20 t/ha, root equatorial diameter from 4.50 to 10.32cm and root polar diameter from 3.78 cm 11.77cm. All these selections were selected for hybridization of turnips for root colour and shape.

In characterization and diversity analysis of flowering related gene/ genes in almond, the partial FLC gene from all almond cultivars/ selections were sequenced. Variation in sequences was observed and based on that it is hypothesized that this variation will have effect on the level of expression of key homeotic and flowering genes which can influence the flowering time in almond. Relative expression of different homeotic/flowering genes like AGAMOUS (AG1), APETALA2 (AP-3) and PISTILLATA was done through RT-PCR for semi-quantitative expression. Difference in level of expression was observed between late and early flowering genotypes.

In development of superior cultivars/hybrids in temperate fruits through conventional and non-conventional methods,19 apple hybrids (Ambri x Vista Bella, Ambri x Mollies Delicious, Golden Delicious x Mollies Delicious , Starkrimson x Tydman's Early, Ambri x White Dotted Red,

Prima x White Dotted Red, Prima x Red Delicious 1, Prima x Red Delicious 2, Golden Delicious x Snow Drift, Ambri x Summer Red, Ambri x Top Red, Prima x Top Red, Golden Delicious x Gala Mast, Well Spur x Vista Bella, M. floribunda x Vista Bella, Ambri x Maharaji, Gold Delicious x Red Fuji, Red Delicious x Gala Mast and Golden Delicious x Oregon Spur) were evaluated for total phenols, flavonoids, flavanols, antioxidative& free radical scavenging potential. Significant variation in free radical scavenging and anti-oxidative potential was observed in hybrids. Physicochemical analysis of apple hybrids reveals that hybrids like Golden Delicious x Snow Drift, Ambri x Mollies Delicious and Golden Delicious x Oregon Spur are having fruit size more than 190 g and hence can fall into grade –A category based on size. Crossing For introgression of disease resistance and fruit quality traits in apple cultivar Ambri, the population developed from crossing of Ambri cultivar with M. floribunda and Red Lane was grafted on clonal rootstock M-9 (Pajam-1). Two crosses made between apple cultivar Ambri with Oregon Spur and Prima for introgression of fruit quality traits from cultivar Oregon Spur and scab resistance from cultivar Prima were also maintained for further evaluation. In apple rootstock improvement programme crossing were 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 for compatibility studies and further rootstock improvement. Total 1347 crosses have been attempted in which maximum fruit set percentage (23.67%) was achieved with the cross combination *Malus baccata* × M-9. Based on preliminary study, the poor fruit set problem in pear cultivars Kashmiri Nakh and Badshah Nakh may be due to self incompatibility and Sand pear can be employed as potential pollinizer for the Nakh cultivars to increase the fruit set percentage.

In development of CMS lines in long day onion, molecular screening of Brown Spanish, CITH-O-1 and CITH-O-2 was done with two male sterile (MS) cytoplasm related markers to identify type as well as frequency of MS cytoplasm present in them. Screening with cob marker revealed absence of male sterility in Brown Spanish and the presence of S type at 11.05 % in CITH-O-1 and 28 % in CITH-O-2, respectively. On the other hand, orf 75 and cox1 markers showed the absence of male sterility in CITH-O-2 while the presence of both T and S cytoplasms in CITH-O-1 and Brown Spanish populations.

To develop nutrarich varieties/hybrids in root vegetable crops, different carrot, radish and turnip accessions were evaluated for hybridization. In turnip, different genotypes were used for hybridization and simultaneously got different F2 programme of turnips whereas in radish, green, white, and pink types were crossed and got F1 hybrids of radish. The 35 carrot accessions and local temperate types were crossed for improvement of anthocyanin, lycopene and β-carotene content in temperate carrot. The twenty two radish types were crossed for enhancement of anthocyanin pigments in F1 generations. In screening of radish germplasm for anthocyanin colour, 55 germplasm of radish along with different coloured skin were screened for anthocyanin content and among screened germplasm, six were found with anthocyanin colour on the skin and flesh. In generation advancement, 90 cross combinations were attempted and seeds harvested for the evaluation in the 2019-20 winter season for radish where as in carrot 35 cross combinations were attempted and seeds are harvested. The fifty F1, forty five F2 and twenty five F3 were advanced to subsequent generation in radishes Besides, promising genotypes were also self-pollinated for the development of inbred lines. Furthermore twenty four F1, ten F2 populations were advanced in carrots. In evaluation of advance lines,40 advance lines were evaluated during winter season for root shape, root size, root colour and yield.

In breeding for development of superior varieties/ hybrids in Solanaceous crops, eight genotypes of tomato and six genotypes of capsicum were evaluated under polyhouse at ICAR-CITH Regional Station Mukteshwar. In tomato, highest average fruit yield of 2.750 kg/ plant was recorded on DTPH-60 followed by VL-4 (2.154 kg/plant) and CITH-M-CT-1 (1.442kg/plant) while heaviest fruit were produced in genotypes VL-4. Among 6 genotypes of capsicum, maximum fruit yield/ plant was recorded in genotype SH-SP-H-1(1196.0 g/ plant) followed by CITH –M-SP-4 (1150.0 g/ plant) and CITH –M-SP- 5 (889.3g/plant). While average fruit weight was registered highest in genotypes CITH-M-SP—4 (186.20 g.).

CROP PRODUCTION

During the year Institute has supplied more than 35000 plants of different temperate fruit crops besides the supply of 11000 scionwood. The institute has grafted/ budded about 80000 plants for next year. In vegetables, 260.20 kg of seed was produced in different vegetable crops for supply and sale to different stakeholders and consumers like kitchen gardeners, vegetable growers, research organization etc while rest 85.05 kg seed was retained for research purpose.

In apple, eight apple varieties namely Gala Redlum, Super Chief, Red Velox, Golden Delicious Reindeers, Elstar, Jona Red Prince, Pinnova and Golden Delicious Clone B were evaluated on Tall Spindle System. All the varieties showed significant bearing and the yield ranged from 6 t/ha in Pinnova to 40 t/ha in Gala Redlum. To find feathering response of one year old nursery plants of different apple genotypes grafted on M.9 rootstock, 20 treatment combination comprising two different method i.e. central leader (M1), renewal leader (M2) and 10 different genotypes were taken. Four spray of 600 ppm of 6-benzyladenine were applied at two week interval for feathering. The findings revealed that central leader method performed better compared to renewal leader in respect of tree height, trunk diameter and number of syllepsis/feathers. Moreover, this method also produced feathers of appropriate length and diameters. However, the crotch angle was higher in feathers produced by renewal leader method. Further, feathering responses of different apple genotype vary to 6-benzyladenie spray. As far as overall growth and number of feathers to concern, among the different genotype Shireen and Top Red gave most and least response, respectively to BA application. In management of pre harvest fruit drop in apple, effect of thinning on quality, yield and fruit drop in apple was studied on four apple varieties.The highest yield efficiency (1.13kg/cm^2) was recorded in Red Velox in by keeping 2 fruits per cluster whereas it was lowest (0.34kg/cm^2) in Super Chief on control. Maximum fruit weight (274.43g), fruit length (78.64mm) and fruit diameter (85.12mm) was recorded in Red Velox with Treatment (1 fruit per cluster).

For enhancing the multiplication rate in clonal rootstocks of apple, different rootstocks were planted in different media. Maximum root length was recorded in M-9 sub clone Pajam-1 with treatment Perlite (100%) while maximum root diameter was recorded in Pajam-1 with 100% Perlite treatment. The maximum root fresh weight was recorded in MM-106 (9.46g) with cocopeat (100%). In a trial regarding propagation of rootstocks through cuttings, different rootstocks and media were used with IBA @ 2500ppm treatment for 1-2 minutes before planting. Irrespective of substrate and genotype maximum survival percentage was recorded in the rootstock MM-106 with the treatment Coco peat 75%+ Vermiculite25%, (94.76) and minimum in the rootstock MM-106 in soil. Air layering was also tried for rootstock multiplication and sufficient rooting has been recorded in rootstock MM-106 and by using air layering two additional rootstocks were harvested in comparison to single rootstocks.

To develop almond based intercropping system involving saffron, erect, semi erect and spreading type of varieties and sole crop were tried. The highest saffron yield was recorded under erect (3.022kg/ha) followed by sole saffron crop (2.940 kg/ha), semi erect (2.488kg/ha) and spreading (2.191kg/ha) type of almond varieties. The highest almond (yield/ha) was recorded in spreading type (4.596 tons). The highest saffron equivalent yield (7.14kg/ha) was recorded in spreading type followed by erect type (5.36 kg/ha) and semierect type (3.91 kg/ha).

For round the year cultivation of kale under Kashmir valley conditions, off season sowings and transplantation of 27 promising genotypes were attempted for two consecutive years to achieve year round availability. The analysis of pooled data revealed that NW-Saag-1 performed most consistently and better than other genotypes. Thus the genotype was found as novel for off season kale cultivation (transplanting from May to July) in Kashmir valley that can perform better than its conventional counter parts Khanyari and GM Dari.

To standardize the integrated nutrient management of vegetables as intercrop in apple orchard with two intercrops for five years, the treatment comprising of Pea with FYM + Vermicompost + Biofertilizer + NPK recorded highest apple yield (91.28 q/ha). However, treatment consisting of cauliflower with FYM + Vermicompost + Biofertilizer + NPK recorded highest apple equivalent yield (190.4 q/ha). Highest land equivalent ratio was observed

in Cauliflower with FYM + Vermicompost + Biofertilizer + NPK (1.91) followed by Pea with FYM + Vermicompost + Biofertilizer + NPK (1.73). The technology was demonstrated to among farmer field under various schemes.

In standardization of growing/nutrients media and growing conditions for cost effective production of quality vegetables and their seedlings; the soil, farm yard manure and locally available forest litter singly and judicious combination may be useful medium for seedling growing in terms of successful seedling production and margin of profit as well for various vegetable crops i.e. tomato, capsicum, cucumber, broccoli, Chinese cabbage and lettuce However, type of crop and variety, seed characteristics, nutritional and health properties of the medium and after care of seedlings/crops along with components costs involved need to be given due consideration for better results. For popularization of technology, a training programme on Lagat Anurup Sabji Phasal Evam Paudh Utpadan Taknikiyan was also organized.

To develop Crop diversification technology for round the year vegetable production under protected conditions in mid and high hills of Uttrakhand, six vegetable crops namely tomato, capsicum, cucumber , broccoli, Chinese cabbage and lettuce were taken under polyhouse at two locations i.e. at high hill and mid hill conditions. The results obtained inferred that polyhouse growers can rely upon capsicum for higher earning at both the mid and high hill conditions, whereas lettuce and Chinese cabbage may be the 2nd and 3rd choice, respectively from the B:C ratio point of view. The case with tomato and cucumber is different as tomato earned more in mid hill (Rs.6112.00) whereas only Rs.4478.00 in high hills. Likewise, cucumber earned more (Rs.5778.10) in high hills contrary to Rs.389.20 only in mid hills. However, broccoli was least and discouraging option for both the location. For popularization of technology a training programme on "Sabji Phasal Utpadan Main Vividhikaran Taknikiyan" was also organized.

CROP PROTECTION

In diagnosis and prognosis of apple viruses, a survey of apple orchards in Jammu and Kashmir revealed the incidence of mosaic disease from 7.14% to 90% in different cultivars, viz., Oregon Spur, Fuji Aztec, Royal Delicious, Red Delicious, Golden Delicious, Red Gold and Gala Mast. The Virome analysis using next generation sequencing (NGS) was done for three cultivars Oregon Spur, Golden Delicious (Symptomatic) and Fuji Aztec (Asymptomatic). In addition to mosaic, symptoms of chlorosis, necrosis and ring spots were also observed on different cultivars of apple. Two new viruses, Apple necrotic mosaic virus (ApNMV) and Apple green crinckle associated virus (AGCaV) and one viroid, Apple hammerhead viroid (AHVd) were identified.

In seasonal variation of virus infection as detected by DAS-ELISA and RT-PCR viz. Apple Mosaic Virus, Apple Chlorotic Leaf Spot Virus, Apple Stem Pitting Virus and Apple Stem Grooving virus showed seasonal variation and also variation with respect to tissue. Highest gene expression of these viruses was observed in leaf for Apple Mosaic Virus and Apple Chlorotic Leaf Spot Virus whereas Apple Stem Pitting Virus and Apple Stem Grooving virus expression was equally higher in stem tissues. Transmission studies of virus through seed were also studied and it was observed that there is no transmission of these viruses through seed. This study will be validated further using DAS-ELISA and RT-PCR studies on plants raised from seeds obtained from infected fruits. Furthermore transfer through pollen will also be studied using pollen from infected plants for pollination of healthy plants.

POST-HARVEST MANAGEMENT

Refinement of process technology was carried out for Apricot and plum fruit bar, Quince candy, Cape gooseberry jam and Osmo dehydrated Rose Hip for up-scaling of product to demonstrations and exhibitions.Twenty eight genotypes of Ambri apple were evaluated for physiological loss under ambient temperature conditions. The maximum fruit weight loss was recorded in Ambri genotype-12 (16.73%) and minimum in Ambri genotype-31 (11.22%).

EXTENSION AND OTHER ACTIVITIES

For the speedy transfer of various technologies, ICAR-CITH, Srinagar and its Regional Stations are continuously using various extension

means for popularization of technologies. The ICAR- CITH, Srinagar has organized one 5 days training programme for officers from Deptt. of Horticulture, Himachal Pradesh. A ten days programmes was also organized for training participants from Uttarakhand. Besides these, five one day (on campus & off campus) programmes were organized for the officers and others. During the year, 12 students visit/ training, one five days & one day visit cum training was organized for the progressive orchardist of Himachal Pradesh. Six one day tainings/ visits were organized for the farmers from different districts of Jammu & Kashmir in addition to displaying one exhibition of different technologies. At ICAR-CITH, Regional Station Mukteshwar, five programme of one day duration were organized for Subject Matter Specialists and officers from line Departments of Uttarakhand. Besides organizing 18 training programmes/ awareness/ demonstration programmes, two farmers visits, 3 students visit, four exhibitions were displayed at various occasions. The staff of the Institute has delivered 28 radio/ TV talks on different aspects for the benefit of farming community of the temperate region.

PUBLICATION AND AWARDS

The scientists of ICAR-CITH, Srinagar published 22 research papers, 3 review articles, 3 books, 1 book chapter, 2 papers in proceedings, 4 popular articles and 8 extension bulletin/ folders for the benefit of students, researchers, extension functionaries and farmers. In addition to various appreciations, the scientists of ICAR- CITH, Srinagar received 8 awards during the year.

INTRODUCTION

India has significant area under temperate region including states/UTs of Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Ladakh and North Eastern states. Maximum area and production of temperate horticultural crops is in Jammu and Kashmir followed by Himachal Pradesh and Uttarakhand but there is lot of scope for further promotion of temperate horticulture in other states as well. Temperate fruit crops represent a group, which is physiologically diverse from the sub-tropical and tropical fruit crops grown in other regions. The North Western and Eastern Himalayan states with temperate climate have monopoly in production of temperate fruits, vegetables, ornamentals, medicinal and aromatic plants which have vital role in nutritional and economic security of the region. These crops serve as the backbone of region's economy by supporting about 10-12 million people and generating revenue of about Rs. 13,000 crores annually. In 1960-61 the area under temperate fruits in the country was just 0.82 lakh hectares which increased to 6.5 lakh hectares with production increased from 3.0 lakh tonnes to 40.0 lakh tones. Among various crops apple and walnut are the major crops of temperate fruits covering about 75% of the total area and accounting for 65% of temperate fruit production, respectively while rest of the production comes from other fruits like peach, plum, almond, apricot, cherry etc. which also have significance in regions economy. During 2018-19 apple crop covered an area of 301 thousand ha and 2327 thousand MT national production. Walnut being second important crop covering an area of 109 thousand ha with 300 thousand MT production at national level. Other important temperate crops include almond with 11,000 ha area and 14, 000 MT production, pear with 44, 000 ha area and 318, 000 MT production, peach with 19, 000 ha area and 114, 000 MT production, plum with 23, 000 ha area and 89, 000 MT production and strawberry with 1, 000 ha area and 5000 MT production etc. No doubt, there has been manifold increase in area, production and productivity but as compared to average world productivity (8.80t/ha) our position is far behind (6.00 t/ha). Temperate fruit crops are contributing significantly to the economic development of the country.

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

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

MANDATE

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

OBJECTIVES

- Establishment of field gene bank and management of genetic resources and scientific data base of temperate horticultural crops.
- Genetic improvement of temperate horticultural crops for yield, maturity, quality, resistance to biotic and abiotic stresses through conventional breeding methods and biotechnological tools.

- Standardization of nursery management and high tech propagation techniques of temperate horticultural crops.
- To device efficient and cost effective production technologies and cropping systems for increasing productivity and improving quality of temperate horticultural crops.
- To develop eco-friendly integrated diseases/ pest management modules and diagnostics.
- Post-harvest value addition, product diversification and waste utilization for increasing availability and returns.
- To work out economics of production and impact assessment of technologies.
- Commercialization and transfer of technologies and skilled manpower development.

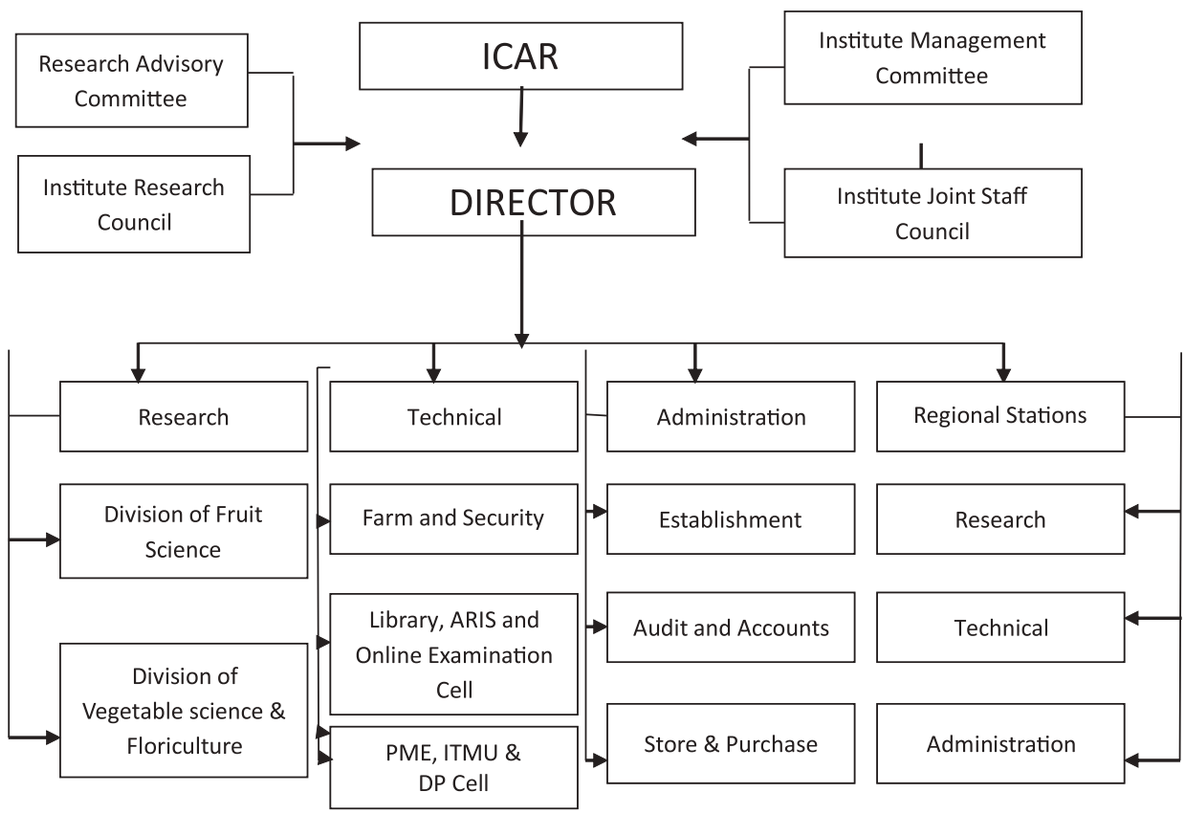
Staff Position (2019-20)

Category	Sanctioned	Filled (as on 31st March, 2020)	Vacant (as on 31st March, 2020)
Scientific	32+1RMP	9+1	23
Administrative	15	13	2
Technical	16	10	6
Supporting	11	11	0
Total	75	44	31

Financial Statement (2019-20)

S. No.	Sub-Head	Expenditure (Rs in Lakhs)
1	Capital	**0.41**
2	Establishment Charges	**489.42**
3	T.A.	**15.60**
4	Research & Operation Expenses	**216.44**
5	Administrative Expenses	**160.65**
6	Miscellaneous Expenses	**1.06**
7	Pension	**13.16**
8	Loans and Advances	**0.00**
	Total	**896.74**

ORGANOGRAM OF CITH



RESEARCH ACHIEVEMENTS

1. CROP IMPROVEMENT

The cultivation and production of large number of horticultural crops in India is the gift of varied agro climatic conditions in different regions. The climatic conditions of North Western Himalayas and some North Eastern Himalayan states are suitable for cultivation of large number of temperate fruits, vegetables, ornamentals, medicinal and aromatic crops as well as many other horticulture based enterprises. Some pockets of these hilly states are famous for off season production of many crops especially vegetable and ornamental crops and their supply to plains lead to fetching of handsome price in the market. The temperate horticulture is said to be the backbone of these hilly states and plays an important role in economic and nutritional security of farmers. It is also a good source of employment generation to about 8 to 10 million people supporting about 10 to 12 lakh families annually. The various temperate fruit crops grown in these regions are apple, pear, plum, apricot, cherry, peaches, walnut, almond and to a limited extent quince, kiwifruit, hazelnut, persimmon, strawberry and other minor temperate fruit and nut crops. But as far as area and production to concern apple, walnut and pear are dominating crops. A significant increase in area and production of temperate horticultural crops has been noticed but the productivity of these temperate horticultural crops in India is still low as compared to advanced countries due to many problems associated with their production and these need to be addressed for boosting quality and productivity. The success of any crop is highly dependent on genotype having desirable traits. The crop improvement plays an important role in any crop by development of elite genotypes by employing various breeding methods and tools. ICAR-CITH, Srinagar along with its regional stations situated at Mukteshwar (Uttarakhand) and Dirang (Arunachal Pradesh) are continuously engaged for identification/ development of superior cultivar/ genotypes and have played a enormous role in past by recommending region specific cultivars for boosting farmers economy. The research work carried out during 2019-20 at main campus and its regional stations is presented project wise below:

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

To utilize the available diversity in temperate horticultural crops as well as its conservation for future use, ICAR- CITH, Srinagar along with its regional stations is continuously enriching germplasm wealth. Continuous efforts are going on for collection, evaluation, characterization and documentation of temperate horticultural germplasm. During 2019-20, 60 germplasm of different fruits like pome (12), stone fruits (18), nuts (5), other fruits (15), ornamentals (2) and vegetables (8) were collected and introduced at ICAR- CITH, Srinagar in the form of plant/ scion wood/ bulbs/ runners. Out of sixty, 25

Table 1. Germplasm Wealth at ICAR-CITH, Srinagar (2019-20)

Sr No	Group	Germplasm Status (2018-19)	Added (2019-20)	Germplasm Status (2019-2020)
1	**Fruits**	**1273**	**50**	**1323**
	Pome fruits	438	12	450
	Stone fruits	253	18	271
	Nuts	398	5	403
	Others	184	15	199
2	**Vegetables**	**1097**	**8**	**1105**
3	**Ornamentals**	**339**	**2**	**341**
4	**Medicinal and aromatic plants**	**33**	**-**	**33**
Total		**2742**	**60**	**2802**

were new introductions and 35 were repeated introductions which failed to survive earlier. The details of new germplasm added in various categories are presented in Table.1. To enrich the germplasm status of ICAR-CITH, Regional Station, Mukteshwar, 110 apple germplasm was supplied from ICAR-CITH, Srinagar and planted in the field.

Fruiting in new genotypes

Among earlier introductions who came to bearing (sample fruiting) this season at CITH-Srinagar were genotypes of apple, pear, almond, plum, plumcot, cherry & hazelnut etc. and were evaluated for fruit traits. In apple, cultivars were planted on different rootstocks and fruit weight varied according to the rootstock and cultivars. The maximum fruit weight recorded in different cultivars of apple was 205g in Scarlett Spur II, 213 g in Oregon Spur II, 258 g in Washington Spur, 262 g in Super Chief, 241 g in Bellerina, 266g in Jeromine, 151g in Scarlet Gala and 202 g in Early Red One. The pear introductions were also planted on different rootstocks and maximum weight recorded in various cultivars was 253 g in Abbat, 150g in Carmen, 132g in Packham, 115g in Red Bartlett, 61g in Korean Giant, 130g in Aryan Sugar, 238 g in Max Red Bartlett, 131 g in Starkrimson, 111g in Chauffer, 270 g in Alozed Hard and 128 g in Monarch. In plum the fruit weight varied from 20.8 to 32.9g in Durate, 18.2 to 22.2g in Stanley, 36.42 to 40.12g in Azaharsah, 9.6 to 11.9g in Abundance, 30.38 to 36.05g in Friar, 34.4 to 40.8 in Auruburum and 12.8 to 15.9 g in Kotagari plum. In three cultivars of plumcot, fruit weight ranged from 14.3 to 16.6g, 22.0 to 24.2g & 38.9 to 46g in DPRU 0708, Flor Tsiraj and Mirocais respectively. In cherry introductions viz. Decessana, Durone Nero II, Regina, Devignola and Merchant the sample fruiting was observed. In almond three late blooming cultivars viz. Ferragnese, Ferralise and Tardy-Nonpareil were introduced earlier and produced nut having weight of 3.73g, 3.1g and 1.2g respectively. In hazelnut two cultivars gave sample fruiting and nut weight of the cultivar Fertilia was 2.67 to 3.75g while cultivar Morville produced nuts of 1.92 to 3.5 g.

Fruits of Plumcot genotype DPRU 0708, Mirocais and Flor Tsiraj

Nuts of hazelnut cultivar morville & Fertelia

Nuts of late blooming cultivar Ferragnese, Ferralise and Tardy Non Pareil

Durate *Auruburum* *Friar* *Azharshah* *Abundance* *Kotagari plum*

Fruits of some introduced plum cultivars


Scarlett Gala


Gale Gala


Scarlett Spur II


Jeromine


Washington Spur


Super Chief


Early Red One


Oregon Spur II

Fruiting in some apple cultivars


Abbat


Carmen


Packham


Aryan Sugar


Alozed Hard


Monarch


Le Conte


Korean Giant

Fruiting in some in recently introduced pear cultivars

APPLE

Evaluation of apple cultivars for phenolic and flavanoid content

During 2019-2020, twenty one genotypes of apple comprising of exotic, indigenous and wild cultivars were evaluated for total phenolic and flavanoid content on fresh weight basis through LC-MSMS. Phenolic acids which were quantitatively analyzed and determined include chlorogenic acid, vanillic acid, syringic acid, ferulic acid, caffeic acid, gallic acid, p-coumaric acid, o-coumaric acid, 2,4-dihydroxy benzoic acid, gentisic acid, proto catechuic acid, t-cinnamic acid, p-hydroxy benzoic acid, benzoic acid, 3-hydroxy benzoic acid, sinapic acid and ellagic acid (Table.2). Chlorogenic acid was the major component found in all the apple cultivars with highest value of 525 µg/g in Fuji followed by 454 µg/g in Coe Red Fuji and 436.0 µg/g in Mollies Delicious. However other components like gallic acid, p-coumaric acid, proto catechuic acid and t-cinnamic acid were also found in adequate amounts with the values ranging from 291.19-17.65µg/g, 199.67-32.60µg/g, 88.60-11.2µg/g and 98.70-34.8 µg/g respectively. Syringic acid and 3-hydroxy benzoic acid were found in small quantities. Flavonoids

Table 2. Quantification of phenolic acid content in different apple genotypes

Phenolic Acids (µg/g FW)	CHA	VAA	SYA	FEA	CFA	GAA	PCA	OCA	DBA	GEA	PCA	TCA	PHBA	BA	HBA	SIA	ELA
Fuji	525.00a	23.20 j	0.13hi	43.30d	22.74d	37.68n	94.11l	32.40n	56.00d	41.20b	80.00b	77.80ef	34.99l	36.20fg	0.96fg	11.22h	1.62i
Coe Red Fuji	454.00b	17.88kl	3.23cde	40.90d	14.54gh	291.19a	142.20d	37.90l	48.00g	32.82d	56.00f	74.40h	29.90m	34.80g	4.70g	28.90e	8.63cde
Gala Mast	404.00e	18.90kl	5.44a	32.20f	12.30j	158.83d	89.90m	22.60o	52.00e	44.10a	58.30e	79.00e	50.90k	29.70h	9.60h	21.02f	8.63cde
Granny Smith	320.00g	18.10kl	2.65cdef	25.50h	12.50ij	220.60b	198.70b	23.70o	44.00h	11.00j	65.90d	87.00d	90.80c	48.60d	7.97d	13.14h	9.59bc
Black Ben Davis	381.00f	17.80kl	3.08bc	20.10j	20.40e	158.83d	199.67a	35.12m	56.00d	12.40j	20.82n	98.00a	98.50a	25.75j	9.22j	23.65f	11.51ab
Star Summer Gold	425.00b	72.60c	4.79b	45.50bc	17.60f	17.65p	167.80c	78.90i	56.00d	27.40e	88.60a	45.82m	72.07g	38.44e	4.38e	26.27e	8.63cde
Mollies Delicious	436.00c	37.31g	0.87ghi	42.20d	18.70f	167.66c	104.20i	82.30h	20.00l	11.00j	75.80c	89.00c	75.64f	36.27fg	2.06fg	19.73g	4.52h
Nema Delicious	211.00h	11.66m	3.54cd	32.50f	34.20b	105.89f	100.50j	88.70f	44.00h	15.10i	33.50jk	98.70a	89.75c	25.39j	1.39j	39.23d	7.86def
Stark Earliest	127.00m	30.32h	0.41hi	34.30e	64.40a	17.65p	98.00k	102.00e	24.00k	28.90e	24.80m	54.70l	65.35i	36.27fg	3.70fg	44.66c	11.51ab
Red Chief	112.00q	72.60c	2.05efg	15.50k	12.80jk	102.00h	34.50q	87.40f	64.00c	9.00k	26.90l	34.80n	65.10i	21.03k	6.58k	15.76g	4.80gh
Silver Spur	104.00s	69.79d	5.39ab	45.60bc	23.69c	26.47o	110.20g	112.00c	30.00j	7.50k	11.20q	68.50i	65.14i	61.29c	6.48c	13.14h	4.49h
Cooper IV	113.00pq	11.72l	0.46hi	34.90e	25.11c	52.94k	82.90n	124.00a	48.00g	22.00g	38.90h	87.90cd	57.50j	99.01a	1.58a	18.39g	8.16de
Red Baron	110.00r	36.15g	0.15hi	15.30k	14.16ghi	103.00gh	54.20p	83.00h	64.00c	28.90e	13.40p	59.00j	91.60bc	36.63f	3.22f	21.02f	10.55b
Lal Ambri	172.00j	27.75i	2.98cdef	22.40i	12.98hij	46.23l	32.60r	76.00j	50.00f	11.00j	18.90o	87.00d	50.19k	37.72f	6.05f	2.97j	8.63cde
Red Spur	127.00m	65.30e	0.72ghi	12.20l	15.51g	104.00g	107.00h	85.00g	32.00i	17.90h	33.90jk	76.00gh	67.83h	26.47ij	2.88ij	47.29c	3.84h
Ambri	176.00i	16.70l	2.57def	44.20c	25.54c	88.24j	166.30c	113.00c	16.00m	24.80f	25.60l	98.30a	92.70b	48.23d	8.90d	13.14h	13.43a
Oregon Spur	144.00k	81.40b	0.11i	18.90j	10.42k	44.12m	112.90f	122.00b	80.00b	11.00j	36.70i	67.90i	90.55c	27.93i	5.14i	28.90e	5.26gh
Spartan	116.00n	43.14f	0.41hi	22.80i	12.75ij	104.00g	76.50o	103.00de	80.00b	33.00d	45.50g	56.90k	79.84e	69.63b	8.30b	15.76g	7.67def
M. baccata	114.00op	23.32j	1.18defg	30.60g	11.45jk	44.12m	32.80r	70.40k	45.00h	38.50c	34.70j	93.90b	90.90c	18.13l	7.90l	186.54a	8.63cde
M. floribunda	135.00l	22.60j	2.00efg	48.90a	18.24f	115.00e	109.30g	104.00d	64.00c	8.90k	80.90b	56.20kl	98.70a	10.00m	9.70m	76.19b	6.72efg
White Dotted Red	115.00no	98.30a	1.54fgh	47.20ab	24.99c	100.00i	115.60e	112.00c	94.00a	24.30f	32.70k	76.30gf	88.90d	30.00h	6.00h	10.51h	8.63cde

Chlorogenic acid	Vanillic acid	Syringic acid	Ferulic acid	Caffeic acid	Gallic acid	p-Coumaric acid	o-Coumaric acid	2,4-Dihydroxy benzoic acid	Gentisic acid	Proto catechuic acid	t-Cinnamic acid	p-Hydroxy benzoic acid	Benzoic acid	3-Hydroxy benzoic acid	Sinapic acid	Ellagic acid
CHA	VAA	SYA	FEA	CFA	GAA	PCA	OCA	DBA	GEA	PCA	TCA	PHBA	BA	HBA	SIA	ELA

Table 3. Quantification of flavonoids content in different apple genotypes

Flavonoids (µg/g FW)	Cat	Umb	Lut	Rut	Hes	Myr	Que	Api	Nar	Kae	Epic	Epig	Fis	Eri	Gal
Fuji	46.55r	0.94a	110.27t	620.00a	2.40b	179.38op	900.00a	67.36i	1.50fghi	2.61e	308.00l	119.00h	0.14a	0.04gh	2.19e
Coe Red Fuji	278.20i	0.94ab	191.32l	455.00b	3.01a	543.01b	810.00b	62.00l	2.00efg	1.35q	550.99d	159.33d	0.10a	0.04fgh	0.91o
Gala mast	160.50h	0.85ab	280.83h	91.79l	1.70d	182.71n	620.00d	17.46r	3.10bc	2.46g	312.96k	105.78j	0.22a	0.12b	1.46k
Granny Smith	56.39e	0.55bcd	138.02r	118.44k	0.56g	333.14g	280.00g	74.84h	1.70efgh	3.40c	220.39o	78.41o	0.13a	0.05efg	2.47c
Black Ben Davis	56.92d	0.8ab	235.61j	309.00c	0.46h	619.38a	240.00j	65.00k	2.30cdef	1.73m	322.60j	52.89t	0.14a	0.04gh	0.82p
Star Summer Gold	119.84k	0.61abcd	128.65s	312.00c	1.07e	307.51h	267.00h	137.21b	0.42jkl	2.21i	281.28m	79.33n	0.70a	0.05efg	2.19e
Mollies Delicious	149.80g	0.62abcd	366.47d	49.86o	2.10c	369.27f	750.00c	122.24d	1.21ghijk	4.82b	247.94n	68.89p	0.08a	0.05efg	1.04m
Nema Delicious	204.91t	0.79abc	171.29o	284.26d	0.82f	166.57q	458.00e	107.27e	1.10ghijkl	1.44p	117.08s	60.82p	0.26a	0.08d	2.92b
Stark Earliest	310.30s	0.61abcd	737.54a	153.97i	0.11kl	256.26j	123.00k	48.65o	0.72hijkl	1.24s	358.14g	80.26m	0.10a	0.04efg	1.28l
Red Chief	524.30p	0.77abcd	349.19e	165.82h	0.17ij	205.01l	87.99n	23.70q	0.27kl	3.01d	330.59h	139.89f	0.97a	0.12b	2.19e
Silver Spur	577.80o	0.85ab	588.12b	272.41d	0.14ij	410.02c	87.99n	59.87m	4.40bcd	9.03a	800.00b	105.78j	0.10a	0.32a	1.97g
Cooper IV	449.40h	0.68abcd	91.89u	236.88e	0.05klm	281.89i	293.31f	66.11j	2.60bcde	1.81k	881.58a	87.40l	0.13a	0.10c	2.92b
Red Baron	963.00q	0.52bcd	248.11i	59.91n	0.02m	256.26j	82.42o	67.36i	0.50ijkl	1.65n	495.89e	185.11c	0.05a	0.04fgh	0.98n
Lal Ambri	264.18c	0.59abcd	306.00g	70.71m	0.04ml	250.88k	112.78l	45.00p	0.12ijkl	1.52o	330.59h	119.00i	0.20a	0.05efg	0.80q
Red Spur	363.80j	0.66abcd	370.33c	59.22n	0.05klm	180.15o	253.42i	54.00n	1.40fghij	2.52f	326.46i	59.90s	0.17a	0.04fgh	1.72i
Ambri	72.87b	0.94a	180.85n	62.30n	0.02m	177.84p	115.42l	12.47s	2.70bcde	2.19j	206.07p	158.66e	0.18a	0.03h	1.83h
Oregon Spur	176.34n	0.36cd	162.47p	302.00cd	0.12kl	150.42r	122.00k	78.58g	2.40cdef	1.28r	606.09c	99.17k	0.09a	0.05efg	2.35d
Spartan	117.70l	1.02a	138.76q	177.66g	0.06klm	205.01l	73.33q	48.65o	2.04defg	0.82t	145.74q	139.23g	0.11a	0.06ef	3.29a
M. baccata	96.30f	0.34d	328.06f	124.36j	0.07klm	402.07o	73.33q	157.16a	3.56b	2.25h	141.33r	330.55b	0.21a	0.07de	1.46k
M. floribunda	99.83a	0.85ab	185.99m	201.35f	0.04ml	191.68m	79.78p	103.53f	9.60a	1.65n	220.39o	436.33a	0.10a	0.07d	2.07f
White Dotted Red	139.10m	0.40cd	210.99k	236.88e	0.10i	384.39e	102.66m	124.73c	2.60bcde	1.77l	468.34f	66.11q	0.08a	0.07d	1.64j

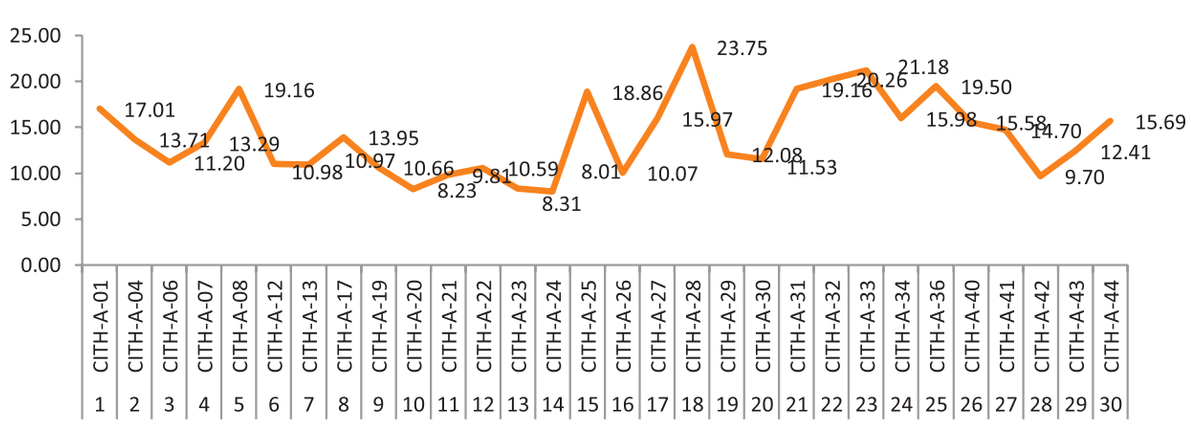
Catechin	Umbelliferone	Luteolin	Rutin	Hesperetin	Myricetin	Quercetin	Apigenin	Naringenin	Kaempferol	Epicatechin	Epigallo-catechin	Fisetin	Eriodic-tyol	Galangin
Cat	Umb	Lut	Rut	Hes	Myr	Que	Api	Nar	Kae	Epic	Epig	Fis	Eri	Gal

which were quantitively analyzed and determined include catechin, umbelliferone, luteolin, rutin, hesperetin, myricetin, quercetin, apigenin, naringenin, kaempferol, epicatechin, epigallo-catechin, fisetin, eriodictyol and galangin (Table.3). Among these quercetin content was found higher in Fuji (900 µg/g) , Coe-Red Fuji (810.0 µ/g) and Mollies Delicious (750.0µg/g). Maximum value of epicatechin was found in Cooper IV (881.58 µg/g) followed by Silver Spur (800.0 µg/g) and Oregon Spur (606.09 µ/g). Luteolin content was found highest in Silver Spur (588.12µg/g) followed by *M. floribunda* (436.33µg/g) and Red Spur (370.33µg/g). However Eriodictyol content was found less in all cultivars with the values ranging from 0.03µg/g in Ambri to 0.32µg/g in Silver Spur.

Evaluation of different Ambri genotypes of apple for various fruit traits

Thirty variants of Ambri cultivar of apple were evaluated for various fruit traits. Among the genotypes maximum fruit weight (174.13g) & fruit length (73.83 mm) was recorded in CITH-A-36 while maximum fruit diameter (79.97 mm) was recorded in CITH-A-34. Maximum pedicle length (33.08mm) was recorded in CITH-A-24 and minimum (11.63mm) in CITH-A-41. Fruit firmness in Ambri genotypes ranged from 51.33 RI (CITH-A-41) to 61.90 RI (CITH-A-24). Maximum TSS (17.97 B°) was recorded in genotype CITH-A-34 and minimum TSS (13.80B°) in CITH-A-24 (Table 4). The colour characteristics (L*, a* b*and tint) of Ambri genotypes also varied. The values for L* ranged from 46.79 in CITH-A-29 to 70.36 in CITH-A-01, a* values ranged from -1.55 in CITH-A-01 to 34.76 in CITH-A-29, values for b* scale range from 16.90 (CITH-A-08) to 35.94 (CITH-A-24). The values for tint ranged between –127.37 in CITH-A-29 to -3.04 in CITH-A-22. The maximum chroma value was recorded in CITH-A-33 (43.55) and minimum in CITH-A-08 (27.01). The maximum value for Hue angle was recorded in CITH-A-01 (32.51) and minimum in CITH-A-22 (-35.66) while maximum value for color index was (38.82) in CITH-A-29 and minimum (0.63) in CITH-A-01.From the above data it can be concluded that among the evaluated genotypes of Ambri genotypes (CITH-A-36, CITH-A-34, and CITH-A-41) are performing comparatively better. The maximum yield (Fig. 1) was recorded in CITH-A-28 (23.75kg) genotype and minimum yield was recorded in CITH-A-24 (8.01kg).From the data, it can be concluded that Ambri genotypes CITH-A-36, CITH-A-34 and CITH-A-24 are superior in respect of yield & quality related traits and can be promoted among the farmers of the valley for revival of Ambri in the valley and can also be used in Ambri improvement programmes.

Fig. 1. Yield (kg/plant) in different Ambri genotypes



CITH-A-36 *CITH-A-06* *CITH-A-07* *CITH-A-17* *CITH-A-19* *CITH-A-41*

Fruiting in some Ambri genotypes

Table 4. Physico chemical characteristics in different Ambri genotypes

S.No	Genotypes	Fruit weight(g)	Fruit Length (mm)	Fruit Diameter (mm)	Pedicle length (mm)	Firmness	TSS (0B)
1	CITH-A-01	106.33^{kgjih}	56.63^{gefih}	62.91^{fkmijhlg}	20.04^{fcebd}	55.17^{ebdc}	15.40^{gcfedh}
2	CITH-A-04	105.43^{kgjih}	58.45^{gefidh}	62.34^{fkmijhlg}	16.31^{fcedg}	58.47^{bdac}	15.23^{gifedh}
3	CITH-A-06	89.57^{kj}	56.25^{gfih}	58.83^{kml}	17.09^{fcebdg}	55.33^{ebdac}	14.23^{mljk}
4	CITH-A-07	115.60^{fgeih}	60.11^{gefcdh}	66.32^{fceibhdg}	22.83^{cb}	59.17^{bdac}	14.90^{gijkh}
5	CITH-A-08	127.73^{fgedc}	59.01^{gefdh}	68.29^{fcebd}	20.97^{cebd}	59.70 ^{bac}	14.03^{mlk}
6	CITH-A-12	91.50^{kji}	53.76^{ih}	60.02^{kmijl}	18.42^{fcebdg}	61.07^{ba}	15.63^{gcfed}
7	CITH-A-13	119.20^{fgedh}	58.86^{gefidh}	65.64^{fceijhdg}	19.60^{fcebdg}	54.53^{ebdc}	16.00^{cbd}
8	CITH-A-17	111.60^{fgjih}	58.54^{gefidh}	64.30^{fkeijhdg}	24.86 ^{b}	55.93^{ebdac}	14.20^{mljk}
9	CITH-A-19	96.90^{kjih}	56.51^{gefih}	60.78^{kmijhlg}	20.46^{cebd}	52.50^{ed}	13.97 ^{ml}
10	CITH-A-20	82.27 ^{k}	51.44^{i}	57.58 ^{ml}	16.00^{fcedg}	53.17^{edc}	14.43^{miljk}
11	CITH-A-21	96.13^{kjih}	56.59^{gefih}	60.58^{kmijhl}	15.06^{fcedg}	57.73^{ebdac}	15.80^{cfed}
12	CITH-A-22	88.23^{kj}	54.18^{ih}	60.84^{kmijhlg}	22.39^{cbd}	53.27^{edc}	13.83 ^{ml}
13	CITH-A-23	86.53 ^{k}	53.24^{ih}	57.39 ^{m}	19.53^{fcebdg}	56.37^{ebdac}	14.47^{miljk}
14	CITH-A-24	95.33^{kjih}	54.84^{gih}	61.08^{kmijhlg}	33.08 a	61.90 ^{a}	13.80 ^{m}
15	CITH-A-25	132.83^{fbedc}	55.06^{gih}	57.02 ^{m}	12.06^{fg}	54.60^{ebdc}	15.13^{gifeh}
16	CITH-A-26	139.83^{bedc}	62.53^{efcd}	68.45^{fcebd}	13.78^{feg}	57.30^{ebdac}	14.63^{miljkh}
17	CITH-A-27	124.77^{fged}	58.30^{gefih}	65.91^{fceihdg}	13.65^{feg}	58.67^{bdac}	14.07^{mlk}
18	CITH-A-28	115.87^{fgeih}	60.52^{gefcdh}	64.56^{fkeijhdg}	12.12^{fg}	54.00^{edc}	16.73 ^{b}
19	CITH-A-29	138.90^{bedc}	62.69^{efcd}	69.41^{cebd}	16.56^{fcedg}	53.03^{edc}	14.20^{mljk}
20	CITH-A-30	117.63^{fgedh}	61.98^{gefcd}	63.59^{fkeijhlg}	16.21^{fcedg}	59.63 ^{bac}	15.77^{cfed}
21	CITH-A-31	127.73^{fgedc}	58.52^{gefidh}	66.83^{fcebdg}	15.19^{fcedg}	55.70^{ebdac}	13.90 ^{ml}
22	CITH-A-32	115.77^{fgeih}	60.07^{gefcdh}	63.23^{fkmeijhlg}	12.93^{feg}	55.03^{ebdc}	16.20^{cb}
23	CITH-A-33	141.17^{bdc}	65.77^{bcd}	68.50^{fcebd}	17.81^{fcebdg}	54.00^{edc}	16.70 ^{b}
24	CITH-A-34	173.67 ^{a}	71.45^{ba}	79.97 ^{a}	13.96^{feg}	55.60^{ebdac}	17.97 ^{a}
25	CITH-A-36	174.13^{a}	73.83 ^{a}	71.04^{cb}	15.54^{fcedg}	51.70 ^{e}	14.70^{iljkh}
26	CITH-A-40	124.60^{fged}	57.68^{gefih}	67.20^{fcebdg}	16.94^{fcebdg}	58.03^{ebdac}	15.40^{gcfedh}
27	CITH-A-41	154.77^{ba}	63.30^{efcd}	71.38^{cb}	11.63 ^{g}	51.33 ^{e}	14.97^{gifjh}
28	CITH-A-42	92.37^{kji}	53.99^{ih}	59.40^{kmjl}	17.47^{fcebdg}	56.20^{ebdac}	15.87^{ced}
29	CITH-A-43	151.33 ^{bac}	63.83^{ecd}	72.49 ^{b}	13.55^{feg}	56.03^{ebdac}	14.03^{mlk}
30	CITH-A-44	165.13 ^{a}	66.63^{bc}	70.65^{cbd}	14.32^{fedg}	54.67^{ebdc}	15.10^{gifeh}

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

PEAR

Evaluation of pear germplasm for various fruit traits

During the year, 27 European/Asian cultivars of pear have been evaluated for fruit related attributes (Table.5). Among the evaluated cultivars, maximum fruit weight (145.06 g), fruit length (78.89 mm) and fruit diameter (62.59 mm) was recorded in cultivar Max Red Bartlett while minimum fruit weight (37.93 g), fruit length (37.98 mm) and fruit diameter (41.17 mm) was recorded in cultivar Sand Pear. Maximum pedicle length (41.78mm) was recorded in Bihe and minimum (21.60) in Pyasua Behapa. Fruit firmness in pear cultivars ranged from 42.80 to 62.80 RI. The colour characteristics (L*, a*,b* and tint) of pear were also determined with a chromameter and L* values ranged from (36.22) in Starkrimson to (73.59) in Cosic-C while, a* value ranged from (-6.83) in Smart to (29.41) in Hayward. Values for b* scale ranged from 9.11 in Starkrimson 47.69 in Pyasua Behapa and no accession showed negative b* value indicated that there is no blue colored variety. Values for Tint ranged from -119.29 in Hayward to 5.27 in Donney Burrah. The values for chroma ranged from 18.50 in King Pear to 48.58 in Cosic C, while values for Hue angle ranged from -87.14 in Kashmiri Nakh to 87.22 in William Bartlett and values for color index ranged from -3.71 in P-R-T-10 to 74.51 in Starkrimson.


Max Red Bartlett


Starkrimson


Hayward


Badshah Nakh


Kashmiri Nakh


Sand Pear

Fruiting in some pear cultivars

Table 5. Physico chemical characteristics of different pear (European/Asian) cultivars.

S.No	Variety	Fruit weight (g)	Fruit length (mm)	Fruit Dia (mm)	Pedicle length(mm)	Firmness
1	Starkrimson	131.57 ^{b}	71.86^{bdec}	62.16 ^{a}	32.56^{ebdhagcf}	56.90^{feg}
2	Max Red Bartlett	145.06^{a}	78.89 ^{a}	62.59 ^{a}	29.85^{edhigcf}	59.30^{cb}
3	Smart	134.57^{ba}	69.46^{fdec}	62.50 ^{a}	25.78^{jhi}	44.60 ^{p}
4	Severenta	65.70^{hgif}	59.63^{ikmjl}	48.49^{dfge}	28.85^{ehigf}	52.73^{lkm}
5	Doney Burrah	41.37^{j}	39.89^{n}	42.53^{ji}	28.57^{ehigf}	46.80 ^{o}
6	Fertility	86.27 ^{d}	74.71^{bdac}	50.98 ^{dc}	36.41^{ebdagcf}	57.63^{fcegd}
7	King Pear	73.03^{hegf}	75.81 bac	47.45^{hfge}	34.48^{ebdhagcf}	60.33 ^{b}
8	William Bartlett	100.00 ^{c}	65.35^{ifheg}	55.66 ^{b}	30.79^{ebdhigcf}	54.70^{hij}
9	Hayward	59.80^{i}	59.35^{ikmjl}	46.56^{hfg}	38.72^{bdac}	58.63^{fcebd}
10	Mayan	110.67 ^{c}	69.47^{fdec}	56.59 ^{b}	30.31^{ebdhigcf}	56.77^{fg}
11	Z.H. Copeace	65.63^{hgif}	62.36^{ikhjg}	47.41^{hfge}	38.65^{bdac}	48.00 ^{on}
12	Berry-de-Amanlis	74.10^{hegdf}	62.71^{ifhjg}	49.08^{dfce}	39.15 ^{bac}	51.03 ^{m}
13	P-R-T 10	59.90^{i}	67.31^{fheg}	43.24^{ji}	36.07^{ebdagcf}	51.97 ^{lm}
14	Santya Braskaya	64.20^{hgi}	55.90^{kml}	48.27^{dfge}	36.38^{ebdagcf}	42.80 ^{q}
15	Gent Drouard	109.88 ^{c}	61.28^{ikhjl}	57.54 ^{b}	29.74^{edhigcf}	57.40^{fcegd}
16	Bihe	74.13^{hegdf}	76.43^{ba}	46.83^{hfg}	41.78 ^{a}	57.10^{fegd}
17	Vicker of Winfield	68.10^{hegif}	68.70^{fdeg}	45.41^{hgi}	35.45^{ebdagcf}	56.00 ^{hg}
18	Doyenne du Comice	76.70^{egdf}	63.89^{ifhg}	51.33 ^{dc}	37.45^{ebdac}	56.07 ^{hg}
19	PyasuaBehapa	99.10 ^{c}	54.12 ^{m}	57.04 ^{b}	21.60 ^{j}	54.63^{hkij}
20	Flemish Beauty	80.20 ^{de}	54.70 ^{ml}	52.36 ^{c}	27.10^{jhig}	62.80 ^{a}

21	Cosic- C	56.20^{i}	55.75^{kml}	44.37^{hji}	33.34^{ebdhagcf}	58.87^{cebd}
22	Punjab Nectar	105.37^{c}	68.35^{fdeg}	56.35^{b}	36.87^{ebdacf}	53.63^{lkij}
23	Punjab Beauty	61.17^{hi}	56.63^{kmjl}	46.57^{hfg}	27.59^{jhigf}	54.80^{hi}
24	Punjab Gold	77.50^{edf}	60.34^{ikmjl}	50.46^{dce}	30.51^{ebdhigcf}	48.07^{on}
25	Badshah Nakh	103.73^{c}	60.52^{ikmjl}	59.07^{b}	35.23^{ebdagcf}	52.81^{lkmj}
26	Kashmiri Nakh	63.73^{hgi}	55.03^{ml}	48.03^{dfge}	39.56^{ba}	58.97^{cbd}
27	Sand Pear	37.93^{j}	37.98^{n}	41.17^{j}	29.38^{edhigf}	49.20^{n}

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

CHERRY

In cherry, 28 genotypes were evaluated for different traits and maximum variability in term of dimension of fruit was observed. The lowest and highest geometric fruit diameter, Dg (13.4 & 20.69 mm) and fruit surface area, FSA (5.63 & 13.44 cm2) were observed in Aval No. and CITH-C-12, respectively (Fig. 2). Fruit sphericity varied from 92.97 to 114.18 %. The minimum and maximum fruit weight was recorded in Awal No (2 g) and CITH-C-05 (7.06), respectively. CITH-C-20 recorded maximum flesh to stone ratio, FSR (15.09) whereas; minimum flesh to stone ratio (6.69) was recorded in Sweet Heart (Fig.3). The fruit TSS content varied from 9.6 to 18.53°B. A good number of genotypes (11) exhibited TSS higher than 15ºB. The titratable acidity and pH of the fruit juice varied from 0.61 to 1.13 per cent and 2.74 to 4.15, respectively. The L*, a*, b* values were measured for fruit skin color. L* value ranged from 17.79 to 46.79, a* values from 13.35 to 41.86 and b* values from 4.27 to 32.03. Chroma, hue angle and color index were varied from 14.01 to 47.30, 17.75 to 62.43 and 11.48 to 175.52 respectively, indicating the wide variation among the different genotypes for color(Fig.4 &5).

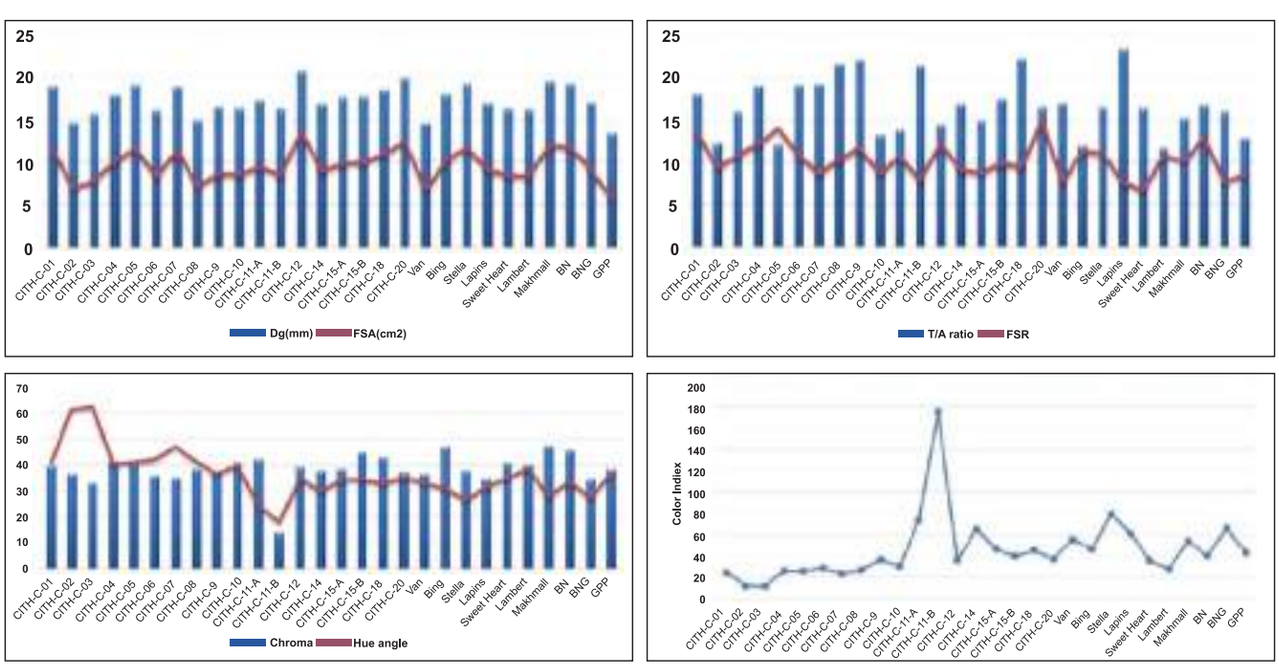


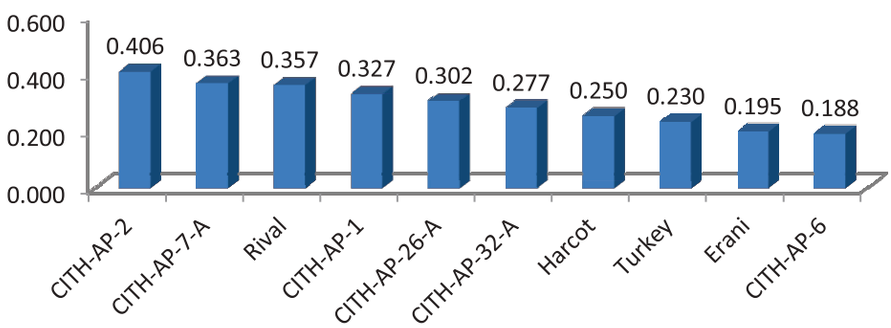
Fig 2 to 5. Geometric mean diameter (Dg), fruit surface area (FSA) , TSS: Acid ratio, Flesh : seed ratio (FSR), chroma, hue angle and colour index value of different cherry genotypes

APRICOT

In apricot, 69 genotypes were evaluated and variation was recorded for various traits. Maximum yield per plant was recorded in CITH-AP-2 (88.42 kg) closely followed by CITH-AP-1 (86.61 kg). Based on yield per plant, top ten genotypes were CITH-AP-2, CITH-AP-1, CITH-AP-3, Turkey, Communis Holy, Harcot, Erani, Nari and CITH-AP-36. The yield efficiency also varied from 0.010 kg/ cm2 (CITH-A-32B) to 0.406 kg/ cm2 (CITH-AP-2).The top ten genotypes

based on yield efficiency were CITH-AP-2, CITH-AP-7-A, Rival, CITH-AP-1, CITH-AP-26-A, CITH-AP-32-A, Harcot, Turkey, Erani and CITH-AP-6 (Fig.6). The heaviest fruits (90.66g) were produced by CITH-A-2 and lowest by plumcot (13.14g). CITH-A-1 produced fruit having weight of 66.69g. The taste of kernel was also recorded for 50 genotypes and out of which 36 produced sweet kernel.

Fig.6. Top ten high yielding genotypes based on yield efficiency (kg/cm^2) in apricot



PEACH

In peach, 14 genotypes were evaluated for various traits and maximum yield was recorded in Quetta followed by Crest Haven, Glo Haven and Red Globe respectively. The yield efficiency was maximum in Red Haven followed by Shan e Punjab) and July Elberta. The heaviest fruits were produced by Crest Haven followed CITH-P-5 and Early Red June.

NECTARINE

During evaluation of 10 nectarine cultivars, maximum number of fruits per plant were produced by Fantasia (202.67) narrowly followed by May Fire (198.67), Snow Queen (195.33) and Silver King (194.33) respectively. Highest fruit weight (114.13g) was recorded in Fantasia. All cultivars were red in color with yellowish flesh color. The highest yield (23.53 kg/plant) was recorded in cultivar Fantasia followed by Vance Missuri (10.97 kg/ plant).

Nectarine cultivars May Fire, Snow Queen, Punjab Nectarine and Syria

Nectarine cultivars Silver King, Independence, Spring Bright, Vance Marble and Fantasia

PLUM

In plum, 20 cultivars (Japanese and European) were evaluated for various physico-chemical and colour parameters (Table 6). Among the evaluated cultivars the maximum fruit weight was recorded in Santa Rosa (65.63g), maximum fruit length in Kubio 26 (60.99mm), fruit diameter in Grand Duke (48.13mm) and pedicle length in Stanley (25.54mm) while the minimum fruit weight (6.27g), fruit length (19.18mm), fruit diameter (22.75mm) were recorded in Kubio Plum. The minimum pedicle length (9.17mm) was recorded in Terrol. Maximum TSS was recorded in Terrol (15.77°B) and the minimum was in Kubio Plum (6.60°B). The maximum value of firmness was recorded in Satluj Purple (58.07RI) and minimum in Krassivica Plum (40.87RI). The pH values ranged from 3.35 in Monarch to 4.93 in Kanto 5. The vitamin C content ranged from 1.20 in Au Rosa to 5.10 in Beauty. Among colour characteristics, L* value ranged from 13.65 in Kala Amritsari to 65.77 in Green Gauge while values of a* scale ranged from 4.63 in Kanto 5 to 36.12 in Beauty. In case of b* scale the value ranged from -2.70 in President Plum to 52.09 in Green Gauge. The values for tint ranged between -155.24 in Beauty to -17.28 in President Plum. The values for chroma ranged from 5.61 in President Plum to 52.44 in Green Gauge. The values for Hue angle ranged from -29.15 in President Plum to 84.63 in Kanto 5 and the values for color index ranged from -90.42 in President Plum to 498.01 in Kala Amritsari.

Frontier *Kanto-5* *Au-Rosa*

Santa Rosa *Au Cherry* *Black Amber*

Fruiting in some plum cultivars

STRAWBERRY

In strawberry, 95 genotypes were evaluated for fruit, and yield traits. The fruit weight varied from 5.15g (IC 319115) to 24.52 g (IC 319093). Similarly fruit length, width, TSS, number of flowers/plant and number of fruits/plant varied from 22.61 to 57.53mm, 23.66 to 26.34mm, 8.26 to 15.730B, 27 to 115.33 and 2 to 96.93, respectively. Based on high yield, Katrian Sweet, Shasta, Addie, Kimberley, Chandler, Jutogh Special and Brighton were found best genotypes. The colour parameters like L, a, b and tint as well as acidity also varied considerably among different genotypes.

Table 6. Physico chemical characteristics and quality attributes of different Plum cultivars.

S No	Cultivars	Fruit weight (g)	Fruit Length (mm)	Fruit Diameter (mm)	Pedicle Length (mm)	Firmness	TSS (0B)	pH	Stone weight (g)	Stone Length(mm)	Stone Diameter (mm)	Vit. C
1	Red Plum	45.67 cd	40.95hfg	42.51 dc	12.55jki	44.63hji	10.43 b	3.80 \e	0.73 b	17.86ji	7.37 f	1.80gh
2	Beauty	36.27efg	42.23efg	38.95fe	15.98fgeh	48.67dfe	7.63 b	3.50 f	1.34 b	21.26egf	8.67ecd	5.10 a
3	Au-Rosa	37.17ef	44.49ed	39.00fe	15.47fgh	43.57kji	14.97 b	4.23 cd	0.85 b	19.33hgi	7.46 f	1.20 h
4	Methley	34.60efg	39.70ihfg	37.56 gf	19.16 cd	45.23ghji	14.50 b	4.47 b	1.24 b	19.01hjgi	8.51 e	3.30becd
5	Black Amber	44.23 cd	39.89ihfg	45.80ba	9.64 l	49.93dce	12.27 b	3.71 e	0.65 b	19.04hjgi	7.59 f	2.50feg
6	Red Beauty	54.10 b	48.45cb	43.88bc	18.88 cd	56.53ba	12.40 b	4.91 a	1.92 b	27.37 a	10.16ba	3.30bced
7	Green Guage	34.13efg	39.24ihg	38.61gfe	14.35jih	47.13ghfe	10.33 b	3.79 e	1.26 b	21.45egf	7.17 f	5.10 a
8	Kanto-5	30.53fg	36.73i	37.52 gf	14.62gih	45.97ghfi	10.97 b	4.93 a	4.40 a	20.43hgf	7.38 f	4.20ba
9	Frontier	50.50cb	47.10 cd	43.53bc	19.16 cd	51.07 dc	10.33 b	4.20 cd	1.79 b	24.96 bac	9.42bc	2.40feg
10	Burbank	21.80 h	33.23 j	32.72 h	12.38jki	47.87gfe	10.33 b	3.90 e	0.78 b	20.87 gf	8.55 e	3.90bc
11	Au-Cherry	10.30i	27.78 k	24.22i	19.56cbd	42.60kj	9.93 b	4.26 cd	0.69 b	17.04ji	7.46 f	3.70bcd
12	Krassivica Plum	9.03i	25.32 k	23.92i	13.48jkih	40.87 k	11.33 b	3.80 e	0.34 b	14.11 k	6.04 h	3.70bcd
13	Santa Rosa	65.63 a	50.44 b	47.92 a	17.10fged	54.77 b	13.87 b	4.38cb	1.80 b	25.34 bac	9.37bcd	2.70fegd
14	Monarch	20.60 h	32.07 j	32.52 h	10.98 kl	45.19ghji	7.83 b	3.35 f	0.67 b	16.63 j	7.26 f	3.60bcd
15	Kubio Plum	6.27i	19.18 l	22.75i	16.09fgeh	46.27ghfi	6.60 b	4.18 cd	0.38 b	11.76 k	6.31gh	2.52feg
16	Terrol	36.97ef	38.98ihg	41.35dce	9.17 l	46.27ghfi	15.77 a	3.48 f	1.16 b	20.93 gf	8.78ecd	3.29bced
17	Stanley	18.90 h	38.60ih	31.40 h	25.54 a	47.70ghfe	12.30 b	3.41 f	1.42 b	24.51bdc	8.59ed	3.17ecd
18	Grand Duke	64.00a	49.31cb	48.13 a	17.56 fed	45.29ghji	9.43 b	3.80 e	2.30 b	26.93ba	9.84ba	3.30bced
19	Black Beauty	56.93 b	41.73ehfg	46.08ba	20.58cb	46.10ghfi	8.27 b	3.75 e	2.10 b	22.48edf	9.72ba	2.70fegd
20	Kala Amritsari	6.87i	20.64 l	22.89i	11.72jkl	50.97 dc	12.40 b	3.39 f	0.43 b	12.30 k	6.91 gf	2.10fgh
21	Satluj Purple	29.24 g	39.27ihg	36.04 g	18.49ced	58.07 a	11.80 b	3.88 e	0.97 b	18.05hji	6.97 gf	3.60bcd
22	President Plum	40.23ed	42.80ef	40.09dfe	9.59 l	47.60ghfe	10.77 b	4.12 d	1.76 b	23.60edc	10.27 a	2.90fced
23	Kubio 26	64.90 a	60.99 a	45.55ba	22.03 b	51.77 c	11.70 b	3.91 e	1.27 b	20.68 gf	7.06 gf	2.93fced

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

OLIVE

In olive, 18 olive cultivars were evaluated for fruit and 17 cultivars evaluated for yield traits. Heaviest fruit weight was observed in Etnea (5.17g) followed by Banicollio (4.74 g), Leccino (4.11 g), Zaituna (4.01 g) and lowest in Moraolio (1.65 g). Fruit length was found maximum in cv. Leccino (23.15 mm) while heaviest stone weight was found in Zaituna (0.95 g). Maximum average yield per plant was found in cv. Picholine (29.71 kg/plant) followed by Itrana (14.81 kg/plant), Zaituna (14.23 kg/plant), Frontoio (11.88 kg/plant), Pendolino (6.29 kg/plant), Coratina (5.91 kg/plant), Cerignola (5.03 kg/plant) and Messenese (4.71 kg/plant). The reasons for low yield in some cultivars during this year might be due to heavy crop load during previous year and damage caused by heavy snowfall before and at the time of harvesting.

ALMOND

In almond, 10 cultivars were evaluated for various traits related to flowering, nut and kernel characteristics and yield. Among the evaluated almond cultivars Merced performed better in respect of physical attributes related to nut and kernel. Further, highest yield was recorded in Waris followed by Pranyaj and Nonpareil (Table-7). Highest kernel recovery was obtained from Primorskij followed by the Nonpareil (Fig. 6). Further, in evaluation of 22 genotypes of almond collected from Kashmir valley, the variation was also observed for kernel recovery, the kernel sphericity and nut length. CITH-Almond-2, CITH-Almond-4 and CITH-Almond-10 were found promising in respect of physical attributes of nut and kernel, whereas CITH-Almond-9, CITH-Almond-16 and CITH-Almond-05 were found promising in respect of nut yield. CITH-Almond-19, CITH-Almond-21, CITH-Almond-22 and CITH-Almond-23 obtained maximum kernel recovery among evaluated genotypes (Table 8). Analysis of micronutrients was also done in 32 almond genotypes and wide variability has been observed. The Ca content in different almond genotypes ranged from 174.73 (CITH-A-16) to 412.50 mg/100g (CITH-A-07). The Mg content varied from 224.60 (Drake) to 318.56 mg/100g (CITH-A-15). The Fe content varied 3 times, ranging 4.11 mg/100g in CITH-A-6 to 12.42 mg/100g in CITH-A-13. In four genotypes, Fe content was found more than 10 mg/100g. Likewise, the Zn content varied 5 times, ranging from 1.22 mg/100g in CITH-A-21 to 6.27 mg/100g in CITH-A-2. However, only three genotypes produced kernel having more than 4 mg/100g Zn. The highest content of Mn (3.45 mg/100g) was obtained in CITH-A-13while it was lowest in CITH-A-19 (2.15 mg/100g). As far as Zn is concerned, it ranged from 0.68 mg/100g in Drake to 2.06 mg/100g in CITH-A-21 (Fig. 7 to 10).

Table 7. Nut, kernel and yield traits of almond cultivars

Cultivars	Nut					Kernel				
	Nut weight (g)	GMD (mm)	Surface area (cm^2)	Sphericity (%)	Yield (kg/tree)	Weight (g)	GMD (mm)	Surface area (cm2)	Sphericity (%)	Yield (kg/tree)
Waris	2.08^{cd}	21.88^{b}	15.04^{b}	65.18^{b}	8.87^{a}	1.06^{bcd}	12.82^{bc}	5.16^{bc}	54.25^{b}	4.31^{a}
Shalimar	2.34^{bc}	20.82^{c}	13.62^{bc}	54.37^{de}	5.22^{c}	1.13^{bc}	12.67^{bcd}	5.06^{bcd}	46.84^{de}	2.56^{cd}
Makhdoom	2.44^{bc}	20.85^{c}	13.66^{bc}	62.77^{bc}	4.97^{cd}	1.13^{bc}	12.82^{bc}	5.17bc	53.73^{b}	2.31^{d}
Merced	3.25^{a}	23.84^{a}	17.94^{a}	69.30^{a}	5.10^{cd}	1.54^{a}	14.76^{a}	6.88^{a}	56.57^{a}	2.49^{cd}
Pranyaj	1.88^{de}	20.79^{c}	13.58^{bc}	60.64^{c}	6.93^{b}	0.99^{bcd}	12.12^{cde}	4.62^{cd}	50.84^{c}	3.69^{b}
Non-Pareil	1.54^{e}	18.81^{e}	11.12^{d}	56.58^{d}	5.16^{c}	0.88^{d}	11.82^{e}	4.39^{d}	48.56^{d}	2.84^{c}
IXL	2.36^{bc}	20.21^{cd}	12.85^{c}	65.00^{b}	2.35^{f}	1.18^{b}	13.27^{b}	5.54^{b}	53.40^{b}	1.06^{f}
Primorskij	1.65^{de}	19.66^{de}	12.15^{cd}	52.57^{e}	4.34^{de}	0.95^{cd}	11.97^{de}	4.51^{cd}	45.63^{e}	2.42^{cd}
CPS	2.78^{b}	23.62^{a}	17.57^{a}	52.96^{e}	3.94^{e}	0.99^{bcd}	11.99^{cde}	4.53^{cd}	45.40^{e}	1.47^{e}
Pr>F	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001

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

Table 8. Range of different traits in almond genotype

Parameters	Range	
Nut weight (g)	1.37 (CITH-A-23)	4.62 (CITH-A-2)
Nut GMD (Dg, mm)	16.84 (CITH-A-18)	23.29 (CITH-A-2)
Kernel Surface area (S, cm2)	8.91 (CITH-A-18)	17.05 (CITH-A-2)
Sphericity (ø, %)	61.85 (CITH-A-2)	74.36 (CITH-A-17)
Shell thickness (mm)	1.14 (CITH-A-23)	2.64 (CITH-A-9)
Weight of 100 nuts (g)	132 (CITH-A-22)	410 (CITH-A-2)
Double kernel (%)	0 (CITH-A-4, 5, 7, 9)	34 (CITH-A-19)
Kernel weight (g)	0.50 (CITH-A-18)	1.15 (CITH-A-2)
Kernel GMD (Dg, mm)	10.04 (CITH-A-23)	12.79 (CITH-A-2)
Kernel Surface area (S, cm2)	3.17 (CITH-A-23)	5.14 (CITH-A-2)
Kernel Sphericity (ø, %)	50.06 (CITH-A-2)	65.24 (CITH-A-17)
Kernel width to length ratio	0.48 (CITH-A-13)	0.64 (CITH-A-17)
Kernel recovery (%)	22.91 (CITH-A-15)	46.36 (CITH-A-21)
Nut yield (kg/tree)	1.27 (CITH-A-23)	11.03 (CITH-A-09)
Kernel yield (kg/tree)	0.39 (CITH-A-2)	3.70 (CITH-A-22)
Nut yield efficiency (g cm2 tcsa)	2.32 (CITH-A-23)	49.19 (CITH-A-18)
Kernel yield efficiency (g cm2 tcsa)	0.93 (CITH-A-2)	15.13 (CITH-A-18)

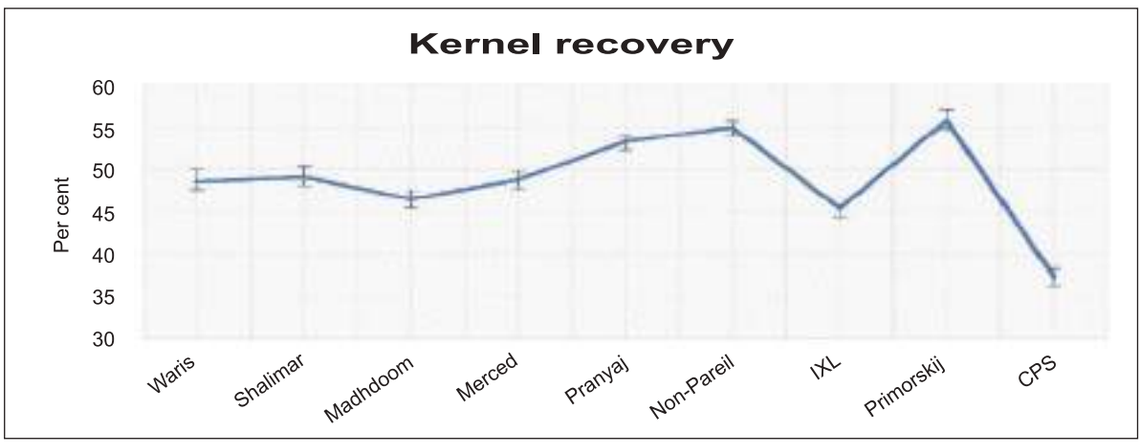


Fig. 6. Kernel recovery obtained from different almond cultivars. The bars represent ±S.D.

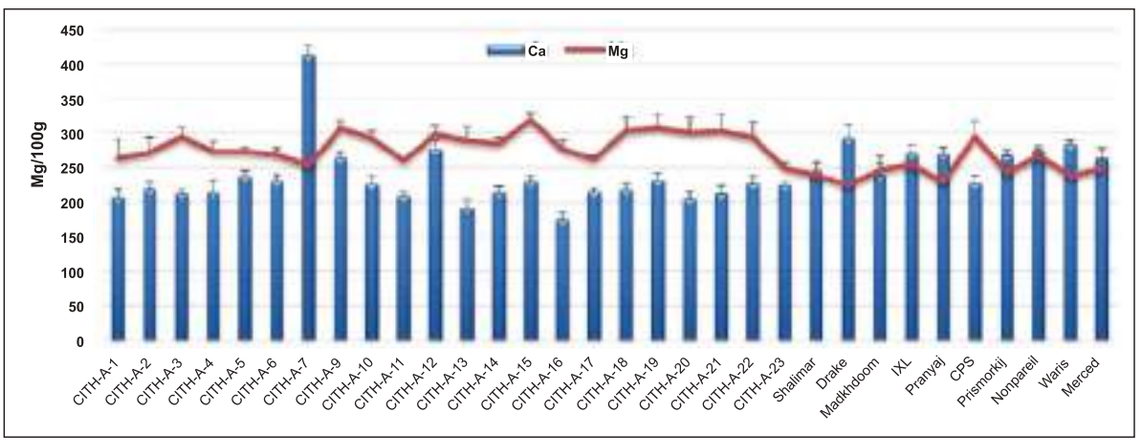


Fig. 7. Calcium and Magnesium contents in 32 almond genotypes. The bars represent ±S.D.

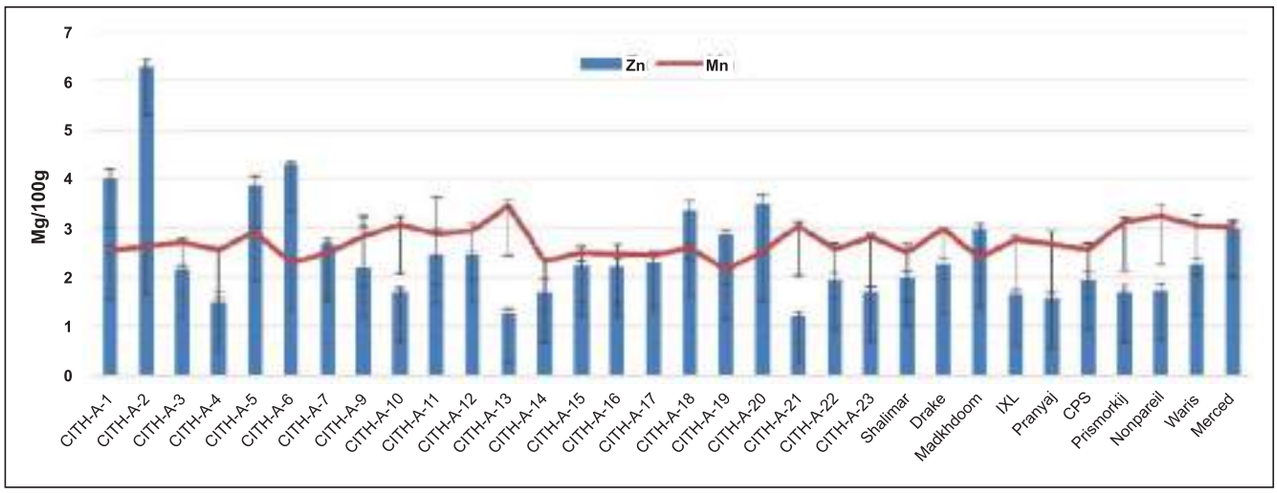


Fig. 8.. Zinc and Manganese contents in 32 almond genotypes. The bars represent ±S.D.

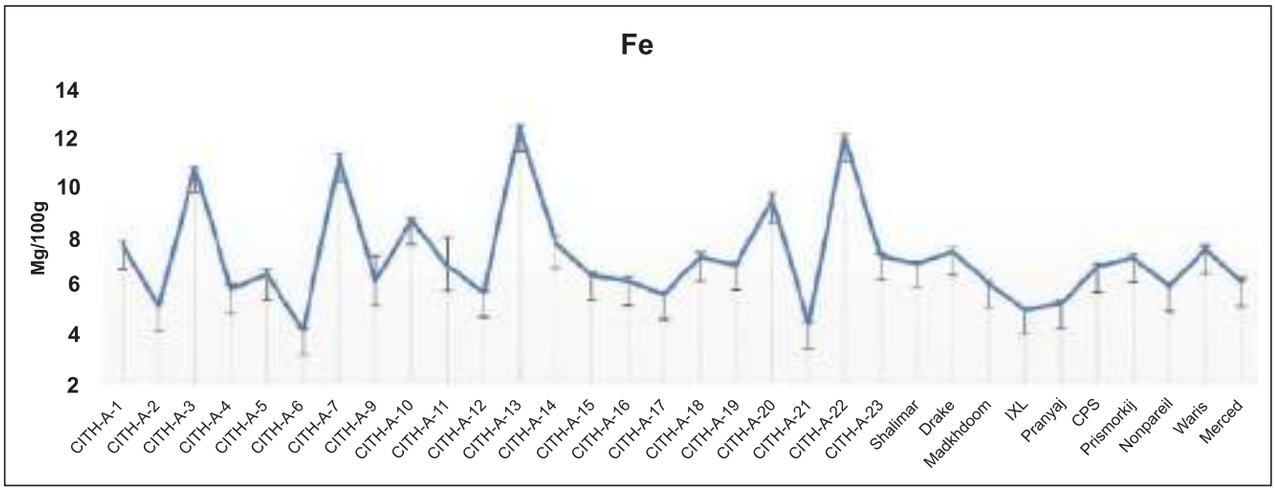


Fig. 9. Iron contents in 32 almond genotypes. The bars represent ±S.D.

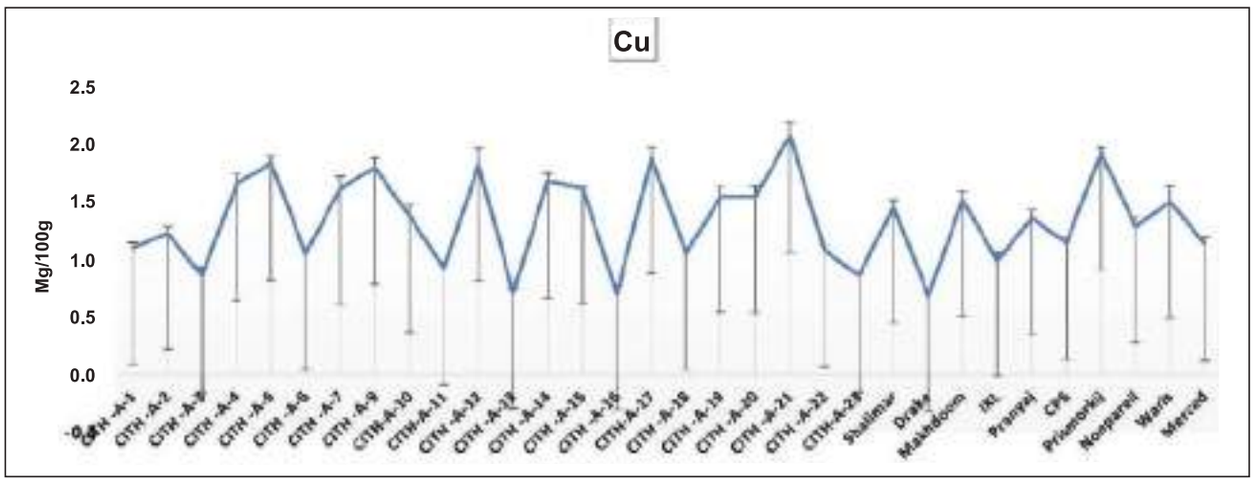


Fig. 10. Copper contents in 32 almond genotypes. The bars represent ±S.D.

WALNUT

In walnut, 239 genotypes were evaluated for various nut and kernel traits. The nut weight ranged from 6.03g (SHS-12) to 26.03g (BSS-8). The nut length, nut width, nut thickness, shell thickness and kernel weight varied 28.62 mm (Tutle) to 63.84 mm (SHS-12), 24.61mm (Seedling 28/5) to 42.99 mm (CITH W 125), 25.08 mm (Tutle) to 42.91mm (CITH W 7), 0.87 mm (BRUS 10) to 2.877 mm (Seedling 35/13) and 2.66g (SHS-12) to 13.46g (BSS-8), respectively. Among all 105 genotypes produced nuts having weight more than 15g and 24 genotypes with nut weight more than 20g. Out of total, 106 genotypes produced nuts having kernel weight more than 7g and 17 genotypes with kernel more than10g. The kernel percentage was more than 45 percent in 113 genotypes and more than 50 % in 52 genotypes. The different genotypes possess different degree of dichogamy ranging from 0 to 100% (Table. 9). Among cultivars (CITH-W-1 to 10), released by Institute lowest degree of dichogamy (31.25 %) was recorded in CITH-W- 5 (Fig.11). The genotypes were classified into four groups based on degree of dichogamy (Table 4). CITH-W- 8 was found best pollinizer for CITH-W- 1, CITH-W- 3 and CITH-W- 10 while CITH-W- 4 was found best pollen source for CITH-W- 2, CITH-W- 5, CITH-W- 6 and CITH-W- 9. Similarly CITH-W- 9 was found better pollinizer for CITH-W- 4 and CITH-W- 7 while CITH- W-2 proved better for CITH-W- 8. In case of Hamadan and Suleiman, a combination of CITH-W- 4 & CITH-W- 9 can give better results based on synchronization of flowering.

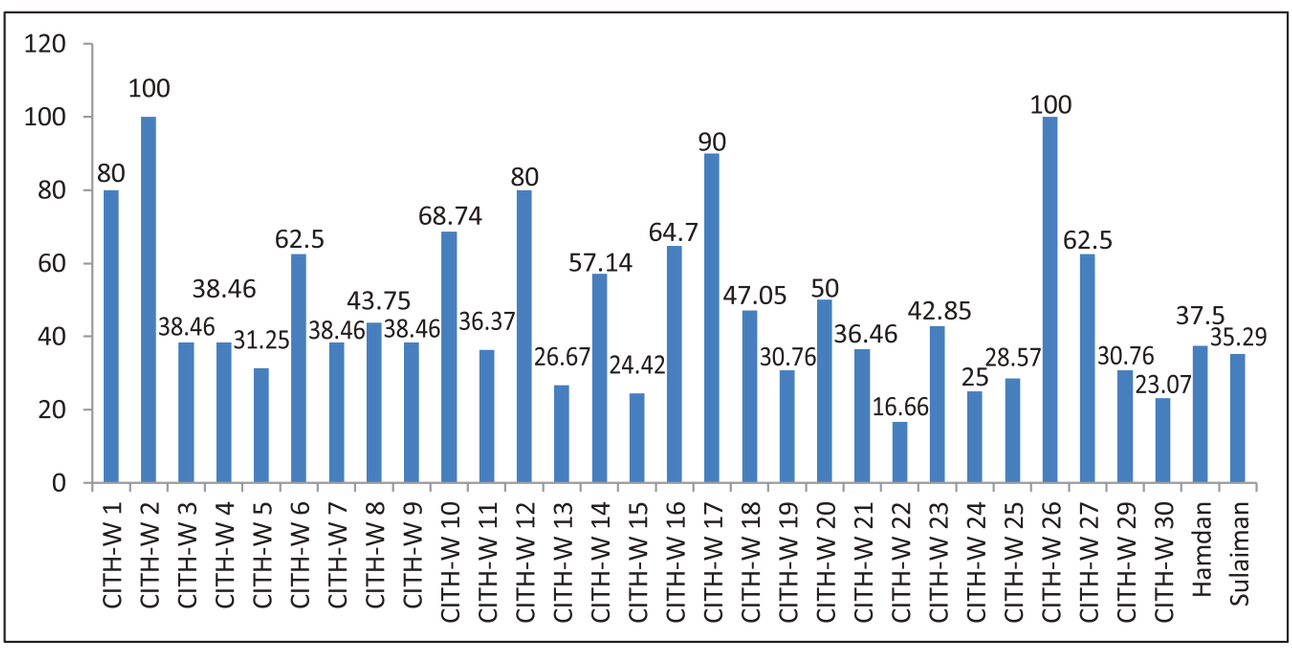


Fig. 11.Degree of Dichogamy in some walnut genotypes

Table 9. Categorization of walnut genotypes based on degree of Dichogamy

Degree of Dichogamy	Genotypes
76-100%	CITH-W-1, CITH-W-2, CITH-W-12, CITH-W-17, CITH-W-26, CITH-W-31, CITH-W-40, CITH-W-44, CITH-W-50, CITH-W-97, CITH-W-100, CITH-W-101, CITH-W-104, CITH-W-106, CITH-W-107, CITH-W-112, CITH-W-116, CITH-W-118, CITH-W-122, CITH-W-123, KB-1, GBV-2, CGB-1 & YD-1
51-75%	CITH-W-6, CITH-W-10, CITH-W-14, CITH-W-16, CITH-W-27, CITH-W-32, CITH-W-35, CITH-W-38, CITH-W-39, CITH-W-41, CITH-W-46, CITH-W-47, CITH-W-49, CITH-W-51, CITH-W-54, CITH-W-66, CITH-W-70, CITH-W-74, CITH-W-76, CITH-W-79, CITH-W-81, CITH-W-82, CITH-W-86, CITH-W-87, CITH-W-96, CITH-W-99, CITH-W-114, CITH-W-119, CITH-W-124 (H),CITH-W-125, CITH-W-126, CITH-W-127, CITH-W-132, CITH-W-134, Shalimar-6, BSS-4, SRK-2, HCB-3, PTS-4, PTS-2, PKB-1, CGB-1, ABB-2, PB-1, KHS-9, ZS-2, CWS-8, RT-16, EC-27484, SBB-5, DP-8, ZS-5, PTS-1 & BC-1

26-50%	CITH-W-3, CITH-W-4, CITH-W-5, CITH-W-7, CITH-W-8, CITH-W-9,CITH-W-11, CITH-W-13, CITH-W-18, CITH-W-19, CITH-W-20, CITH-W-21, CITH-W-23, CITH-W-25, CITH-W-29, CITH-W-33, CITH-W-36, CITH-W-37, CITH-W-42, CITH-W-43, CITH-W-45, CITH-W-52, CITH-W-53, CITH-W-55, CITH-W-56, CITH-W-57, CITH-W-58, CITH-W-59, CITH-W-60, CITH-W-61, CITH-W-62, CITH-W-63, CITH-W-64, CITH-W-65, CITH-W-67, CITH-W-69, CITH-W-72, CITH-W-73, CITH-W-75, CITH-W-78, CITH-W-80, CITH-W-83, CITH-W-85, CITH-W-88, CITH-W-89, CITH-W-90, CITH-W-91, CITH-W-94, CITH-W-102, CITH-W-108, CITH-W-109, CITH-W-120, CITH-W-121, CITH-W-128 ,CITH-W-131, CITH-W-135, Hamdan, Suliaman, Partap, Nugget, Serr, Batpora, Chienovo, Tutle, Shalimar-7, SRK-4, S-10, HDL-2, NBB-3, BRUS-10, BC-3, DB-2, ZGB-1, ZP-3, BB-3, RT-1, BSP-1, ZS-3, BCS-13, BCS-14, BUC-5, SBS-1, S-287, NB-2, CGB-2, BB-3, KGM-1, BSS-8, KHS-5, SHS-12 ,BBS-1, APB-3, BMC-7, PMC-6, DP-7, ZGV-1, PTS-5, BP-3, SHS-9, CITH-W-119A, CITH-W-78A, PTS-6 & CITH-W-65A
0 to 25%	CITH-W-15, CITH-W-22, CITH-W-24, CITH-W-30, CITH-W-48, CITH-W-64, CITH-W-68, CITH-W-71, CITH-W-77, CITH-W-84, CITH-W-92, CITH-W-93, CITH-W-95, CITH-W-98, CITH-W-103, CITH-W-105, CITH-W-110, CITH-W-111(H), CITH-W-115, CITH-W-117, CITH-W-133, Payne, Opex Caulchary, Franquette, Victoria, Shalimar-2, Shalimar-5, SKUA-0022, UKB-3, SBB-11, SSS-10, PKB-2, PSB-3, WLG-2, RT-12, PTS-23, PTS-22, KBB-1, LBT-1 & KC-3

PISTACHIO

In Pistachio, eight selections were evaluated for floral and nut traits. Out of 8 selections, two were found to be male and six were observed female. Significant differences were noticed for nut weight, nut length and kernel width. The heaviest nut weight (1.016 g) and kernel weight (0.415 g) was produced by CITH-Pistachio- Selection-4 (Fig. 12). Highest kernel percentage (67.36 %) was recorded in CITH- Pistachio-Selection-3. Non significant differences were found for nut width, nut thickness, shell thickness, kernel weight, kernel length and kernel thickness. The flowering in male plants initiated from 14th to 20th April, while in female plant from 18th to 25th April. Based on nut weight & kernel weight CITH-Pistachio -Selection -4 was found best, while on the basis of kernel recovery, CITH- Pistachio-Selection-3 (67.35 %) was found promising.

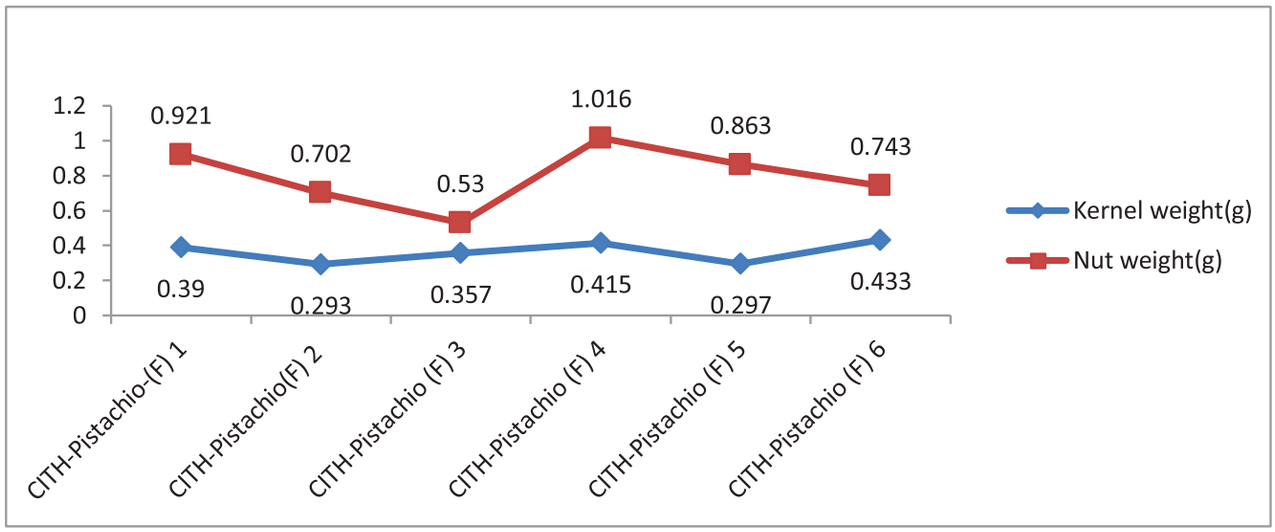


Fig. 12.Nut and Kernel weight of different Pistachio selections

CITH- Pistachio 1

CITH- Pistachio 2

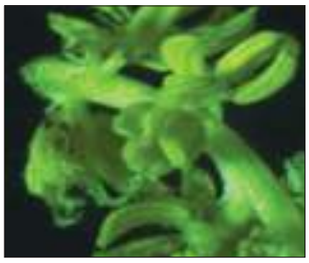
CITH- Pistachio 3

CITH- Pistachio 4

CITH- Pistachio 5

CITH- Pistachio 6

Fruiting in different Pistachio Selections



Male inflorescence of Pistachio

Female inflorescence of Pistachio

VEGETABLE CROPS

Survey, collection, characterization and documentation of temperate horticultural crops

In vegetable crops, the germplasm of kale, pea, exotic Allium species, pran, lettuce, Swiss chard, Chinese cabbage, broccoli and other exotic vegetable was maintained and evaluation was done on some hybrids of breeding Brassica crops. The evaluation work was also carried out in root crops like radish, turnip and carrot.

KALE

Thirty four kale genotypes were evaluated for yield and related traits. The yield ranged from 9.49 to 36.45 t/ha with an average of 20.24 t/ha. The highest yielders CITH-KC-28 (36.45) and CITH-KC-26 (33.33) were significantly better than checks i.e. Khanyari (19.67) and GM Dari (18.37) and rest of the germplasm.

Evaluation of Chinese cabbage and Swiss chard

During evaluation of Chinese cabbage, Swiss chard, a yield of 87.36t/ha , 23.69 t/ha & 52.16 t/ha and TSS of 5.76°B, 10.68°B & 10.62°B was recorded on in CITH Chinese Cabbage 1, CITH Swiss Chard- Green and CITH Swiss Chard- Red, respectively (Table 10).

Table 10. Yield and TSS of some Chinese cabbage and swiss chard genotypes

Crop	Average head yield (Kg)	Yield (t/ha)	Average TSS (%)
CITH-Chinese cabbage-1	2.60	87.36	5.76
CITH-SC-Green	-	23.69	10.68
CITH-SC-Red	-	52.16	10.62

Evaluation of cabbage hybrid (Brassica oleracea var. capitata and Brassica oleracea var. capitata f. rubra)

Since red cabbage line (CITH-RC-1) fails to produce proper heads with slight change in weather and the yields obtained were inconsistent and generally low. So hybridization were attempted during the year 2017-18 with cabbage cv. Golden Acre to obtain multicolored, nutritionally enriched cabbage hybrid with high yield for salad purpose. During the year 2019-20, the winter crops of both parents and hybrid were raised and data collected on head yield and TSS revealed no significant differences between the hybrid and male parent Golden Acre. However, with respect to head polar diameter (PD), the hybrid had significantly larger value (18.00 cm). The plant height and plant spread of hybrid were also significantly more than the Golden Acre. The female parent however did not produce heads during the season. The data are presented in (Table 11).

Table 11. Plant, head and yield traits of hybrid and parents.

Entry	Head yield (t/ha)	Head weight (kg)	Head ED (cm)	Head PD (cm)	TSS (%)	Plant height (cm)	Plant spread (cm)
Hybrid	55.98	1.513	20.44	18.00	9.02	32.00	69.28
Golden Acre	50.34	1.361	18.47	15.33	8.42	20.50	54.86
CITH-RC-1	Heads not available (formed)						
CD at 5%	NS	NS	NS	2.41	NS	4.43	6.01

Evaluation of hybrid attempted between Brussels' Sprouts and Broccoli

An F_1 hybrid was attempted between Brussels' Sprouts variety Hild's Ideal and Broccoli genotype CITH-B-1 in 2018-19. The hybrid produced large succulent leaves in bulk with excellent taste. While the hybrid has shown good consumer and farmer acceptability, so preliminary data was collected during 2019-20 for leaf yield. Average leaf yield was found to be 0.687 kg, average number of leaves 57 and calculated yield per hectare was 25.45 t/ha when planted at 60 cm x 45 cm spacing.

Plants of F1attempted between Brussels' Sprouts x Broccoli

CARROT

Ten genotypes of temperate carrot have been documented with NBPGR, New Delhi whose IC number obtained are 0632150 (CITH-Car-1), 0632151 (CITH-Car-2), 0632152 (CITH-Car-3), 0632153(CITH-Car-4), 0632154 (CITH-Car-5), 0632155 (CITH-Car-6), 0632155 (CITH-Car-7), 0632156 (CITH-Car-8), 0632157 (CITH-Car-8), 0632158 (CITH-Car-9) and 0632159(CITH-Car-10). Thirty one collections of carrot were evaluated for structural and economic traits and yield of the different germplasm ranged from 13.95 to 33.30t/ha, root length from 11.21 to 25.35cm, root diameter from 1.38 to 4.03cm, core diameter from 0.84 to 0.90cm and average weight form 0.025 to 0.300 kg. All these selections were chosen for hybridization and backcrossing of carrots for root colour and shape.

RADISH

Ten genotypes of temperate radish have been documented with NBPGR, New Delhi whose IC number are 632616 (CITH-Rad-1), 632617 (CITH-Rad-1), 632618 (CITH-Rad-1), 632619 (CITH-Rad-1), 632620(CITH-Rad-1), 632621 (CITH-Rad-1), 632622 (CITH-Rad-1), 632623 (CITH-Rad-1), 632624 (CITH-Rad-1) and 632625 (CITH-Rad-1). Twenty five collections of radish were evaluated and yield of the different germplasm ranged from 17.25 to 54.40t/ha, root length from 8.65 to 40.40cm, root diameter from 23.24 to 100.91cm, and average weight form 0.323 to 3.27kg. All these selections were chosen for hybridization and backcrossing radishes for root colour and shape.

TURNIP

Ten genotypes of temperate turnip have been documented with NBPGR, New Delhi whose IC number are 0632160 (CITH-Tur-1), 0632161 (CITH-Tur-1), 0632162 (CITH-Tur-1), 0632163(CITH-Tur-1), 0632164 (CITH-Tur-1), 0632165 (CITH-Tur-1), 0632166 (CITH-Tur-1), 0632167 (CITH-Tur-1), 0632168 (CITH-Tur-1) and 0632169 (CITH-Tur-1). Thirty genotypes of turnip were evaluated for economic yield traits and root yield of the different germplasm ranged from 20.82 to 84.20t/ha, root equatorial diameter from 4.50 to

10.32cm, root polar diameter from 3.78 to 11.77cm. All these selections were chosen for hybridization of turnips for root colour and shape.

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

Characterization and expression of flower development genes

Flowering Locus C (FLC) is an important gene regulating flowering in plants and its role in almond flowering time and duration has also been elucidated by the researchers. The partial FLC gene from all almond cultivars established at ICAR-CITH, Srinagar including the selections made by the institute were sequenced. Variation in sequences was observed and based on that it is hypothesized that this variation will have effect on the level of expression of key homeotic and flowering genes which can influence the flowering time in almond. Relative expression of different homeotic/flowering genes like AGAMOUS (AG1), APETALA2 (AP-3) and PISTILLATA was done through RT-PCR for semi-quantitative expression. Difference in level of expression was observed between late and early flowering genotypes. This will be further validated through quantitative real time PCR analysis. Furthermore whole genome transcriptome analysis between early flowering (Shalimar, Makhdoom, Waris and & Nonpareil) and late flowering almond cultivars (Tardy-Nonpareil, Ferragnese and Ferralise) has been initiated to identify the genes and pathways differentially expressed is either early flowering or late flowering genotypes. Phenological stage development and flowering time in different almond varieties has been studied with respect to effect of GDH/GDD accumulation on flowering time and phenological development. Breeding for introgression of late flowering trait in commercial varieties of almond will be initiated after completing comparative transcriptome studies. 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.

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

Fruit quality analysis of apple hybrids

Nineteen apple hybrids (Ambri x Vista Bella, Ambri x Mollies Delicious, Golden Delicious x Mollies Delicious , Starkrimson x Tydeman's Early Worcester, Ambri x White Dotted Red, Prima x White Dotted Red, Prima x Red Delicious 1, Prima x Red Delicious 2, Golden Delicious x Snow Drift, Ambri x Summer Red, Ambri x Top Red, Prima x Top Red, Golden Delicious x Gala Mast, Well Spur x Vista Bella, *M. floribunda* x Vista Bella, Ambri x Maharaji, Gold Delicious x Red Fuji, Red Delicious x Gala Mast and Golden Delicious x Oregon Spur) were evaluated for total phenols, flavonoids, flavanols, antioxidative& free radical scavenging potential during 2019-20. Significant variation in free radical scavenging and anti-oxidative potential was observed in hybrids and presented in Table 12.

Table 12. Anti-oxidative and free radical scavenging potential of apple hybrids

Hybrids	Phenols mg GAE / 100g FW)	Flavonoids mg QE/100gFW	Flavanols mg QE/100gFW	DPPH (µmol AAE/g FW)	FRAP µmol FeSO4 E/100g FW)
Ambri x Vista Bella	121.02^{k}	262.2^{b}	1.75^{c}	35.0^{f}	258.3^{d}
Ambri x Mollies Delicious	132.1^{j}	105.1^{m}	1.58^{g}	63.3^{c}	226.5^{g}
Golden Delicious x Mollies Del	152.0^{i}	200.4^{f}	1.71^{d}	10.2^{m}	125.1^{n}
Starkrimson x Tydman's Early	225.1^{ed}	193.5^{g}	1.59^{g}	53.7^{e}	81.6^{o}
Ambri x White Dotted Red	189.2^{g}	125.6^{l}	0.97^{m}	11.5^{l}	171.4^{i}
Prima x White Dotted Red	99.2^{l}	154.1^{j}	1.43^{h}	10.5^{m}	69.2^{p}
Prima x Red Delicious 1	156.4^{i}	262.5^{b}	1.75^{c}	6.9^{n}	164.1^{k}

Prima x Red Delicious 2	389.5^{a}	100.0$^{n.}$	3.63^{a}	19.2^{j}	253.0^{e}
Golden Delicious x Snow Drift	267.7^{cb}	254.1^{c}	1.71^{d}	58^{d}	125.5^{n}
Ambri x Summer Red	154.3^{i}	238.5^{d}	1.32^{i}	18.9^{j}	156.1^{l}
Ambri x Top Red	221.2^{e}	179.3^{j}	1.29^{j}	15.9^{k}	180.7^{h}
Prima x Top Red	274.0^{b}	223.0^{i}	1.69^{e}	16.3^{k}	125.2^{n}
Golden Delicious x Gala Mast	185.1^{g}	183.4^{h}	2.51^{b}	31.7^{g}	259.0^{d}
Well Spur x Vista Bella	208.2^{f}	97.6^{o}	0.62^{n}	80.2^{a}	238.3^{f}
M. Floribunda x Vista Bella	264.7^{c}	75.9^{p}	1.08^{l}	24.2^{i}	261.4^{c}
Ambri x Maharaja	127.0^{kj}	124.7^{l}	0.97^{m}	11.5^{l}	289.5^{b}
Gold del x Red Fuji	232.3^{d}	154.3^{j}	1.13^{k}	69.0^{b}	295.3^{a}
Red Del x Gala Mast	218.1^{e}	291.2^{a}	1.67^{f}	10.1^{m}	145.2^{m}
Golden Delicious x Oregon Spur	175.6^{h}	129.0^{k}	1.28^{j}	25.1^{h}	168.1^{j}

Physicochemical analysis of apple hybrids reveals that hybrids like Golden Delicious x Snow Drift, Ambri x Mollies Delicious and Golden Delicious x Oregon Spur are having fruit size more than 190 g and hence can fall into grade –A category based on size. Significant variation exists between the hybrids in parameters like firmness, acidity, TSS and ascorbic acid (Table 13).

Table 13. Physicochemical analysis of apple hybrids

Hybrids	Weight (g)	Firmness (RI)	TSS (%)	Acidity (%)	Ascorbic Acid (mg/100g)
Ambri x Vista Bella	145^{j}	52.4^{q}	12.9^{h}	0.2^{ih}	9.28^{ebdfcg}
Ambri x Mollies Delicious	176.5^{d}	59.3^{m}	13.5^{h}	0.19^{i}	8.9^{edfg}
Golden Delicious x Mollies Del	159.3^{f}	64.4^{h}	15.8^{g}	0.25^{fg}	11.2^{bdac}
Starkrimson x Tydman's Early	166^{e}	56.7^{n}	16^{g}	0.26^{fg}	6.25^{h}
Ambri x White Dotted Red	135.11^{l}	59.4^{l}	13^{h}	0.21^{h}	9.05^{edfcg}
Prima x White Dotted Red	187^{c}	39.4^{r}	16.2^{fg}	0.25^{g}	7.59^{hfg}
Prima x Red Delicious 1	115.3^{m}	66.1^{g}	19^{d}	0.31^{d}	11.58^{ba}
Prima x Red Delicious 2	90^{o}	61.6^{k}	18.5^{d}	0.28^{e}	10.86^{ebdac}
Golden Del x Snow Drift	216.2^{a}	71.6^{b}	16.8^{fe}	0.25^{g}	11.21^{bdac}
Ambri x Summer Red	64.6^{q}	70.5^{c}	18.7^{d}	0.28^{fe}	8.56^{efg}
Ambri x Top Red	87.1^{p}	74.4^{a}	18.5^{d}	0.27^{fe}	9.52^{ebdfc}
Prima x Top Red	135.4^{l}	62.4^{j}	17.1^{e}	0.25^{g}	8.51^{efg}
Golden Delicious x Gala Mast	158.2^{g}	68.5^{e}	20.5^{ba}	0.35^{ba}	8.51^{efg}
Well Spur x Vista Bella	95.5^{n}	62.5^{i}	21.2^{a}	0.37^{a}	9.22^{ebdfc}
M. floribunda x Vista Bella	155.1^{h}	69.4^{d}	19.5^{c}	0.36^{a}	12.53^{a}
Ambri x Maharaji	136.8^{k}	55.1^{p}	20^{bc}	0.33^{c}	11.31^{bac}
Gold Del x Red Fuji	154.2^{i}	67.4^{f}	20.1^{bc}	0.34^{bc}	9.59^{ebdfc}
Red Del x Gala Mast	90.5^{o}	55.9^{o}	20.5^{ba}	0.33^{c}	7.3^{hg}
Golden Delicious x Oregon Spur	195.2^{b}	62.4^{j}	18.5^{d}	0.31^{d}	9.23^{ebdfcg}

Fruits of Apple hybrids developed and their respective parents evaluated for fruit quality parameters during 2019-20

	Hybrid Fruit	Parent 1	Parent 2
Ambri x Maharaji			
Ambri x Mollies Delicious			
Ambri x Summer Red			
Ambri x Top Red			
Ambri x Vista Bella			
Ambri x White Dotted Red			

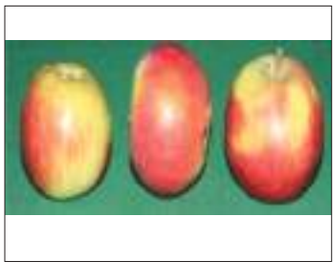
Fruits of Apple hybrids developed and their respective parents evaluated for fruit quality parameters during 2019-20

	Hybrid Fruit	Parent 1	Parent 2
Golden Delicious x Oregon Spur			
Golden Delicious x Red Fuji			
Golden Delicious x Snow Drift			
Golden Delicious x Gala Mast			
M. floribunda x Vista Bella			
Prima x Red Delicious (1)			

Fruits of Apple hybrids developed and their respective parents evaluated for fruit quality parameters during 2019-20

	Hybrid Fruit	Parent 1	Parent 2
Prima x Red Delicious (2)			
Prima x Top Red			
Prima x White Dotted Red			
Red Delicious x Gala Mast			
Red Delicious x Mollies Delicious			
Starkrimson x Tydeman's Early			

Fruits of Apple hybrids developed and their respective parents evaluated for fruit quality parameters during 2019-20

	Hybrid Fruit	Parent 1	Parent 2
Well Spur x Vista Bella			
Ambri x Maharaji			
Ambri x Mollies Delicious			
Ambri x Summer Red			
Ambri x Top Red			
Ambri x Vista Bella			

Fruits of Apple hybrids developed and their respective parents evaluated for fruit quality parameters during 2019-20

	Hybrid Fruit	Parent 1	Parent 2
Ambri x White Dotted Red			
Golden Delicious x Oregon spur			
Golden Delicious x Red Fuji			

Crossing for introgression of disease resistance and fruit quality traits in apple cultivar Ambri

During 2019-20 the population developed from crossing of Ambri cultivar with *M. floribunda* and Red Lane was grafted on clonal rootstock M-9 (Pajam-1). Two crosses made between apple cultivar Ambri with Oregon Spur and Prima for introgression of fruit quality traits from cultivar Oregon Spur and scab resistance from cultivar Prima were also maintained for further evaluation. Crossing population of about 1000 individuals were raised in each cross and was grafted on M-9 rootstock for early bearing and further evaluation

Grafted plants of hybrids

Rootstock breeding in apple

Apple rootstock improvement programme has been initiated by ICAR- CITH, Srinagar from 2018. In this direction during the year 2019, crossing were preformed between *Malus baccata L.* with different Malling and Malling Merton series rootstocks as well as between Malling and Malling Merton series of apple rootstocks for compatibility

studies and further rootstock improvement. Total 1347 crosses have been attempted in which maximum fruit set percentage (23.67%) was achieved with the cross combination *Malus baccata* × M-9, followed by *Malus baccata* × MM-106 and minimum fruit set (2.88%) were recorded in the cross between MM-106 × MM-111 (Fig. 13). The fruits obtained from these crosses were harvested and seeds were sown for further evaluation. The population raised during the previous year's crosses was sown for further evaluation.

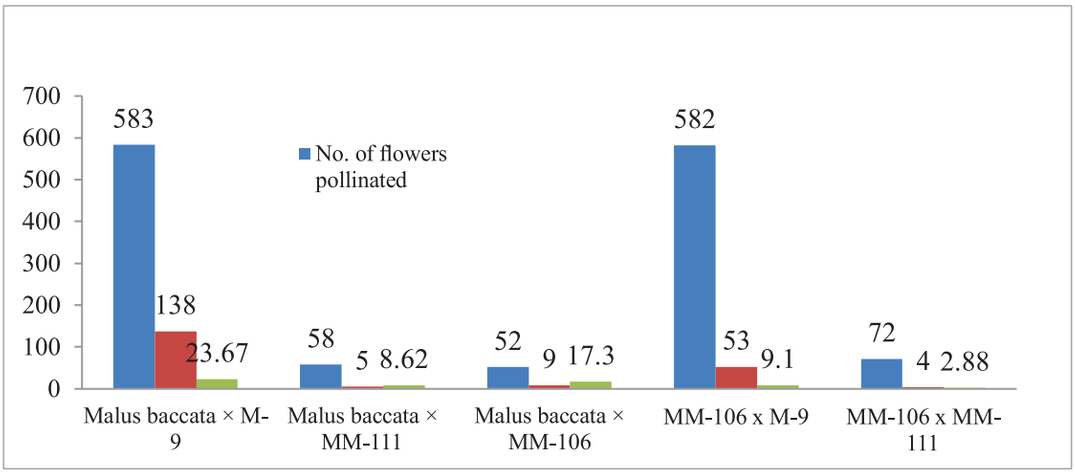


Fig. 13. Number of crosses, number of fruit set and fruit percentage in different crosses

Self-Incompatibility studies and hybridization in pear

In pear, two cultivars namely Kashmiri Nakh and Badshah Nakh farmers are facing lot of problem due to poor fruit set. So to observe the main reason of this, selfing was carried out in these cultivars (920 & 1020 flowers in Badshah Nakh and 940 & 980 flowers in Kashmiri Nakh during 2018 & 19) and no fruitset was observed during last two years which clearly indicates self incompatibility in these cultivars but information needs to further validation for reaching the conclusion through S-allele typing. After further study a suitable pollinizer need to be recommended.

Simultaneously crossing work was also attempted by using four parents viz. Kashmiri Nakh (KN), Badshah Nakh (BN), Sand Pear (SP) and Starkrimson (ST). Total 917 numbers of crosses were performed during 2019. Among the crosses performed the fruit set percentage ranges from 4.90% to16.24% (Fig 14). The highest fruit set percentage (20.12%) was recorded in cross between (BN x SP). From the information it can

Selfing studies in pear

be concluded that Sand pear can be employed as potential pollinizer for the Nakh cultivars and can increase the fruit set percentage. The population obtained from previous year crosses has been established in field for further evaluation

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

Hybrids obtained from crosses between short day male sterile lines and promising long day onion

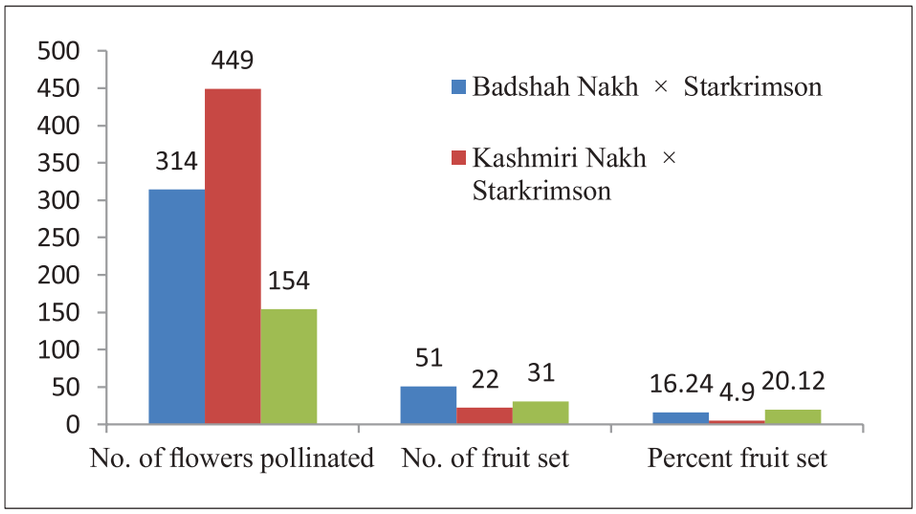
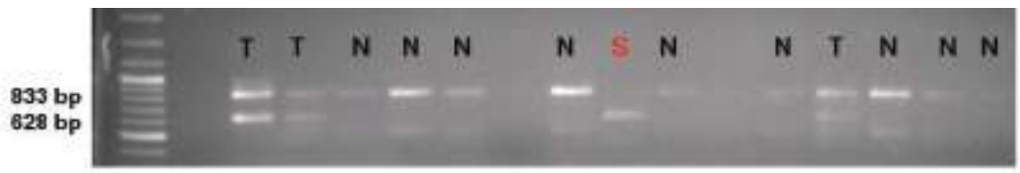


Fig. 14. Number of crosses , number of fruits and fruit set percentage of different cross combinations

genotypes were planted for evaluation under long day conditions in December 2018. The data on bulb yield and storage traits was collected in 2019-20 and analysis and result interpretation is underway. Additionally, molecular screening of Brown Spanish, CITH-O-1 and CITH-O-2 was done with two male sterile (MS) cytoplasm related markers to identify type as well as frequency of MS cytoplasm present in them. Screening with cob marker revealed absence of male sterility in Brown Spanish and the presence of S type at 11.05 % in CITH-O-1 and 28 % in CITH-O-2, respectively. On the other hand, orf 75 and cox1 markers showed the absence of male sterility in CITH-O-2 while the presence of both T and S cytoplasms in CITH-O-1 and Brown Spanish populations. These observations suggest discrepancy in results given by either marker and may be due to weak linkage disequilibrium between the markers and the long day onion populations available with the institute (Table 14& 15).

Amplification with cob marker



Amplification with combined cox1 and orf75 markers

Table14. Frequency of male sterile cytoplasm as revealed by cob marker

Genotype	No. of plants screened	Cytoplasmic type			Frequency of sterile cytoplasm
		N	T	S	
CITH-O-1	199	177	0	22	11.05
CITH-O-2	25	18	0	7	28.00
Brown Spanish	12	12	0	0	0

Table.15. Frequency of male sterile cytoplasm as revealed by combination of *orf75* and *cox1* markers

Genotype	No. of plants screened	Cytoplasmic type			Frequency of sterile cytoplasm
		N	T	S	
CITH-O-1	77	46	20	11	40.26
CITH-O-2	36	36	0	0	0
Brown Spanish	151	145	15	6	12.57

Breeding for nutrarich varieties/ hybrids in root vegetable crops

To develop nutrarich varieties/hybrids in root vegetable crops, different carrot, radish and turnip accessions were evaluated for hybridization. The different crosses of Purple Globe, Purple Round, Pink Top White Globe, Pink Top White Round, Pink Top White Flat, Mustard Yellow, Pink Round, White Round, White Globe, White Flat, Pink Flat, Pink Globe, Golden Ball and Pusa Chandrima were made in turnip hybridization programme and simultaneously got different F_2 programme of turnips whereas in radish, green, white, and pink types were crossed and got F_1 hybrids of radish. The 35 carrot accessions and local temperate types were crossed for improvement of anthocyanin, lycopene and β-carotene content in temperate carrot. The different twenty two radish types were crossed for enhancement of anthocyanin pigments in F_1 generations.

Screening of radish germplasm for anthocyanin colour

Fifty five germplasm of radish with different coloured skin were screened for anthocyanin content under greenhouse condition by RHS colour chart. Observations were recorded by using RHS colour chart and economic traits. Among

Screening of radish germplasm for anthocyanin colour

Anthocyanin expression F_{2-3} advanced generations of radish

Anthocyanin expression in different F_1 generations of radish

screened germplasm, six were found anthocyanin colour on the skin and flesh.

Generation advancement

During 2018-19, 90 cross combinations were attempted and seed were harvested for the evaluation in the 2019-20 winter season for radish, where as in carrot 35 cross combinations were attempted and seed were harvested. The fifty F1, forty five F_2 and twenty five F_3 were advanced to subsequent generation in radishes (Fig 2 and 3). Besides, promising genotypes were also self-pollinated for the development of inbred lines. Furthermore twenty four F1, ten F2 carrot populations were advanced in carrots.

Evaluation of advance lines

Forty advance lines were evaluated during winter season for root shape, root size, root colour and yield.

ICAR-CITH, REGIONAL STATION, MUKTESHWAR

Survey, collection, maintenance and evaluation of temperate fruits

ICAR-CITH RS Mukteshwar is also enriching its germplasm wealth year after year for evaluation and for future use in breeding work. During the year collection of germplasm was carried out in the form of plants/ scion wood/ runners in various crops like apple, pear, peach, plum, apricot, walnut, strawberry and chest nut. More than 210 genotypes were collected and planted/ propagated at ICAR-CITH, RS Mukteshwar.

Evaluation of temperate fruit germplasm

Evaluation work was carried out in peach, plum, apple and kiwi fruit for various physio chemical traits including antioxidant potential under mid hill conditions of Uttarakhand. In peach seven cultivars (Red June, FLA-16-33, Flordasun, Flordaking, Red Nectarine & Golden Monarch) were evaluated and on the basis of the physico-chemical characteristics of fruits Red June was found superior as compared to other peach cultivars. In plum 5 cultivars (Santa Rosa, Green Gage, Kalegi, Satsuma & Late plum) were evaluated and based on the physico-chemical characteristics of fruits, Satsuma was found superior as compared to other plum cultivars. In apple, 27 apple cultivars belonging to Delicious group, spur type and colour strains were evaluated for various traits and the cultivar Red Delicious, Rich-a-Red, Bright-N-Early, Starkrimson, Red Chief and Skyline Supreme performed better in the region under prevailing climatic conditions. In evaluation of four kiwifruit cultivars, most of the physico-chemical characteristics of fruits were found superior in Hayward and Allison as compared to other cultivars. Besides this, a survey was conducted in Kumaon hills of Uttarakhand and twenty five plum genotypes were collected and evaluated. The Collection-1, 8, 19 & 22 were found superior in most of the physico-chemical characteristics and seems promising.

Breeding for development of superior varieties/hybrids in Solanaceous vegetables

Under this project, eight genotypes of tomato and six genotypes of capsicum were evaluated under polyhouse during summer - kharif 2019-20 at ICAR-CITH Regional Station Mukteshwar for their growth and yield parameters.

TOMATO

In tomato, genotypes namely CITH-M-CT-1, VL-4, TO-3150, DPTH-60, CITH-M-T-6, FMSxCITH-M-

Fruiting in different tomato genotypes

Table16. Growth and yield parameters of different tomato genotypes

S.N.	Variety/ genotype	Average Plant height(cm)	Average Number no of fruit/plant	Average fruit weight (g)	Average fruit yield/ plant(kg)	Average fruit yield (q/ha)
1	CITH-M-CT-1	266.8	25.01	93.60	1.442	980.66
2	VL-4	199.2	31.9	152.80	2.154	717.99
3	TO 3150	81.9	25.1	94.20	1.252	417.33
4	DTPH-60	219.9	60.9	88.20	2.750	916.66
5	CITH-M-T-6	117.5	13.3	67.00	0.896	298.66
6	FMSxCITH-M-T-1	109.3	11.5	47.20	0.711	237.00
7	FMSxVL-4	103.2	14.3	25.60	0.599	199.66
8	FMSx210	100.6	16.3	35.40	0.703	234.33
Mean		149.80	24.79	75.50	1.31	500.29

CT-1(F3), FMSxVL-4(F3) and FMSx210 (F3) were evaluated (Table16) and highest average fruit yield of 2.750 kg/ plant was recorded on DTPH-60 followed by VL-4 (2.154 kg/plant) and CITH-M-CT-1(1.442 kg / plant). However the heaviest fruit was produced in genotypes VL-4 (152.80 g.) followed by TO-3150 (94.20 g.) and CITH-M-CT-1 (93.60 g.). The average plant height was exhibited maximum by genotype CITH-M-T-1 (266.8 cm) which was followed by DTPH-60 (219.90 cm) and VL-4 (199.20 cm)

CAPSICUM

Among 6 sweet pepper genotypes, average fruit yield/plant was recorded highest in genotype SH-SP-H-1(1196.0 g./ plant followed by CITH –M-SP-4 (1150.0 g./ plant) and CITH –M-SP- 5 (889.3g/plant).Whereas average fruit weight was registered highest in genotypes CITH-M-SP—4 (186.20 g.), followed by SH-SP-H-1 (137.00 gm.) and CITH-M-SP-5 (111.2 g.) and the three top ranking genotypes in terms of number of fruits / plant were CITH-M-SP-7 (12.00), CITH-M-SP-6(11.30) and CITH-M-SP-2 (10.00). The tallest plants in terms of average plant height (112.3 cm) with maximum number of branches /plant (5.0) was genotype CITH –M-SP-5 (Table17).

Table 17. Growth and yield parameters of capsicum genotypes

S.N.	Genotypes	Average Plant height (cm)	Average number of fruits/plant	Average Fruit length (mm)	Average Fruit breadth (mm)	Average Fruit yield / plant(g.)	Average fruit weight (g)	Total fruit yield (q/ ha)
1.	CITH-M-SP-2	63.1	10.0	82.1	52.6	669.3	67.5	297.33
2.	CITH-M-SP-4	77.0	6.3	87.5	80.4	1150.0	186.2	511.11
3.	CITH-M-SP-5	112.3	8.0	91.9	57.0	889.3	111.2	395.11
4.	SH-SP-H-1	67.6	9.0	78.7	69.0	1196.0	137.0	531.55
5.	CITH-M-SP-6	60.0	11.3	116.8	24.2	245.3	21.8	108.89
6.	CITH-M-SP-7	64.8	12.0	122.1	22.2	524.0	42.0	232.89
	Mean	74.1	9.4	96.5	50.9	779.0	94.3	346.22

Fruiting in different capsicum genotypes

ICAR-CITH, REGIONAL STATION, DIRANG

The establishment of experimental field for research and extension was initiated at ICAR-CITH Regional Station Dirang (Arunachal Pradesh). Different varieties of apple, peach, apricot, almond and walnut were planted in mother orchards of, Regional Station. Exploration and collection of minor temperate fruit crops in West Kameng and Tawang District of Arunachal Pradesh was carried out by ICAR-Central Institute of Temperate Horticulture, Srinagar in collaboration with ICAR-NBPGR, Regional Station, Bhowali, Uttarakhand from 19th August, 2019 to 3rd September, 2019. A total number of 78 accessions were collected including *Rubus* spp., *Sorbus* spp., *Prunus* spp., *Docynia* spp., *Ribes* spp., *Pyrus* spp., *Malus* spp., *Corylus* spp. and *Allium* spp. etc. Official formalities for transfer of land to ICAR-CITH, Regional Station, Dirang (30 hac.) from State Department of Horticulture (Arunachal Pradesh) were also initiated.

2. CROP PRODUCTION

The outcome of horticultural industry depends upon many factors and quality planting material is the key factor to boost the productivity as well as quality of produce and can increase income and socio economic status of farmers. The quality planting material coupled with production technologies like training, pruning, nutrient & water management, pollination, post harvesting handling, diseases and pest management etc. ultimately decides the benefit to farmer especially in temperate fruit crops. 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 quality planting material along with production technology is increasing year after year. During the year 2019-20, institute has supplied more than 35000 plants of different temperate fruit crops in addition supplied 11000 no's of scionwood sticks. The institute has grafted/ budded about 80000 plants for coming year. In vegetables, 345.25 kilogram of seed was produced in vegetable crops and supplied/ sold to different stakeholders and consumers like kitchen gardeners, vegetable growers, research organization etc. During the year 2019-20 emphasis was given for multiplication and commercialization of walnut varieties released by ICAR-CITH, Srinagar. About 11000 grafted plants of walnut were provided to Uttarakhand Forest Resource Management Project for establishment of mother orchards under project promotion of walnut in Uttarakhand funded under JICA. Likewise, one thousand grafted plants of walnut were provided to Department of Horticulture, Govt of Arunachal Pradesh. During the year 2019-20 planting material of walnut was also provided to Department of Horticulture, Kashmir for establishment of progeny orchards for further popularization of these varieties among the farmers. The significant findings of various experiments carried out for generating production technology are described briefly below:

Evaluation of newly introduced apple trained in Tall Spindle system

Eight apple varieties namely Gala Redlum, Super Chief, Red Velox, Golden Delicious Reinders, Elstar, Jona Red Prince, Pinnova and Golden

Super Chief on Tall Spindle System

Gala Redlum on Tall Spindle System

Profuse fruit bearing in newly introduced apple cultivars at ICAR-CITH, Srinagar

Delicious Clone B were introduced by Department of Horticulture, Kashmir and one demonstration was laid at ICAR-CITH, Srinagar during 2016. The trees are planted at spacing of 3.0 m x 1.5m and 3.0 m x 1.0 m, canopy architecture has been maintained in Tall Spindle System. During 2019-20 all the varieties showed significant bearing and the yield ranged from 6 t/ha in Pinnova to 40 t/ha in Gala Redlum. Significant variation was also observed in fruit weight, TSS, firmness, ascorbic acid content and colour parameters among the varieties (Table 18).

Table 18. Physicochemical analysis of new varieties trained in Tall Spindle System

S. No.	Variety	Weight (g)	Yield t/ha	TSS (%)	Firmness (RI)	Ascorbic Acid (mg/100g)	Color			
							L	a	b	Tint
1	Gala Redlum	220^{e}	40^{c}	14.86^{b}	60.1^{a}	10.93^{c}	40.15^{b}	35.23^{d}	18.19^{a}	-150.23^{c}
2	Elstar	97.5^{a}	10^{a}	14.9^{b}	60.2^{a}	9.39^{b}	52.76^{c}	38.23^{d}	41.51^{b}	-150.5^{c}
3	Jona Red Prince	140.23^{b}	8^{a}	16.8^{d}	65.6^{c}	8.29^{a}	48.52^{b}	20.91^{c}	36.52^{b}	-105.53^{b}
4	Pinnova	148.98^{bc}	6^{a}	14.5^{b}	63.9^{b}	9.21^{b}	65.72^{d}	32.18^{d}	49.71^{b}	-112.8^{b}
5	Super Chief	181.08^{d}	15^{ab}	14.5^{b}	69.5^{d}	9.1^{b}	33.05^{a}	14.72^{c}	5^{a}	-61.82^{a}
6	Red Velox	165.84^{cd}	20^{b}	12.5^{a}	59.8^{a}	8.15^{a}	35.09^{a}	19.7^{c}	7.43^{a}	-81.38^{a}
7	Golden Del Reinders	154.03^{c}	20^{b}	15^{bc}	62.2^{b}	9.0^{b}	65.45^{b}	-7.52^{b}	39.96^{b}	-71.67^{a}
8	Golden Del Clone B	116.5^{b}	8^{a}	15.9^{c}	60^{a}	11.2^{c}	59.58^{c}	-1.24^{a}	34.78^{b}	-22.21^{a}

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

To find feathering response of one year old nursery plants of different apple genotypes grafted on M.9 rootstock planted at 90 x 60 cm spacing, an experiment was conducted. The experiment consisted of 20 treatment combination comprising two different method i.e. central leaders (M1), renewal leader (M2) and 10 diverse genotypes i.e. Red Chief (G1), Red Spur (G2), Starkrimson (G3), Oregon Spur (G4), Red Volex (G5), Top Red (G6), Red Gold (G7), Gala Mast (G8), Golden Delicious (G9) and Shireen (G10). Four spray of 600 ppm of 6-benzyladenine were applied at two weeks interval for feathering. In first method nursery plants were headed back during late winter at 70 to 80 cm above the ground (depending upon vigor and caliper of nursery tree) which resulted in development of 2-4 prolepic shoots below the cut during spring. The vigorously growing proleptic shoot was selected as a renewal leader and remaining branches were removed. In second method central leader was allowed to grow naturally. The first spray of 6-benzyladenine was applied when central leader and renewal leader attained about 15 cm new growth. A silicon based adjuvant, Wetwell (Biostadt India Ltd.) was added to spray solution at the rate of 300 µL per litre. In the fall, trees were measured in the nursery for tree height, trunk diameter (10 cm above bud union), total number of proleptics (shoots produced by preformed stem unit), total number of sylleptics (shoots produced by neoformed stem unit and more than 5 cm in length), number of feathers (useful syllepsis i.e. syllepsis longer than 10 cm were considered as feathers), distance from the ground level to each of the induced feathers, length, diameter and crotch angle of each feather and branching zone. The experimental results revealed that the central leader method performed better compared to renewal leader in respect of tree height, trunk diameter and number of syllepsis/feathers and produced feathers of appropriate length and diameters. However, the crotch angle was more in feathers produced by renewal leader method. Further, feathering response of different apple genotype varies to 6-benzyladenie spray. As far as overall growth and number of feathers is concerned, among the different genotype Shireen and Top Red gave most and least response, respectively to BA application (Fig 15).

Management of pre harvest fruit drop in apple.

Effect of thinning on quality, yield and fruit drop in apple (Malus domestics Borkh)

The trial was conducted during 2019 at ICAR-CITH training block, established during the year 2016.Four varieties (standard and spur) of apple viz. Gala Redlum, Red Velox, Super Chief and Golden Delicious Reinders on M9-T339 rootstock

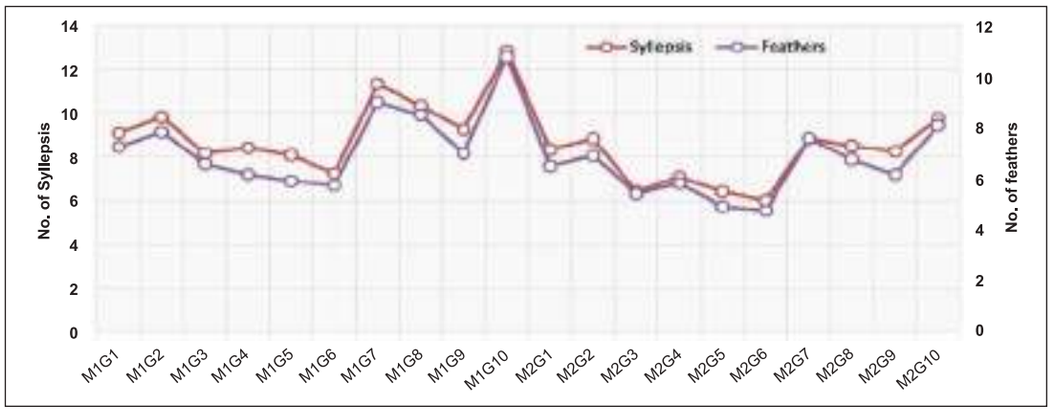
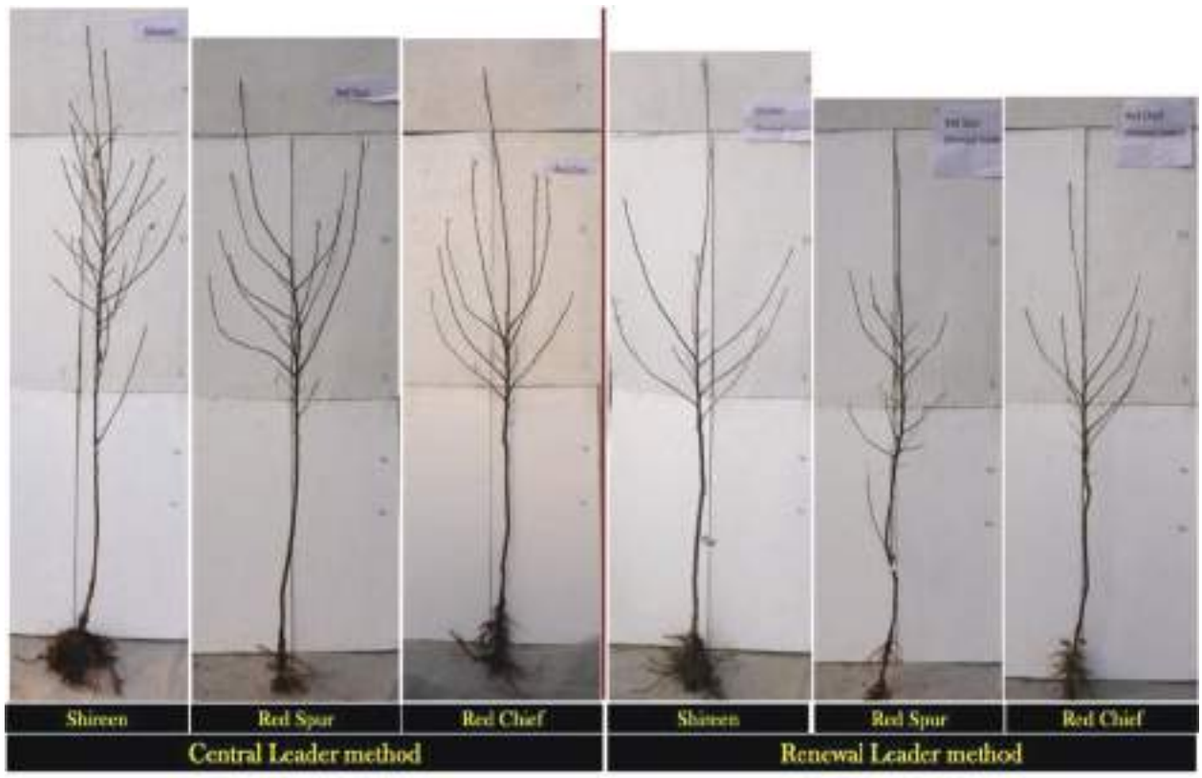


Fig. 15. Response of different apple genotypes using central and renewal leader methods to 6-BA application



Response of one year old nursery plants of Shireen, Red Spur and Red Chief to foliar application of 6-benzyladenine for feathering using central and renewal leader method

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 maximum fruit weight, fruit length, fruit diameter was recorded in the thinning treatment (1 fruit per cluster) and minimum values were recorded in control. In case of varieties, maximum fruit weight (274.43g), fruit length (78.64mm) and fruit diameter (85.12mm) was recorded in Red Velox with Treatment (1 fruit per cluster). The maximum pedicle length (21.68mm) was recorded in Gala Redlum. 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 32.69 in Super Chief on Treatment (2 fruits per cluster) to 66.60in Golden Delicious Rendiers in Treatment (2 fruits per cluster), the a* values ranged from -0.48 in Golden Delicious Rendiers on control to 38.25 in Gala Redlum on treatment 1 (1 fruit per cluster), values for b* scale range from 4.68 in Red Velox on Treatment 2 (bearing 2 fruits per cluster) to 46.92 in Golden Delicious Rendiers Treatment 3 (3 fruits per cluster). The values for tint ranged between-150.88 in Gala Redlum on Treatment (1 fruit per cluster) to -19.22 in Golden

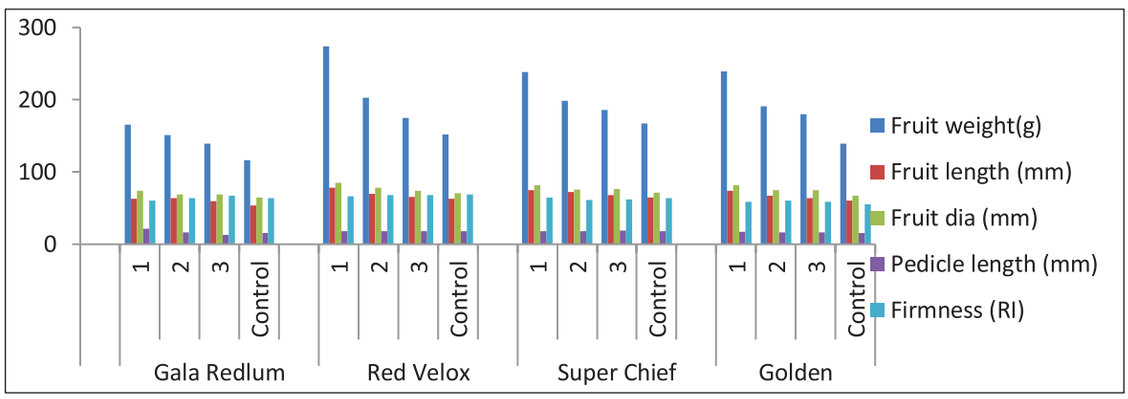


Fig16. Effect of thinning on quality parameters of apple cultivars

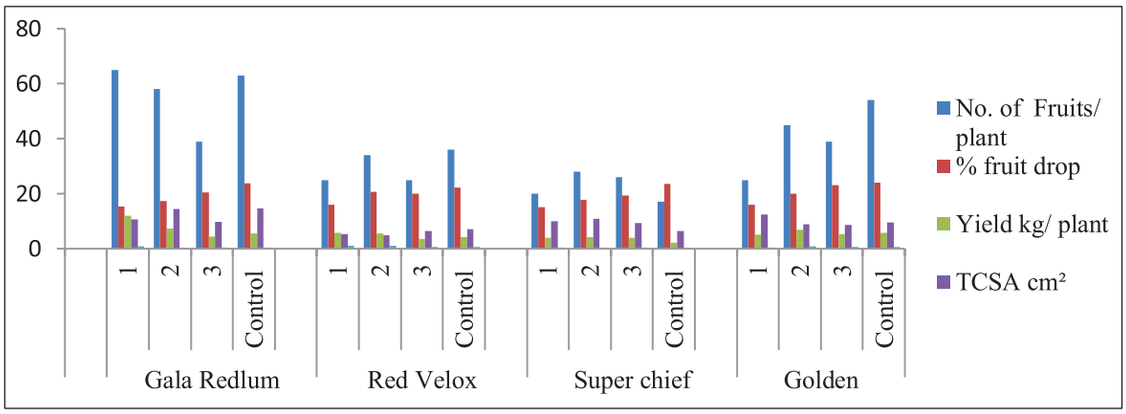


Fig. 17. Effect of thinning on yield efficiency and fruit drop in apple cultivars

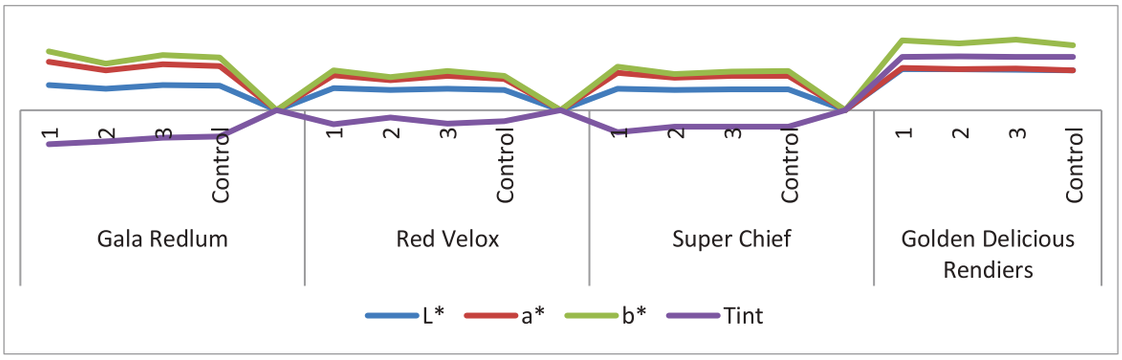


Fig.18. Effect of thinning treatments on colour traits in apple

1Fruit/Cluster *2Fruit/Cluster* *3Fruit/Cluster* *Control*

Different thinning treatments in apple cv. Red Velox.

Delicious Rendiers on Control. The firmness of the fruits ranges from 55.67 in Golden Delicious Reinders of control to 68.80 in Red Velox of Control. Irrespective of varieties maximum fruit drop % was recorded in control in all varieties and minimum in Treatment Control (1 fruit per cluster). Among the varieties maximum fruit drop% was recorded in Golden Delicious Reinders (24.07%) in Control whereas the minimum fruit drop % was recorded (15%) in Super Chief in Treatment (1 fruit per cluster). The TCSA values of the plants ranged from 4.84cm^2 in Red Velox on Treatment (2 fruits per cluster) to 14.74 in Gala Redlum on Control. The simplest way to express yield versus tree size is to determine the yield efficiency (yield per trunk cross sectional area). The highest yield efficiency (1.13kg/cm^2) was recorded in Red Velox in Treatment (2 fruits per cluster) whereas the lowest (0.34kg/cm2) was recorded in Super Chief on control (Fig.16, 17 &18).

Development of almond based intercropping system involving saffron

Saffron is an important crop in Kashmir associated with many production problems leading to more losses to farmers especially due to biotic and abiotic factors. So to develop almond based intercropping system involving saffron; erect, semi erect and spreading type of almond varieties along with sole crop were tried.The highest saffron yield was recorded under erect type (3.022kg/ha) followed by sole saffron crop (2.940 kg/ha), semi erect type (2.488kg/ha) and spreading type (2.191kg/ha) of almond varieties. The highest almond (yield/ha) was recorded in spreading type (4.596 tons) followed by erect type (2.34 tons) and semi erect type (1.418 tons). The highest saffron equivalent yield (7.14kg/ha) was recorded in spreading type (Fig.19) followed by erect type (5.36 kg/ha) and semierect type (3.91 kg/ha). Non significant effect has been observed for most of plant and flower traits. Thus saffron-almond cropping system is the best combination and there is less antagonistic effect of almond varieties having different growing habit on economic traits of saffron. Thus the almond crop can give additional returns to growers and will be more beneficial to compensate losses during adverse weather conditions. The spreading type of almond varieties can give more returns to the growers due to more yields which is due to varietal potential as more number of spurs or due to large canopy area.

Flowering in saffron under spreading and erect type of almond varieties

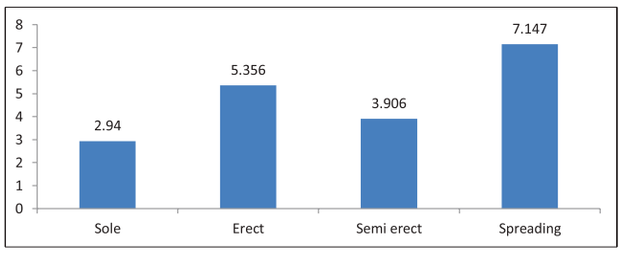


Fig. 19.Saffron quivalent yield (kg/h) in different tratments

Round the year cultivation of kale under Kashmir valley conditions

In this project, off season sowings and transplanting of 27 promising genotypes of kale were attempted for two consecutive years (2017-18 and 2018-19) to achieve year round availability of kale under Kashmir valley conditions. The pooled data were analyzed and project was concluded in 2019-20. It was observed that sowing of kale in months beyond July were uneconomical in open conditions. Under polyhouse conditions, although seedling emergence was improved significantly when sowing was attempted in August, September and October, but transplanted

seedlings could not survive in open field conditions. Sowing of selected genotypes with apparent winter hardiness was attempted in polyhouse with extra protection by using second layer of polythene under the polyhouse in January, 2020. There was proper emergence and production of healthy seedlings. However, on transplanting in March, the genotypes bolted immediately after achieving a short vegetative phase. Therefore, proper transplanting time was restricted from May to August months preceded by March, April, May, June and July sowings only. The yield data obtained from these months of transplanting are shown in the Table 19&20.

Perusal of data reveals that NW-Saag-1 performed most consistently and better than other genotypes including local checks Khanyari and GM Dari. NW-Saag-1 yielded 36.66 t/ha in July 2017 transplanting, 23.75 t/ha in May, 2018 transplanting and 13.35 t/ha in July, 2018 transplanting. In conclusion, this genotype is novel candidate for off season kale cultivation (transplanting from May to July) in Kashmir valley that can perform better than its conventional counterparts Khanyari and GM Dari.

Table 19.Highest yielding genotypes during offseason (2017-18)

Date of transplanting	Highest yielding genotypes	Yield range (t/ha)	CD at 5%.
10.7.2017	Khanyari (41.90) NW-Saag-42 (37.57) NW-Saag-1 (36.66) CITH-KC-26 (33.91)	33.91 – 41.90	10.92
21.10.2017	Insufficient seedlings and no establishment	-	-

Table 20. Highest yielding kale genotypes during offseason (2018-19)

Date of transplanting	Highest yielding genotypes	Yield range (t/ha)	CD at 5%
05.05.2018	CITH-KC-16 (27.13) HW-1 (24.21) NW-Saag-1 (23.75) CITH-KC-18 (23.02) CITH-KC-20 (22.02)	4.44 – 27.13	13.43
23.07.2018	NW-Saag-1 (13.35) NW-Saag-21 (Red) (9.86) HW-1 (9.81) CITH-KC-20 (9.02) CITH-KC-38 (7.89)	1.11 – 13.35	4.38
20.09.2018	CITH-KC-14 (0.40) NW-Saag-23 (0.35) CITH-KC-11 (0.34) CITH-KC-48 (0.33) GM Dari (Puckering) (0.33)	0.26 – 0.40	NS

Rootstock Multiplication

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

During the year 2019, for enhancing the multiplication rate in clonal rootstocks of apple, a trail was conducted at ICAR-CITH, Srinagar. The rootstocks were planted at an angle of 15° angle (slanting) in a green house followed by other recommended practices to initiate the laterals in the month of March. Different soilless substrates were employed and the rootstocks behaved differently with different media combinations. Clonal rootstocks (MM- 106, MM-111, B-9, P-22 and M-27) including three sub clones of M-9 (T337, T339 and Pajam-1) of apple were evaluated for various root related traits. Among the recorded parameters root length varies from 15.13cm to 33.67cm with maximum root length in M-9 sub clone Pajam-1 in treatment Perlite (100%) and minimum was recorded in M-27 in the same treatment. Root diameter was in the range of 1.11mm to 29.23mm with maximum in Pajam-1 in treatment (100% Perlite) and the minimum in rootstock Pajam-1 with Cocopeat (100%). The maximum root fresh weight 9.46g was recorded in MM-106 in Cocopeat (100%) and minimum in Pajam-1with Perlite (100%). The root dry weight varies from 4.30g to 43g with maximum value in MM-106 in Cocopeat (100%) and minimum in Pajam-1 with Perlite (100%).

Enhancement in multiplication rate of clonal rootstocks in green house

Propagation of clonal rootstocks of apple through cutting in greenhouse using soilless rooting medium.

Clonal propagation of rootstocks through cuttings is of special significance as it is an additional tool to increase the production of rootstocks. Whereas, during grafting top portion of rootstock (> 80%) goes waste. If this part of plant is converted into plantlets through cuttings the multiplication rate of rootstock can be increased manifold and scarcity of rootstock can be solved up to large extent. Keeping in view this fact an experiment was devised to raise the cutting in a soilless condition using different rooting medium (Cocopeat, Perlite and vermiculite individually/ in combinations) under greenhouse conditions while soil as control. Apple clonal rootstocks (M-9, MM-106, and MM-111) which are in huge demand were selected. The hard wood cuttings of 15-20 cm length and 0.8-1.2 cm in diameter having 7-9 buds were prepared from dormant twigs of rootstock. Before planting in the pots the cuttings were placed in fungicidal treatment for 10-15 minutes. This basal portion of the cuttings was dipped in IBA @ 2500ppm, for 1-2 minutes and planted in pots filled with rooting medium in the first week of February and recommended cultural practices for nursery raising were followed. After 20 days of growth only vigorously growing shoot were kept and rest were removed when the shoot attained 3-5cm growth. Various parameters related to growth average number of roots, length of main

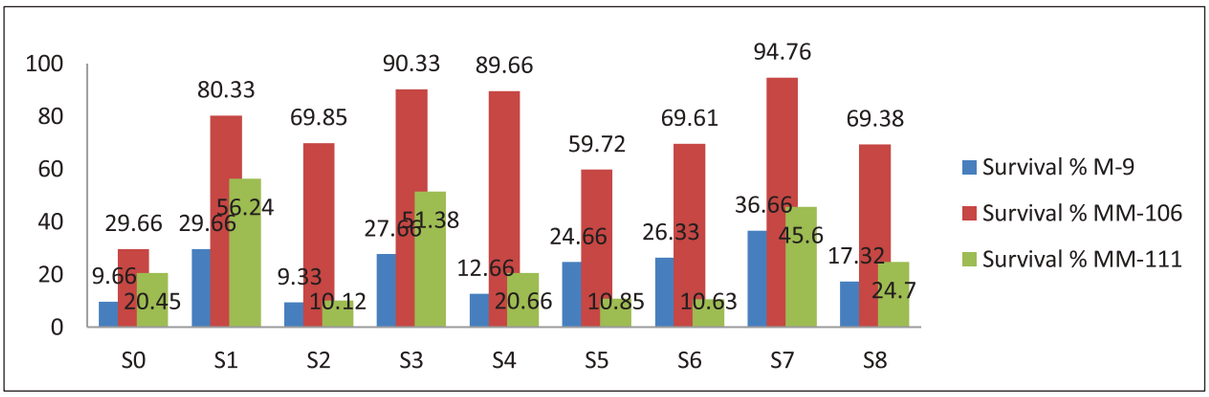


Fig. 20. Survival % of different rootstoks raised through cutting in different rooting media

S0= Soil, S1= Sand, S2= Saw Dust, S3= Coco peat 100%, S4= Vermiculite100% S5= Perlite, 100% S6= Coco peat 50% +Vermiculite 50%, S7= Coco peat 75%+ Vermiculite25%, S8= Cocopeat 50%+ Vermiculite25% + Perlite25%.

Propagation of rootstocks through cuttings and root growth in different media

root, root girth, root weight, plant height, plant girth, root fresh weight, root dry weight were recorded. Irrespective of substrate and genotype maximum survival percentage was recorded in the rootstock MM-106 with the treatment S7 (94.76) and minimum in the rootstock MM-106 in control (Fig.20).

The maximum plant height (77.15cm) were recorded in the substrate S_0 in genotype MM106 and minimum in treatment S_7 (48.25cm) in rootstock M-9. Maximum plant diameter (6.51mm) in MM-106 with treatment S_5 and minimum in (3.23mm) in rootstock M-9 with treatment S_0.The maximum number of adventitious roots per plant were recorded in treatment S_4 (6.8) in genotype MM-106. The maximum root fresh weight (13.41g) was recorded in MM-106 rootstock with treatment S_7 and minimum (1.52g) in rootstock MM-111 with treatment S_0. Maximum root dry weight (8.6g) was found in rootstock MM-106 with treatment S_7 and minimum (0.85g) in rootstock M-9 with treatment S_4. This technology which shows the success percentage (94%) in some rootstocks can be instrumental for increasing the multiplication rate of rootstocks, thus increasingly the availabilities of rootstocks and will reduce the cost of planting material.

Air layering in apple rootstocks

Layering is a form of rooting of cuttings in which adventitious roots are initiated on a stem while it is still attached to the plant. The rooted stem (layer) is then detached, transplanted, which later becomes a separate plant on its own roots. Whilst multiplying the clonal rootstocks of apple in the polyhouse, some plants grow > 4 ft 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, an experiment has been done to initiate rooting along the entire stem at different points based on the height and thickness of the shoot so that this portion of plant can be utilized in a most efficient way. First those plants having a diameter of (5-7 mm) were selected and wounding/incision has been given and rooting hormones IBA (2500 ppm) was applied in the form of lanolin paste 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 was used (Cocopeat). Staking was done to hold the bags in fixed position. Watering at regular intervals was done to keep the rooting media moist. Sufficient rooting has been recorded in rootstock MM-106.Two additional plants were harvested in comparison to single rootstocks. This technology needs further refinement so that maximum number of rootstocks can be harvested. This technology will be very useful in promoting the vertical expansion of the nursery in the greenhouse conditions and number of plants per unit area can be increased many fold.

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

A total of 4 growing media/treatments such as Soil, Farm Yard Manure (FYM), Vermicompost (VC), Forest Litter (FL), and their various combinations in equal proportion viz. Soil + FYM, Soil + VC, Soil + FL, FYM + VC, FYM +FL, VC+ FL, Soil + FYM +VC, FYM +VC + FL, Soil +FYM + FL, Soil + FYM +VC + FL were used to raise seedling of six vegetable crops namely tomato, capsicum, cucumber, broccoli, Chinese cabbage and lettuce in trays under natural ventilated polyhouse during 2016-17 and 2017-18. Analysis of various mediums for nutrients and microbial population showed that FYM possessed more organic matter (66.28%) and organic carbon (38.45%) whereas vermicompost and forest litter contain 40.96 and 23.76 percent organic matter, respectively. Similarly, maximum fungi as well as actinomycetes

Different stages of air layering in clonal rootstocks of apple

count were observed at 7th day of inoculation in FYM media. The maximum bacterial count (32.33 x 106) was recorded at 7th day of inoculation in vermicompost medium. The seedlings of various crops also planted under polyhouse to record various growth and yield parameters. It is observed that treatments exhibited significant differences for most of seedling characteristics of all the six crops during both years. Similarly, the plants of which seedling were raised with various growing media showed significant differences for most of growth and yield traits in all the six crops. From the results it was concluded that soil, farm yard manure and locally available forest litter singly and judicious combination thereof may be useful growing mediums in terms of successful seedling production and margin of profit as well for various vegetable crops under study. However, type of crop and variety, seed characteristics, nutritional and health properties of the medium and after care of seedlings/crops along with components costs involved need to be given due consideration for better results. A training programme on Lagat Anurup Sabji Phasal Evam Paudh Utpadan Taknikiyan was organized under the project on 13th February, 2020 in which 68 participants participated.

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

Six vegetable crops namely tomato, capsicum, cucumber (during summer- Kharif), broccoli, Chinese cabbage and lettuce (during winter season) were taken under polyhouse conditions at two different locations i.e. at high hill (Mukteshwer) and mid hill (Pokhrad). During the year 2015-16, 32 genotype of tomato, 19 of capsicum were evaluated in rod row planting at Mukteshwer under polyhouse. The crop viz., fenugreek, coriander, radish and green onion were grown during November 2015 to March 2016 under polyhouse at Mukteshwer and obtained maximum of 5 cuttings in coriander followed by 4 times harvesting of radish, 3 cuttings of fenugreek and one time harvesting of green onion. Fourteen genotype of tomato, 12 of capsicum were evaluated at both the locations, whereas 3 and 4 genotype of cucumber was tested at Mukteshwer and Pokhrad, respectively during 2016-17. During the year 2017-18, seven genotype of tomato, 11 of capsicum, 6 of cucumber, 6 of broccoli, 6 of lettuce and 1 of Chinese cabbage were evaluate at both the altitude. Genotype exhibited significant differences for most of the traits in all the six crops during both the year and locations.

In tomato, genotype VL-4 and CITH-M-T-5 and hybrid Badshah and Laxmi recorded highest fruit yield of 3.475 kg & 4.420 kg and 0.583 kg. & 0.606 kg per plant at high and mid hill during 2016-17 and 2017-18, respectively under polyhouse conditions. In capsicum, hybrid Yamuna (1.55kg/ plant) and Orebelle (1.90 kg/ plant) during 2016-17 and KT-1(1.24 kg/ plant) and Orebelle (0.630 kg/ plant) during 2017-18 recorded highest fruit yield/ plant at high and mid hills, respectively. Cucumber hybrid Malini and var. Japanese Green Long recorded highest fruit yield of 2.80 kg and 7.94 kg per plant at high and mid hills, respectively during 2016-17, while as Japanese Green Long and Pusa Sanyog exhibited highest of 3.30 and 5.44 kg fruit yield/plant at Mukteshwer and Pokhrad, respectively during 2017-18 under polyhouse. The broccoli hybrid Lucky F-1 and Canavera recorded highest head yield/ plants of 105.00 and 90.00g at Mukteshwer and Pokhrad location, respectively during 2017-18. Likewise, Chinese cabbage cv. Solan Band Sarson (360.00 and 303.33g head yield/ plants) and lettuce genotype C-1 (105.00 and 90.00g leaf yield/plant) exhibited highest yield at both the locations i.e. high and mid hills during 2017-18 under polyhouse.

As viewed economic point of view, capsicum fetches net return of Rs.31735.00 per 200 m2 with 9.20 B:C ratio followed by lettuce with net returns of Rs.10905.00 and 3.70 B:C ratio in high hill conditions under polyhouse. Other succeeding crop were Chinese cabbage which gave net returns of Rs.7978.50 with 2.62 B: C ratio, cucumber (Rs.5778.10 with 2.20 B: C ratio), tomato (Rs.4478.10 with 1.36 B: C ratio) and broccoli (Rs.568.40 with 0.17 B: C ratio). Under mid hill situation, the profit and B:C ratio was comparatively of similar magnitude. Capsicum crop provided maximum of Rs.12105.50 net returns per 200 m2 area with 3.51 B:C ratio followed by lettuce (Rs.9231.00 with 3.13 B:C ratio), tomato (Rs.6112.00 with 1.85 B:C ratio), Chinese cabbage (Rs.3931.00 with 1.29 B:C ratio) and broccoli (Rs.389.20 with 0.15 B:C ratio). Thus, it can be inferred that polyhouse growers can rely upon capsicum for higher earnings at both mid and high hill conditions, whereas lettuce and Chinese cabbage may be the 2nd and 3rd choice,

respectively from the B:C ratio point of view. The case with tomato and cucumber is different as tomato earned more in mid hill (Rs.6112.00) whereas only Rs.4478.00 in high hills. Likewise, cucumber is also quite different earned more (Rs.5778.10) in high hills contrary to Rs.389.20 only in mid hills. However, broccoli was least and discouraging option for both the location. A training programme on "Sabji Phasal Utpadan Main Vividhikaran Taknikiyan" was organized under the project on 12th February, 2020 in which 60 participants participated.

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

Among the various treatment combinations applied in apple orchard with two intercrops i.e. Pea and cauliflower during 2013 to 2018. On the basis of five year pooled data, the treatment comprising of Pea with FYM + Vermicompost + Biofertilizer + NPK recorded highest apple yield (91.28 q/ha) followed by cauliflower with FYM + Vermicompost + Biofertilizer + NPK (81.68 q/ha). However, treatment consisting of cauliflower with FYM + Vermicompost + Biofertilizer + NPK recorded highest apple equivalent yield (190.4 q/ha) followed by cauliflower with FYM + Vermicompost + NPK (167.66 q/ha). Highest land equivalent ratio was observed in Cauliflower with FYM + Vermi-compost + Bio-fertilizer + NPK (1.91) followed by Pea with FYM + Vermicompost + Bio-fertilizer + NPK (1.73). Moreover, technology were demonstrated among farmer under NMSHE (TF-6) project and MGMG scheme at Sunkiya village during 2019-20 with the aim to promote crop diversification for sustainable production for better utilization of space as well as natural resources without eroding soil health for enhancing production per unit area.

Data with respect to soil fertility status of pre and post sowing of intercrops were also recorded during the course of investigation. During pre-sowing Pea, highest pH (5.77) and electrical conductivity (0.123 ds/m) was recorded in Pea with FYM + NPK (RDF) where as lowest pH (5.5) and electrical conductivity (0.037 ds/m) was found in Pea with FYM + Vermicompost + Biofertilizer + NPK. The treatment comprising of Pea with FYM + Vermicompost + Biofertilizer + NPK exhibited highest organic carbon (13.99 g/kg), available nitrogen (122.17 mg/kg), available phosphorus (6.53 mg/kg) and available potassium (301.65 mg/kg) followed by Pea with FYM + Vermicompost + NPK. During post sowing, highest pH (5.90) and electrical conductivity (0.136 ds/m) was recorded in Pea with FYM + NPK (RDF) where as lowest pH (5.73) and electrical conductivity (0.039 ds/m) was found in Pea with FYM + Vermicompost + Biofertilizer + NPK. The highest organic carbon (29.70 g/kg), available nitrogen (166.13 mg/kg), available phosphorus (6.74 mg/kg) and available potassium (330.34 mg/kg) were assessed in the treatment comprising of Pea with FYM + Vermicompost + Bio-fertilizer + NPK followed by Pea with FYM + Vermicompost + NPK. The highest pH (6.27) and electrical conductivity (0.118 ds/m) were recorded in pre-sowing plots in which FYM + NPK (RDF) were applied to grow Cauliflower where as lowest pH (6.13) and electrical conductivity (0.096 ds/m) was found in Cauliflower with FYM + Vermicompost + Biofertilizer + NPK. The treatment consisting of Cauliflower with FYM + Vermicompost + Biofertilizer + NPK recorded highest organic carbon (27.01 g/kg), available nitrogen (123.98 mg/kg), available phosphorus (20.36 mg/kg) and available potassium (299.40 mg/kg) followed by Cauliflower with FYM + Vermicompost + NPK. During post sowing, highest pH (6.38) and electrical conductivity (0.124 ds/m) was recorded in Cauliflower with FYM + NPK (RDF) where as lowest pH (6.25) and electrical conductivity (0.106 ds/m) was found in Cauliflower with FYM + Vermicompost + Biofertilizer + NPK. The treatment combination of Cauliflower with FYM + Vermicompost + Biofertilizer + NPK reported highest organic carbon (27.17 g/kg), available nitrogen (150.61 mg/kg), available phosphorus (17.85 mg/kg) and available potassium (323.61 mg/kg) followed by Cauliflower with FYM + Vermicompost + NPK.

3. CROP PROTECTION

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

Virome analysis using next generation sequencing for identification of viruses in various cultivars of apple (Malus domestic Borkh.)

A survey of apple orchards in Jammu and Kashmir revealed the incidence of mosaic disease

Table 21.Viruses and viroids identified from different apple cultivars through next generation sequencing

Cultivar	Symptoms	Number (virus/ viroid)	Virus (es)	Viroid
Oregon Spur	Symptomatic	3/1	APNMV, ASGV,ASPV	AHVd
Golden Delicious	Symptomatic	4/1	APNMV, ApMV, ASGV, ASPV	AHVd
Fuji Aztec	Non symptomatic	3/0	ACLSV, AGCaV, ASPV 6+5	-

Apple mosaic virus (ApMV) , Apple necrotic mosaic virus (ApNMV), Apple stem pitting virus (ASPV), Apple stem grooving virus (ASGV), Apple chlorotic leaf spot virus (AcLSV), Apple green crinckle associated virus (AGCaV), Apple hammerhead viroid (AHVd)

from 7.14% to 90% in different cultivars, viz., Oregon Spur, Fuji Aztec, Royal Delicious, Red Delicious, Golden Delicious, Red Gold and Gala Mast. The Virome analysis using next generation sequencing (NGS) was done for three cultivars Oregon Spur, Golden Delicious (Symptomatic) Fuji Aztec (Asymptomatic). In addition to mosaic, symptoms of chlorosis, necrosis and ring spots were also observed on different cultivars of apple. The number and name of viruses/ viroids were identified are given in Table 21. Two new viruses, Apple necrotic mosaic virus (ApNMV) and Apple green crinckle associated virus (AGCaV) and one viroid, Apple hammerhead viroid (AHVd) was identified.

Seasonal variation of virus infection as detected by DAS-ELISA

Spatial and temporal variation in virus infection was tested again during 2019-20 through DAS-ELISA and RT-PCR and it was observed that four viruses viz Apple Mosaic Virus, Apple Chlorotic Leaf Spot Virus, Apple Stem Pitting Virus and Apple Stem Grooving virus show seasonal variation and also variation with respect to tissue. Relative gene expression studies using Real Time PCR & semi-quantitative assay using RT-PCR also revealed seasonal and tissue specific variation. Highest gene expression of these viruses was observed in leaf for Apple Mosaic Virus and Apple Chlorotic Leaf Spot Virus whereas Apple Stem Pitting Virus and Apple Stem Grooving virus expression was equally higher in stem tissues. Transmission studies of virus through seed were also studied and it was observed that there is no transmission of these viruses through seed. This study will be validated further using DAS-ELISA and RT-PCR studies on plants raised from seeds obtained from infected fruits. The population of about 500 plants has been raised from seeds obtained from infected fruits and the same will be tested for infection during different stages of plant growth. Furthermore transfer through pollen will also be studied using pollen from infected plants for pollination of healthy plants. Host range studies and screening of different apple varieties for resistance against viruses will also be studied after preparing infectious clones of these viruses in future.

4. POST-HARVEST TECHNOLOGY

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

ICAR-CITH, Srinagar has standardized different process technologies for making value added products in temperate fruit crops. During 2019-20, the process technologies were further validated and refined for up-scaling the quality products. These products were demonstrated during different exhibitions and visits. Licensing of the process technologies for different products will be taken up.

Response of Ambri genotypes of apple for physiological loss under ambient temperature conditions.

Ambri is well known for its shelf life and characteristic aroma. The study was carried out to see the physiological loss during the post-harvest keeping quality of 28 Ambri genotypes maintained at CITH Ambri Block. Important post-harvest quality parameters (Fruit weight loss, firmness, TSS and Titerable acidity) were recorded after every ten days interval starting from second week of November. From the data it is revealed that there was continuous decrease in fruit weight, and fruit firmness. The average

Products	Product description	Photograph
Apricot and plum Fruit Bar	It has excellent texture, color, aroma, taste, chewing quality, no sticking character and has acceptable microbial load, least browning and spoilage which can be stored up to 9 months without loss in quality, nutrition and appeal. By this technology post harvest losses can be minimized up to 75% by converting in to products	  *Apricot fruit bar* *Plum fruit bar*
Quince candy	Quince candy showed retention of TSS, pH, reducing, total and non-reducing sugars during storage at ambient conditions. The prepared products are acceptable in terms of colour, taste, consistency/texture even up to storage interval of 9 months at ambient conditions.	  *Quince candy*
Cape gooseberry Jam	Product has appealing colour, shine, texture, flavour, taste, aroma and has very good acceptable physical & chemical characters with excellent mouth refreshing ability. Product is rich in vitamin C (18 mg/ 100 g) and carotenoids (300 µg/100 g) ,TSS (48-50° B) and moisture content 14-18 percent.	
Osmo dehydrated Rose Hip	It is excellent in taste, flavour, texture and colour and has very good physical and chemical characteristics with excellent mouth refreshing ability. The product has moisture content (14-18%), TSS (55-60oB), vitamin C (75mg/100), acidity (1.42%), carotenoids (600IU) and can be stored for 9 months in cold and dark place without losing quality.	

mean fruit weight at the time of storage was 118.23g and after 15 weeks it has reduced to 103.01 during the storage period in genotypes as under ambient storage conditions. The maximum fruit weight loss (%) was recorded in Ambri genotype-12 (16.73%) and minimum in Ambri genotype-31 (11.22%). Continuous and significant loss of firmness were observed in all genotypes during the storage of 105 days under ambient conditions and the reason might be the continuous respiration and water loss. The maximum loss was recorded in genotype Ambri- 22 (61.20%) and minimum in Ambri genotype-36 (29.33%). Significant increase in TSS among all the genotypes has been recorded. The maximum TSS increase was recorded in Ambri genotype-13 (28.060B) and minimum in Ambri genotype-8 (13.690B). The titrable acidity (%) was significantly reduced in all the genotypes and maximum loss was recorded in Ambri genotype-34 (72.67%) and minimum in Ambri genotype-1 (34.91%).It is clear from the above data that different genotypes of Ambri showed different response in ambient temperature conditions (Fig 21 & 22).

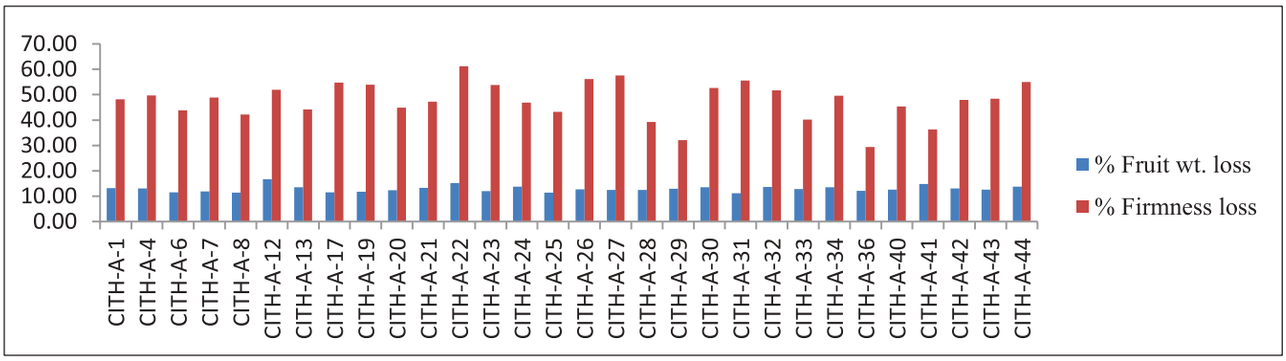


Fig.21 Physiological loss in Ambri genotypes for fruit weight and firmness under ambient temperature conditions.

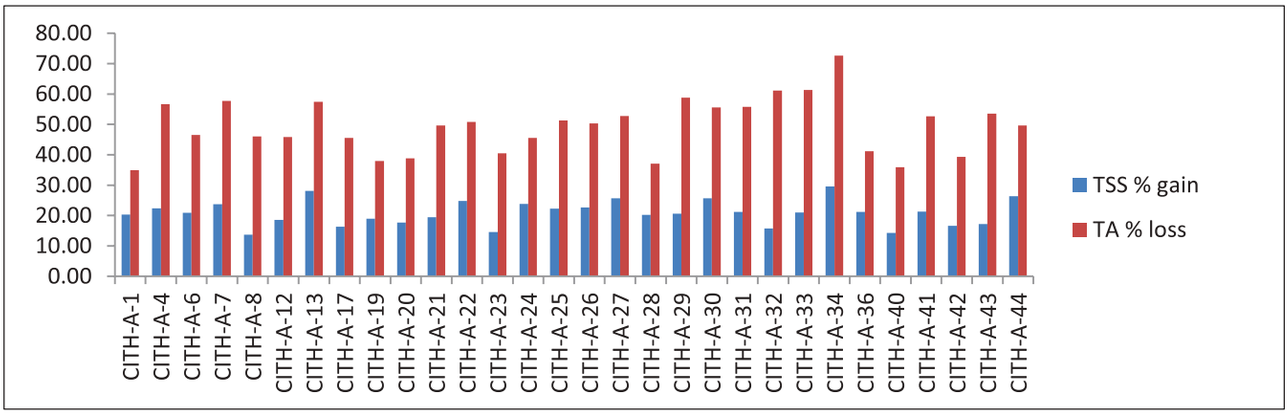


Fig.22. Physiological loss in Ambri genotypes for TSS and Titerable acidity under ambient temperature conditions

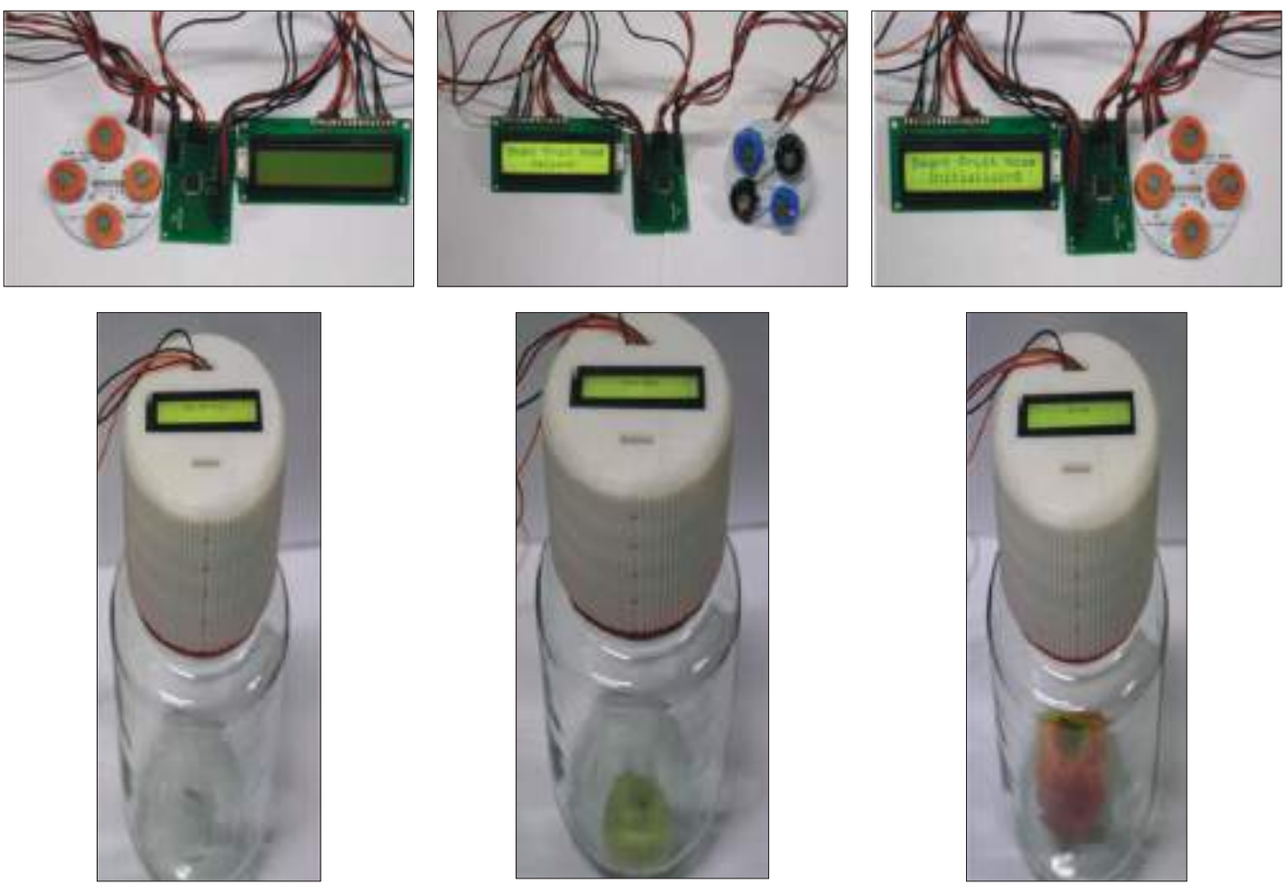
EXTERNALLY FUNDED /NETWORK PROJECTS

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

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

Activities done during 2019-20 by ICAR-CITH, Srinagar

Samples of four apple cultivars (Vista Bella, Shireen, Red Delicious and Golden Delicious) were collected at different stages and were processed and send to IIT, Roorkee for volatile profiling and normalization of prototype developed for e-nose in apple. Apple samples were collected on different harvest dates during ending June and September. From each collection, three different groups of 40 fruits each were created and sent for further evaluation at IIT, Roorkee. Prototype developed by IIT, Roorkee will be evaluated on about 200 apple varieties at ICAR-CITH, Srinagar in 2020. Volatile profile for apple cultivar 'Shireen', 'Golden Delicious' and 'Red Delicious' at all the pre-harvesting and post harvest stages has been completed. Nutritional profile for apple cultivar 'Shireen', 'Golden Delicious' and 'Red Delicious' at all the pre-harvest stage has been completed, four post time points have been completed and profiling for final two time points are under progress. Physiochemical properties of apple varieties have been thoroughly investigated. Sensor prototype for monitoring harvesting stages (real time on tree) of apple has been successfully developed. Sensor proto-type for monitoring shelf life and major nutritional parameter (sugar, protein, phenolics and flavonoid) under post harvest storage condition has also been developed.



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

DUS centre for temperate fruits and nuts

During 2019-20, fourteen applications of apple, peach, pear and cherry were received from PPV&FRA, New Delhi for onsite-DUS testing. DUS testing of two farmer's varieties of apple viz HRMN 99 and APS from villages Paniyala and Jaltahar respectively of Himachal Pradesh was done during 2019-20. Apple, peach, cherry and pear varieties were tested in Kargil region of Ladakh. Along with DUS testing data as per the DUS descriptor developed by ICAR-CITH, Srinagar their commercial and agronomic traits were also send to PPV&FRA. Five new walnut varieties submitted by the Institute were evaluated again in 2019-20 for DUS characters, agronomic and commercial traits for their registration through PPV&FRA, New Delhi.

In addition characterization of apple, pear, peach, plum, apricot, cherry, walnut, almond, and strawberry reference varieties was done as per the DUS descriptor developed by ICAR-CITH, Srinagar. The characterized data was converted into different notes which can act as data base for comparing candidate varieties with reference varieties at any time. Maintenance of reference varieties is being done and all traits/characters are being tested at nodal centre ICAR-CITH, Srinagar for their uniformity and stability. Under this project one monogram of apple has been compiled and published which covers all reference varieties and their description as per the DUS descriptor developed by ICAR-CITH, Srinagar and published by PPV&FRA, New Delhi.

On-site DUS testing of farmers variety APS at Kotkhai, Shimla

On-site DUS testing of farmers variety Hariman at Bilaspur, HP

On-site DUS testing of farmers variety at Kargil, Ladakh

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

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

During 2019-20 technologies and varieties developed by the Institute were documented. Passport data for new collections was prepared and send to NBPGR for allotment of IC numbers and IC numbers were allotted. All these new collections are being maintained at field gene bank of ICAR-Central Institute of Temperate Horticulture, Srinagar. Registration of germplasm through NBPGR has been initiated. In addition protection of plant varieties through PPV & FRA, New Delhi is being done in coordination with DUS Centre. Compilation of technology inventory and germplasm inventory is being done for documentation of all the available germplasm and technologies developed by the Institute. Monograph of apple varieties have been compiled and published. Variety release proposal for four apple hybrids have been compiled and submitted

Validation and Development of DUS guidelines in olive

During 2019-20 data was recorded for 41 different traits (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. Some varieties were also available at Ramban, Jammu and at ROCL, Rajasthan. Characterization of reference varieties and data recording as per the UPOV descriptor was also done at all the three sites with available varieties to check the uniformity and stability of the characters mentioned in UPOV guidelines.

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

Canopy management and plant architectural engineering is most essential component but often ignored in temperate fruit crops. The aim of present study was to develop efficient plant architectural systems using different rootstocks and scion cultivars, to harvest solar energy through increased light interception & improve sink source relationship, to utilize maximum vertical space & energy to maximize production and improve quality produce. Project was implemented in 8 centers initially & seven centers during 2019-20 with different temperate fruit crops of their regional importance. The summary of the results obtained in different crops at different centers is presented in Table 22.

Table 22. Summary of results at different centers on canopy management and plant architectural engineering in temperate fruit crops.

Centre	Crop	Number of training system/ cultivars/ rootstock	Salient findings
ICAR-CITH, Srinagar	Apple	Six training systems, four rootstocks and two cultivars	• Based on productivity, maximum productivity was recorded in Oregon Spur cultivar on MM 111 rootstock (92.86 t/ha) followed by MM 106 (91.88 t/ha) on Vertical Axis system. Light interception was found more in Cordon System
	Pear	Four training systems, two rootstocks and four cultivars	• On the basis of productivity, Vertical axis system gave highest yield (44.27t/ha) in cultivar Red Bartlett on Q C rootstock.
ICAR-CITH, Regional Station, Mukteshwar	Apple	Six training systems, four rootstocks and two cultivars	• Maximum plant height (1.61m) and plant diameter (1.75 cm) was recorded in Modified Leader System in CITH Lodh Apple-1 on MM-106 rootstock. The highest (3.17) number of branches/plant was recorded in Modified Leader System in cultivar CITH Lodh Apple-1 on M-9 rootstock.
	Peach	Four training system & two varieties	• The highest plant height (1.79 m) was recorded in Central Leader System while the highest plant diameter (3.29 cm) and highest number of branches/plant (4.34) was recorded in Open Centre System.
ICAR Research Complex for NEH Region, Shillong, Meghalaya	Peach	Four training system & two peach cultivars	• Maximum fruit yield and yield efficiency was recorded in cv. Partap on Y shape training system (19.1 kg/plant and 0.47 kg cm2 TCSA). Hence peaches should be trained on Y shape trellis system for higher productivity and quality at mid hills of Meghalaya.
Basar Centre (Arunachal Pradesh)	Peach	Four training system & two peach cultivars	• Plant height (2.04 m), canopy volume (4.13 m3), trunk cross section area (0.82 cm2), scion girth (0.97 cm) and rootstock girth (1.10 cm) was recorded highest in cv. Flordaprince. Peaches trained on Y shape trellis recorded highest yield (3.61 kg/plant) and found significantly superior over others.
Tadong Centre Gangtok, Sikkim	Kiwi fruit	Two cultivars, and six training systems along with two additional training system	• Kiwifruit plants trained on Extended T-Bar and Pergola systems were the first one to turn out in to reproductive phase and yielded fruits. In Extended T Bar system, yield of 8.94 and 8.44kg/plant was recorded in cultivar Hayward and Allison while these cultivars gave yield of 7.97 & 9.36 kg/plant in Pergola system

Dr Yashwant Singh Parmar University of Horticulture and Forestry, Regional Station Bajaura (Kullu), HP	Apple	Six training systems, four varieties and two rootstocks	• In cultivar Jeromine, maximum fruit yield (6.95 kg/ plant) was recorded in Vertical Axis system of training on M 9 rootstock. • In apple cv. Red Velox, maximum fruit yield (8.25 kg/plant) was observed on M 9 rootstock in Head and Spread training system. • In apple cultivar Super Chief on M-7, the highest fruit yield (6.91 kg/plant) was recorded in Spindle Bush system of training. • In case of apple cv. Gala on M-9 rootstock, maximum fruit yield (7.89 kg/plant) was recorded in Spindle bush system of training.
Punjab Agriculture University, Ludhiana	Pear Plum	Three varieties, 2 rootstocks & four training systems	• Pear varieties grafted on Quince C rootstock recorded 2.5 times lesser tree height as compared to pear plants grafted on kainth rootstock. • Fruit number per plant was maximum in pear plants grafted on Kainth rootstock in Tatura Trellis system followed by modified leader system. • Maximum inverted bottleneck was recorded in Punjab Beauty/ Quince C rootstock combination. • In case of plum, the fruit number per plant in Satluj Purple plum was maximum in Tatura trellis system followed by MLS.
Dr Yashwant Singh Parmar University of Horticulture and Forestry, Solan	Peach	Four training system with two varieties and seedling rootstock	• In Snow Queen nectarine, maximum fruit yield (10.20 kg/plant) was recorded in Espalier System • In case of peach cv Red Haven, maximum fruit yield (11.30 kg/ plant) was recorded in Espalier system, which was statistically at par with Tatura Trellis system.

Oregon Spur on Modified Central leader system

Oregon Spur on Spindle bush system

Oregon Spur on Vertical axis system

Oregon Spur on Espalier system

Oregon Spur on Cordon system

Oregon Spur on Head and Spread system

Fruiting in different training systems at ICAR-CITH, Srinagar

Pear cultivar Starkrimson, Red Bartlett and William Bartlett on different training systems at ICAR-CITH, Srinagar

Espalier system *Y Shape trellis*

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

Extended T Bar System *Pergola System*

Fruiting in Kiwifruit at Tadong Centre Gangtok, Sikkim

Incompatibility on Quince rootstock

Pear on Kainth trained on V axis system

Pear on Kainth trained on Espalier system

Pear on Q C rootstock

Pear on Q C rootstock trained on Espalier system

Pears trained on different systems at PAU, Ludhiana

Vertical Axis system

Espalier system

Head and Spread

Cordon system

Bearing in Jeromine apple trained on vertical axis

Bearing in Jeromine apple trained on spindle bush

Fruiting in Modified Central Leader system

Fruiting in Scarlet Spur on Head and Spread

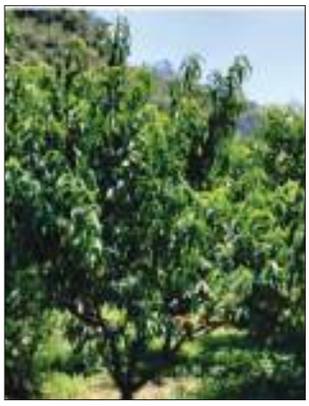
Red Velox on Vertical axis system

Gala on Espalier System of training

Fruiting in different apple cultivars on various training systems at Bajaura, Kullu (Himachal Pradesh)

Tatura system

Espalier system



Open system

Center Leader system

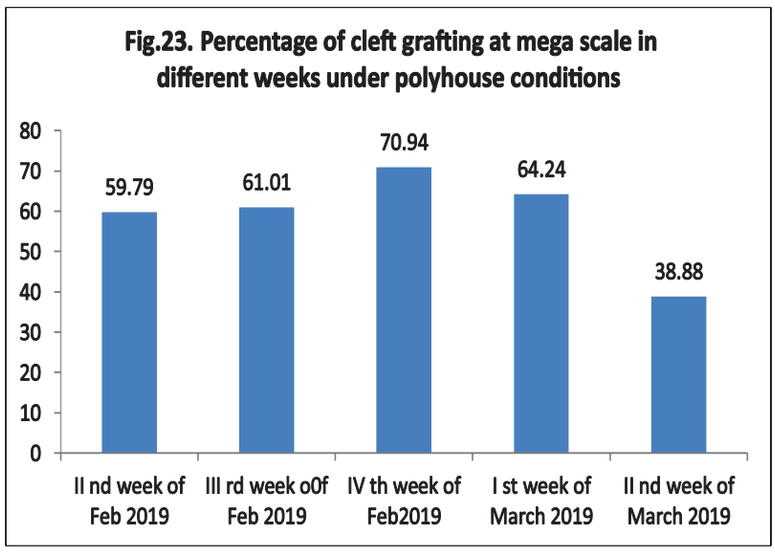
Training systems in Nectarine at Solan

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. So ICAR-CITH, Srinagar along with its Regional station, Mukteshwar started producing vegetatively propagated walnut plants as well as human resource development of staff and farmers of Uttarakhand along with standardization of propagation method and time. The propagation success depends upon many factors and success of different methods varies from region to region due to prevailing microclimate conditions. The walnut propagation was done under the polyhouse conditions due to low temperature outside which is unsuitable for better success at ICAR-CITH, Srinagar.

To study the success of various methods in different dates, different trials were conducted at ICAR-CITH, Srinagar. In first trial, different methods like chip budding, wedge (manual), wedge (machine), cleft and tongue grafting along with one more method with L shape cut on rootstock and inverted L shape cut on scion under polyhouse conditions were tried at different dates starting from 6th February to 20th March. The comparison studies on chip budding at different dates reveals that maximum budding success was recorded in 27th February (4th week of February) while in wedge grafting (manually) it was maximum on 13th February (IInd week of February). The cleft grafting gave maximum success on 6th February (1st week of February) and 13th March (IInd week of March).The Maximum success in Tongue grafting was recorded on 20th February (IIIrd week of February). The new method gave maximum but low success on 13th March (IInd week of March).The wedge grafting performed through machine gave maximum but low success on 4th week of February, IInd and IIIrd week of March indicating unsuitability of these methods for adoption to large scale multiplication. Based on overall comparison it was concluded that chip budding can be practiced from 2nd week of Feb to first week of March, wedge grafting (manual) from 2nd to 3rd week of February, cleft grafting from first week of February to 2nd week of March and tongue grafting from 2nd week to 3rd week of February for obtaining success about 50% and above. These results are based on trial conducted on small population of plants and need further validation in next year. Based on many factors and above results it was found that cleft grafting gives much time span for grafting. Hence the cleft grafting done on large scale in another trial on weekly basis revealed grafting success in different weeks as 59.79 %, 61.01%, 70.94%, 64.24% and 38.88% during IInd ,IIIrd ,IVth week of February, Ist week of March and IInd week of March (Fig. 23). Hence suitable time for cleft grafting is from IInd week of February to 1st week of March to get better success. In another trial, different grafting and budding methods were tried under open conditions on different dates from 22nd February to 22nd March. Chip budding gave maximum success on 4th week of February and 1st week of March while no success was recorded on wedge grafting (manual). Cleft grafting also gave maximum success from 4th week of February to 1st week of March. Cleft grafting in IInd and IIIrd week of March also gave better success. Tongue

and wedge grafting (machine) gave better success in IInd week of March. All these above mentioned trials were conducted on few plants and there may be variation on success when done on mega scale.



During 2019-20, 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. Sufficient rootstocks were planted and grafted /budded during February-March, 2020 for next year supply. This project was also implemented at Regional Station, Mukteshwar where some plants were produced and propagation was also performed for next year supply. During the year, one ten days training program was organized at ICAR-CITH, Srinagar for gardeners from Uttarakhand and one day programme for officers at Regional Station , Mukteshwar. Besides these, three one day training programmes/ demonstrations were organized at Magra, Sony and Silalekh in Uttarakhand (Table 23). The production of more than thousand grafted plants in these locations, showed great impact of training /demonstrations and human resource development conducted last year which is a step that can lead to self sufficiency of grafted plants in future in Uttarakhand.

Table 23. Training/ demonstration programmes organized at various locations

Sr No	Date	Duration	Venue	Training/ demonstration	No. of participants	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	Mukteshwar	Walnut propagation for quality planting material production	41	Officers from Deptt of Forest, Deptt of Horticulture and farmers from Uttarakhand

Glimpses of training programme and Magra, Sony and Silalekh


Glimpses of one day training programmes/ demonstrations organized at 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 project is briefly presented under different sub-projects as below:

Germplasm collection, evaluation and maintenance

No new germplasm could be collected in Allium crops during the year. The onion germplasm maintained at the institute ranged in marketable yield from 18.32 q/ha to 488.90 q/ha and average marketable yield of germplasm was estimated to be 230.54 q/ha. CITH-O-33-1(488.90q/ha) was the highest yielder but at par with check Brown Spanish (468.10). Total soluble solids (%) in germplasm ranged from 7.80 to 19.30 with an average of 13.85. CITH-O-15-2 (19.30) exhibited highest TSS, which was significantly better than check Brown Spanish at (13.20). In garlic germplasm, the marketable yield ranged from 97.90 q/ha to 430.97 q/ha with a mean of 240.91 q/ha and CITH-G-5 (430.97q/ha) showed the highest yield, which was at par with check CITH-G-1 (406.30). Total soluble solids ranged from 30.60% to 45.40 % with an average of 35.14 %. The highest TSS was exhibited by CITH-G-23 (45.40%), which was significantly higher than best check Kodaikanal-Sel-2 (37.90).

Molecular diversity analysis of long day onion and garlic

Diversity analysis of long day onions and their comparison with intermediate and short day onions at SSR loci was initiated during the reporting period in which 27 markers were run in 22 genotypes of long, intermediate and short day origins collected from J&K, HP, Punjab and Maharashtra. The experiment is underway to reach a significant conclusion.

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

Long day onion hybrids/ varieties/ genotypes available in local seed markets and those developed by the institute were evaluated for marketable bulb yield and TSS (%) for recommendation to local onion growers. Among 8 tested entries, highest marketable yield (t/ha) was observed in CITH-O-2 (47.47) and Brown Spanish (44.50) followed by Super Ex (41.03) and Red Coral (37.97). The highest TSS was found in CITH-O-2 (14.87 %) followed by Super Ex (14.30 %).

Flowering induction and true seed production in garlic

Effect of spray treatments of gibbrellic acid and 6-BAP at various concentrations on garlic characteristics linked to true seed production was studied on 6 genotypes. The highest number of flowers per umbel was obtained in CITH-G-3 at 100 ppm BAP (110.30), VLL-2 at 200 ppm GA3 (108.70), CITH-G-3 at 200 ppm 6-BAP (102.1), CITH-G-61 at 50 ppm GA3 (99.7) and CITH-G-3 at 25 ppm 6-BAP (98.30). In conclusion, genotype CITH-G-3 responded better to 6-BAP at different concentrations than any other genotype treated with either 6-BAP or GA3. However, none of the treatment-genotype combination succeeded in producing true seeds.

Fertilizer scheduling through drip irrigation system in onion

In this experiment, none of the irrigation/ fertigation treatments (T1-flood irrigation+100% RFD, T2-drip irrigation +100% RFD, T3- drip irrigation +80% RFD & T4- drip irrigation +60% RFD) showed significant differences from others. Marketable bulb yield produced in different treatments ranged from 40.90 to 45.74 t/ha. However, differences were not significant though quantity of water used (L/season/ha) varied significantly with flood irrigation (T1)being the treatment with highest value (1868229.00). The benefit cost ratio was highest for T1 (2.17) i.e., flood irrigation.

Evaluation of new molecule and its combination for insect pests and disease complex of onion

Among new molecules and their combinations evaluated for insect pests and disease complex of onion, treatment T4 (Fipronil) was most effective for controlling thrips in terms of average number of thrips after treatment (2.27) followed by (5.60)

in T1(Prophenophos+ Cypermethrin) and (5.60) in T3 (Netiram+Pyraclostrobin +Prophenophos+ Cypermetherin) which were statistically at par with each other. However, least per cent damage by insect pests was observed in T4-Fipronil (4.00) which was at par with T3 (5.33) and T1 (8.67).

For controlling Stemphylium blight, minimum incidences (2.67) was recordedin treatments T5 (Propiconazol) while 3.33 percent incidences were recorded in T2 (Metiram +Pyraclostrobin) gave (3.33)and were found at par and most effective followed by 8.00 % in T3 (Metiram + Pyroclostrobin +Prophenophos+ cypermetherin). In case of purple blotch, T4 (2.00) and T2 (4.00) were best and at par with each other..

Seed production of onion and garlic

During the year, the variety wise seed produced in onion& garlic was 7kg of Brown Spanish,& 30.50kg of Yellow Globe in onion while in garlic 137 kg of CITH-G-1 & 86 kg of CITH-G3 was produced

ICAR-CITH, RS Mukteshwar (Uttarakhand)

Onion

Three trials of long day onion namely IET on Long Day Onion, AVT-I on Long Day Onion and AVT-II on Long Day Onion Hybrid, besides a varietal evaluation of released onion varieties were conducted at ICAR-CITH Regional Station, Mukteshwar during rabi extended summer 2018-19. Sixty one genotypes of onion in Toto were evaluated in which which 15 in IET, 13 in AVT-I, 23 in AVT-II Hybrid and 10 in varietal evaluation.

In IET on long day Onion, 15 genotypes were evaluated and higher bulbs yield per plot (8.89 kg/plot and 222.25q/h), maximum average bulb weight (83.46 g), highest TSS content (14.850brix) and minimum storage loss 17.84 % was recorded in OA-18-13. In AVT-I on long day Onion trial, the highest yielding genotype i.e. OB-18-74 (11.59 kg/plot and 289.76q/ha) also exhibited higher values for average bulb weight (99.20 g), plant height (49.26cm), polar and equatorial diameter of bulb (58.53and54.71mm), leaf length (34.68 cm). TSS was recorded maximum in genotype OB-18-69 (14.130B). The weight loss percentage during two months of storage was minimum (6.34 %) in OB-18-74.In AVT-II on Long day Onion hybrid, maximum yield (11.53 kg/plot and 512.69 q/ha) was recorded OC-18-97 while the genotype OC-18-88 exhibited maximum plant height at harvest (56.38 cm), average bulb weight (110.66 g), polar and equatorial diameter of bulb (69.55and 59.55mm). TSS was recorded maximum in genotype OC-18-84 (15.260Brix) while maximum double bulbs % (59.00 %) was recorded in OC-18-96 and minimum (4.33 %) in OC-18-88. The minimum weight loss of 11.91 % was recorded in OC-18-88

In varietal evaluation trial, maximum yield (7.51 kg/plot and 162.16 q/ha) was recorded in Bhima Super while maximum average bulb weight (64.40 g) was recorded in Bhima Raj. TSS was recorded maximum in genotype Bhima Raj (14.680Brix) and minimum storage loss of 16.21 % was recorded in Bhima Red.More importantly it is observed that no any symptoms and occurrence/ incidence off specified and other diseases, insect pests were found in the crop during the growth and development period in the genotypes tested under various trials.

Garlic

In garlic total of 17 genotypes of long day garlic were tested out of which 8 under AVT-I and 9 under AVT-II were evaluated for various traits during rabi extended summer 2018-19.

In AVT-I trial, GN-17-25 was found at top in term of bulb yield (4.45 kg/plot and 197.77q/ha) The highest average bulb weight of 40.06g was recorded in GN-17-21.The highest average clove weight of 6.78 g recorded in GN-17-21. The total soluble solid content was found maximum in genotype GN-17-08(41.600 B) followed by GN-17-19 (40.360 B) and GN-17-03(40.200 B). The weight loss percentage during two months of storage was minimum (2.44 %) in GN-17-25.In AVT-II trial, GN-15-78 produced maximum bulb yield(5.29 kg/plot and 235.11q/ha) while maximum average bulb weight (47.20 g) was recorded in GN-15-78. The average clove weigh was recorded maximum in GN-15-78 (4.53 g). The genotype GN-15-52 recorded maximum number of cloves per bulb (13.60) while maximum TSS of 41.300brix was recorded in genotype GN-15-78. The storage loss was recorded minimum (2.55 %) in GN-15-85 during two month storage.

As far as disease and insect pests are concerned, neither any disease nor any insect incidences/ attack on any genotype of study was observed during the crop growth and development period in the germplasm of both the trials.Apart from evaluation of long day onion & garlic under various AINRP (Onion & Garlic) trials, the station has maintained five germplasm lines (Local Selections) and also produced 362kg seed bulbs of different selections as well as three released varieties i.e..i.e. CITH-M-G-1, BhimaOmkar and Bhima Purple. Further the var. CITH-M-G-1 also demonstrated at farmer's field at 14 farmers fields of Sunkiya village.

AVT-I on long day garlic

AVT-II on long day garlic

All India Coordinated Research Project (Vegetable Crops)

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

ICAR-CITH, Srinagar

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

Collection, evaluation, conservation and utilization of germplasm

Five new collections in chilli, one in paprika and two in kale were made during the year 2019-20. The details of collection are presented in the Table 24.

Table 24.Number of collections made in different crops

Crop	Collection name	Source	Form in which collected
Chilli	CITH Chilli-2	Dirang, Arunachal Pradesh	Dried fruit
	CITH Chilli-3		Dried fruit
	CITH Chilli-4		Dried fruit
	CITH Chilli-5		Dried fruit
	CITH Chilli-6		Dried fruit
Paprika	CITH Paprika-2	Srinagar	Fresh fruit
Kale	CITH Kale-1	Srinagar	Seed
	CITH Kale-2	Srinagar	Seed

Varietal and hybrid trials

The trials conducted during the reporting year alongwith number of entries tested in different crops are presented in Table 25.

Table 25. Number of trials conducted in different vegetable crops

Crop	Trial	Number of entries tested
Chilli	IET (hybrid)	6
	AVT-I (hybrid)	5
	AVT-II (hybrid)	6
	IET (variety)	6
Capsicum	IET (variety)	4
Determinate tomato	AVT-I (hybrid)	4
	AVT-II (hybrid)	7
	IET (variety)	6
	AVT-I (variety)	9
	AVT-I (variety)	12
Indeterminate tomato	IET (variety)	7
Cherry tomato	IET (variety)	5
	AVT-I (variety)	6
Round brinjal	AVT-I (variety)	7
	AVT-II (variety)	9
Long brinjal	IET (variety)	9
	AVT-I (variety)	9
	AVT-II (variety)	2
Small round brinjal	AVT-I (variety)	5

CITH Chilli-2 *CITH Chilli-3* *CITH Chilli-6* *CITH Chilli-5* *CITH Chilli-6*

Chilli collections made from Arunachal Pradesh

ICAR-CITH, Mukteshwar

The results of various trials on different crops like cherry tomato, parthenocarpic cucumber, pea, French bean and radish are presented experiment wise below:

Cherry tomato (AVT-I)

Nineteen genotypes of cherry tomato were evaluated during summer extended rabi 2019-20 and most of lines exhibited significant differences for various growth, and yield parameters (Table.26). Maximum plant height of 286.80 cm was recorded in 2016/TOCVAR-5 Maximum average branch length of 176.16 cm was recorded in genotype Pusa Cherry hybrid-1 and maximum number of branches per plant was recorded in 2016/TOCVAR-6(8.62). The maximum plant spread East-West were recorded in CITH-M-CT-7 (96.76 cm) while maximum plant spread north-south was recorded in 2016/TOCVAR-3 (108.45 cm) Three top ranking genotypes for average fruit weight were CITH-M-CT-1, CITH-M-CT-4 and CITH-M-CT-3 with 10.26 g, 7.66 g and 7.06 g, respectively. The genotypes Pusa Cherry Hybrid-1 was recorded maximum number of fruits per plant (186.10) followed by CITH-M-CT-5 (177.73) and CITH-M-CT-6 (167.30). However, maximum fruit length of 35.77 mm and 35.01 mm were recorded in CITH-M-CT-7 and 2016/TOCVAR-4, respectively.

Table 26. Evaluation of cherry tomato genotypes for various traits

S. No.	Genotypes	Plant height (cm)	No. of branches /plant	Av. branch length (cm)	Plant spread (E-W) cm	Plant spread (N-S) cm	Fruit length (mm)	Fruit breadth (mm)	Av. fruit weight (g)	Total no. of fruits/ plant	Total fruit yield/ plant (g)	Fruit yield (q/ ha)
1.	CITH-M-CT-1	131.527	3.600	91.833	46.827	45.093	29.767	25.333	10.267	123.800	1271.05	423.68
2.	CITH-M-CT-2-Red	128.753	4.600	90.100	50.180	44.400	20.830	21.867	6.800	156.600	1064.88	354.96
3.	CITH-M-CT-2-Yellow	155.573	3.333	110.880	50.793	49.087	19.990	20.500	6.133	132.400	812.01	270.67
4.	CITH-M-CT-3	93.540	3.533	71.573	37.387	37.393	19.917	21.567	7.067	98.400	695.39	231.80
5.	CITH-M-CT-4	135.787	3.867	98.320	40.347	36.480	30.953	17.300	7.600	104.667	795.47	265.15
6.	CITH-M-CT-5	174.953	3.733	123.820	56.267	45.947	27.640	16.200	5.067	177.733	900.57	300.19
7.	CITH-M-CT-6	90.500	3.000	100.610	90.340	40.780	24.287	23.927	2.960	167.300	495.21	165.07
8.	CITH-M-CT-7	101.750	3.500	77.620	96.760	41.310	35.770	21.127	4.695	115.400	541.80	180.60
9.	2016/TOCVAR-1	94.140	2.300	73.700	39.867	36.510	27.357	21.867	4.034	83.900	338.45	112.82
10	2016/TOCVAR-2	107.510	2.700	98.820	45.840	39.380	26.190	21.047	3.337	120.500	402.11	134.03
11.	2016/TOCVAR-3	179.735	4.750	122.388	62.125	108.450	22.177	23.337	4.030	133.200	536.80	178.93
12.	2016/TOCVAR-4	192.413	6.625	134.663	68.538	53.200	35.010	21.857	4.614	142.800	658.88	219.62
13.	2016/TOCVAR-5	286.800	6.875	133.300	94.238	82.363	21.070	21.367	3.572	135.800	485.08	161.69
14.	2016/TOCVAR-6	256.650	8.625	126.875	75.700	65.825	26.475	26.930	4.652	129.400	601.97	200.65
15.	CITH-M-CT-2 Red 2018/15	144.838	3.750	109.875	45.938	43.975	31.427	23.127	4.867	120.600	586.96	195.65
16.	CITH-M-CT-2 Red (2018/1)	81.075	3.000	50.100	46.800	43.650	31.918	22.197	4.075	138.000	562.35	187.45
17.	CITH-M-CT-2 Red (2018/3)	78.825	3.125	53.563	45.400	42.138	32.618	22.511	4.262	96.300	410.43	136.81
18.	CITH-M-CT-2 Red (2018/2)	84.837	3.000	58.613	48.050	40.075	32.342	22.239	4.636	96.700	448.30	149.43
19.	Pusa Cherry Hybrid-1	279.963	6.000	170.165	69.138	62.013	24.272	25.079	3.607	186.100	671.26	223.75
	CD at 5%	**22.31**	**0.832**	**25.07**	**6.10**	**6.22**	**2.97**	**1.99**	**1.233**	**29.13**	**40.96**	**13.65**

Fruiting and fruit of different tomato genotypes

Maximum fruit breadth 26.93 mm was recorded in genotype 2016/TOCVAR-6 followed by CITH-M-CT-1 (25.33 mm).Among the genotypes, CITH-M-CT-1 recorded maximum fruit yield of 1271.05 g/plant and 423.68 q/ha followed by 1064.88g/plant and 354.96 q/ha in CITH-M-CT-2-Red.

Parthenocarpic Cucumber (AVT-I)

Four genotypes of parthenocarpic cucumber were evaluated and significant differences for most of the traits under study except fruit width and number of fruits per plant. Among the genotypes, Japanese Long Green variety recorded highest values for plant height (401.90 cm), fruit length 34.18 cm and fruit yield/plant (5.234 kg). The highest total fruit yield q/ha (353.71) recorded in Pant Parthenocarpic Cucumber-3 followed by 348.94 q/ha in Japanese Long Green. However, maximum number of fruits/plant (17.53) and fruit width of 49.69 mm was recorded in Pant Parthenocarpic cucumber-2. The average fruit weight of 0.332 kg was recorded in Pant Parthenocarpic Cucumber-3.

Fruiting and fruit of different cucumber genotypes

French bean (IET)

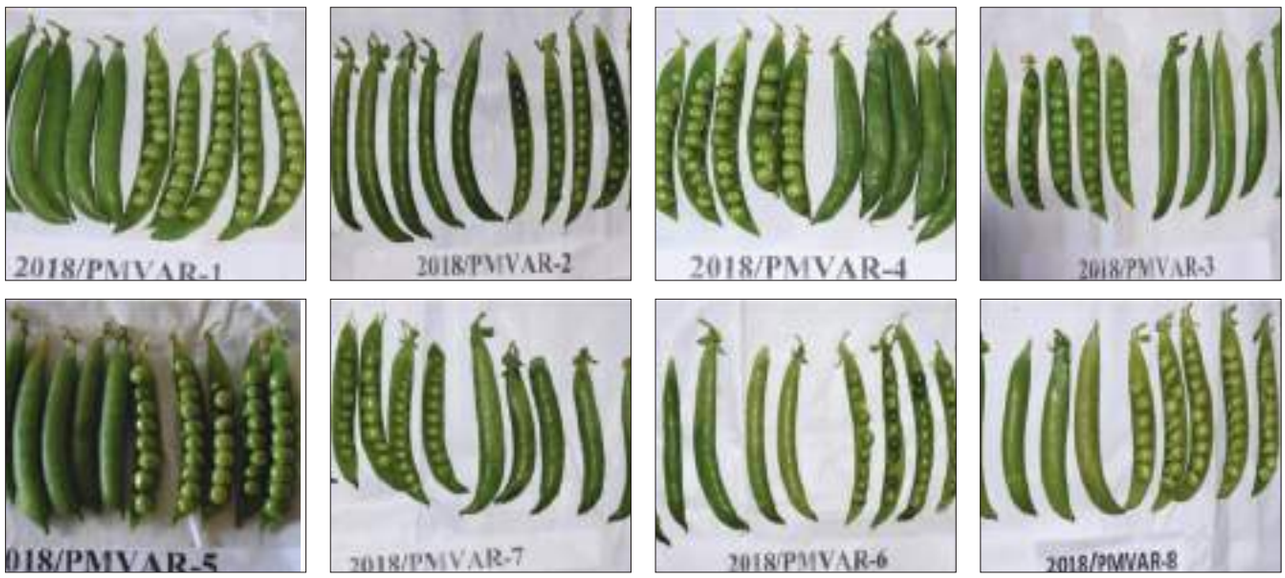
Eleven genotypes of French bean were evaluated during Kharif 2019-20 and maximum pod length (12.78 cm) was recorded in genotype Arka Suvidha. The genotype 2017/FBBVAR-2 exhibited heaviest pod weight (6.53 g) while maximum number of pods/plant (26.53), average pod yield/plant (148.59 g) and pod yield (742.93 q/ha) were recorded in genotype CITH-FB-1

Garden Pea Mid (IET)

Eight genotypes of Garden pea were evaluated and maximum plant height (92.14 cm), pod yield/m^2 (1152.67g) and pod yield q/ha (115.27) were recorded in genotypes 2018/PMVAR-3. The maximum pod length (11.47 cm), number of pods/kg (216.16) and number of seeds/pod (9.33) was recorded in genotypes 2018/PMVAR-1, 2018/PMVAR-4 and 2018/PMVAR-6, respectively.

Garden Pea Early (AVT-I)

Seven genotypes of Garden pea were evaluated maximum number of pods/kg (334.15) was recorded in 2018/PEVAR-7. Highest total pod yield/m^2 (1149.33 g) and q/ha (114.93) was



Pods of different pae genotypes

recorded in 2018/PEVAR-4. However, number of pods per kg and number of seed per pod found were maximum in genotype 2018/PEVAR-7 and/ PEVAR-I respectively.

Garden Pea Edible Pod (IET)

Eight genotypes of Garden pea were evaluated and maximum pod length (10.52 cm) was recorded in genotypes 2018/PEDAVR-7 while pod yield/ m^2 (2698.67 g) and q/ha (269.87) was recorded heighest in genotype 2018/PEDAVR-5.

Radish (AVT-I)

Seven genotypes of radish were evaluated and genotypes exhibited significant differences for most of traits under study except root length and root width. Among the genotypes, RADVAR-6 recorded maximum plant height of (47.85 cm) and leaf length (41.22 cm). However, leaf width (11.86 cm) and root width (35.26 mm) were recorded maximum in the genotype RADVAR-1. Genotype RADVAR-5 produced maximum number of leaves/plant (15.13) as well as longest root (30.04 cm). Highest total leaf yield/plant (125.86 g), root weight/plant (191.06 g) and average root yield (477.67q/ha) was recorded in RADVAR-2.

National Mission for Sustainable Himalayan ecosystem (TF-6)

This project was implemented at ICAR- CITH, Srinagar and Regional station Mukteshwar.

Roots and leaves of different radish genotypes

During the report year work was carried out at at Regional station Mukteshwar. Theproject was started in 2015 and at Mukteshwar initial stage, 03 villages namely Sunkiya, Nainital (UK); Jurkfun, Almora (UK) and Kumahali, Shimla (HP) were selected for implementing the project activities at the farmers fields of the stated villages. During the year 2019-20, demonstrated tomato cv. CITH-M-T-5 and T-3150; cabbage hybrids Varun, Krishna and Green Cornet; broccoli cv. KTS-1, garden pea cv. VL-13 at 14 farmers' fields in Sunkiya village. Similarly, long day onion cv. VL- Piyaz-3 and garlic cv. CITH –M-G-1 Bhima Omkar and Bhima Purple were demonstrated at 27 farmers field in Sunkiya and Jurkafun villages. Likewise, the potato cv. Kufri Grindhari was also demonstrated at 32 farmers field of both the villages. The tomato cv. CITH-M-T-5 produced average fruit yield of 3.0 kg/plants and pea cv. VL- 13 registered pod yield of 210.0 g per m^2 in open field condition at farmers field of Sunkiya village. The Onion cv. VL Piyaz-3 recorded average bulb yield of 4.50 kg m^2. Likewise garlic cv. CITH-M-G-1 produced 10.73 kg and 8.10 kg bulbs per one kg. of seed cloves in Sunkiya and Jurkafun village, respectively. Whereas garlic cv. Bhima Omkar and Bhima Purple registered 6.08 kg and 5.94 kg. bulb yields per one kg. of seed clove in Sunkiya village. However, potato cv. Kufri Giridhari registered 12.0 kg tuber yield from one kg. of seed tuber in Sunkiya village. The plant growth parameters recorded on the preceding years plantation of fruit crops under the project in Sunkiya and Jurkafun villages. On the basis of average of plant height of fruit crops viz, plum cv. Santrosa (126.06 cm), apricot cv. CITH-A-3 (231.8 cm) apple cv. Oregon Spur (135.14 cm), Kiwi fruit cv. Tomuri (193.43cm) malta (254.98 cm) and Kagzi Lime (24.84 cm), in Sunkiya and plum cv. Santrosa (125.55 cm) peach cv. Paradelux

Glimpses of Activities undertaken under NMSHE (TF-6)

Tomato crop in polyhouse condition & capsicum in open field in Sunkiya village

Potato distribution, training & pruning in peach and kiwi fruit in Jurkafun village

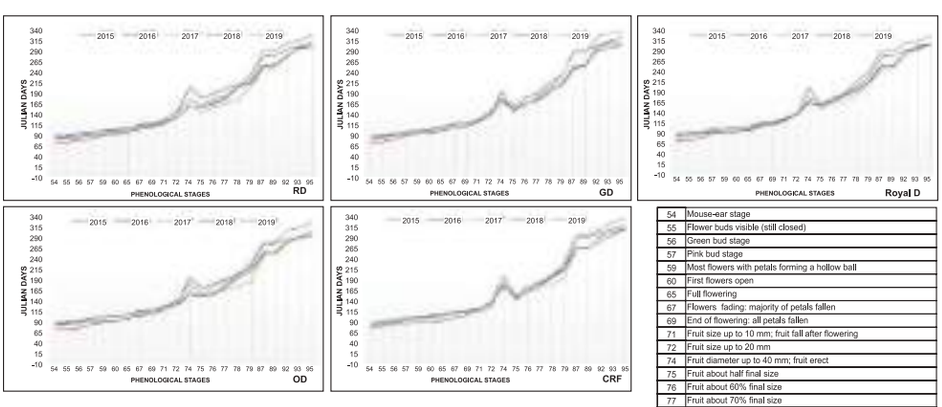
Potato distribution & field visit in Sunkiya village

(221.1 cm), Apricot cv. CITH-A-1(350.55 cm) , Kiwi fruit cv. Tomuri (105.8 cm), Malta (41.29 cm) and Kagzi Lime (38.5 cm) in Jurkafun village are found climate resilient fruit crops. Similarly, tomato cv. VL-4 and CITH-M-T-5, Capsicum cv. California Wonder and Bharat, broccoli cv. KTS-1, onion cv. VL Piyaz- 3 garlic cv. CITH-M-G-1, and potato cv. Kufri Giridhari found suitable for growing in the region under changing climatic condition.

Besides, 13 visits, 02 Kishan Goshties, 05 training cum- awareness programmas were conducted in the Sunkiya village, and in Jurkafun village, 01 training, 01 FAP, 1 Review meeting of NMSHE (TF-6) and 09 visits were organised during the year 2019-2020.

National Innovations on Climate Resilient Agriculture

During 2015 to 2019 different phenological stages in apple cultivars (Red Delicious, Golden Delicious, Royal Delicious, Oregon Spur and Coe Red Fuji -according to BBCH scale- 54 phenological stages) and walnut cultivars (CITH-W-1 and CITH-W-2) as influenced by climatic variability, from dormancy to senescence was monitored. A variation in duration and timing of various phenological stages, as influenced by climatic variable in apple and walnut during 2015, 2016, 2017, 2018 and 2019 was revealed. The main phonological stages of all the five cultivars observed in apple and two walnut cultivars at ICAR-CITH, Srinagar during the last 5 years are shown in Fig. 24 to 28 and Fig. 29 and 30, respectively.

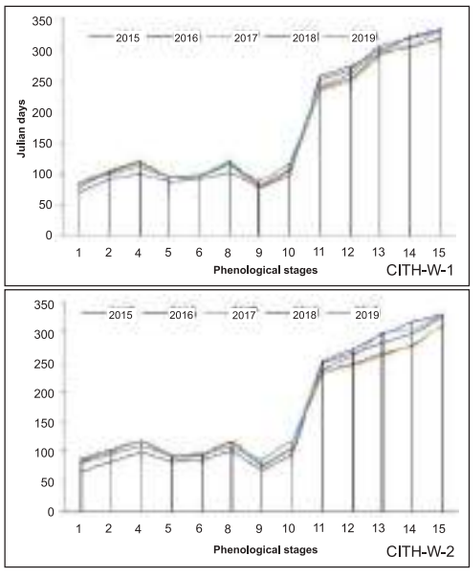


54	Mouse-ear stage
55	Flower buds visible (still closed)
56	Green bud stage
57	Pink bud stage
59	Most flowers with petals forming a hollow ball
60	First flowers open
65	Full flowering
67	Flowers fading: majority of petals fallen
69	End of flowering: all petals fallen
71	Fruit size up to 10 mm; fruit fall after flowering
72	Fruit size up to 20 mm
74	Fruit diameter up to 40 mm; fruit erect
75	Fruit about half final size
76	Fruit about 60% final size
77	Fruit about 70% final size
78	Fruit about 80% final size
79	Fruit about 90% final size
87	Fruit ripe for picking
89	Fruit ripe for consumption
92	Leaves begin to discolour
93	Beginning of leaf fall
95	50% of leaves discoloured

IE : Inflorescence emergence; F: Flowering; FD : Development of fruit; M: Maturity of fruit; S: Senescence

Advancement/Delay in phenological stages as influenced by mean temperature in (a) Red Delicious, (b) Golden Delicious, (c) Royal Delicious, (d) Oregon Spur and (e) Coe Red Fuji apple

Fig 24 to 28. Advancement/delay in phenological stages in different apple cultivars during last 5 years.



Code	Phenological stage
01	Initiation of catkin growth
02	1st male bloom
04	Last male bloom
05	Initiation of female flowering
06	1st female bloom
08	Last female bloom
09	Initiation of leaf bud
11	Hull splitting stage
12	Harvesting stage
13	Leaves began to discolor
14	50 per cent leaf discolor
15	All leaves fallen

Advancement/Delay in Phenological stages as influenced by mean temperature in CITH-Walnut-1 and CITH-Walnut-2 during last five years

Fig 29 & 30. Advancement/delay in phenological stages in CITH-W-1 and CITH-W-2 during last 5 years.

MEETINGS AND EVENTS

During the year 2019-20, ICAR- CITH, Srinagar and its Regional Stations viz. Mukteshwar & Dirang organized many events and meetings which are presented below and summarized in the Table 27.

Union Minister of State for Agriculture and Farmers Welfare visits ICAR-CITH, Srinagar

Union Minister of State for Agriculture and Farmers Welfare, Sh. Kailash Choudhary made a maiden visit to ICAR-Central Institute of Temperate Horticulture, Srinagar on 26th September, 2019. During his visit he interacted with Scientists & Staff of institute and farmers/ orchardists. He was appraised about the new technologies developed by ICAR-CITH, Srinagar by Dr. D.B. Singh, Director of the Institute. Sh. Choudhary appreciated the efforts made by ICAR-CITH to uplift the socio-economic status of farming community. Hon'ble Minister visited the experimental fields and technology park where scientists explained the field trials and extension activities of the Institute. He emphasized on production of quality planting material/ seed for distribution to farmers of the area. He also emphasized on extension services for speedy transfer of technologies. He further advised youth of valley to take advantage of various schemes implemented by Government of India.

Address by Sh. Kailash Choudhary, Union Minister of State for Agriculture and Farmers Welfare

Workshop cum Apple day organized at ICAR-Regional Station, Mukteshwar

Apple day cum workshop on Climate resilient apple production technologies for enhancing farmer's income was organized at CITH, Regional Station, Mukteshwar on 23rd October, 2019 in which more than 190 farmers participated. The guest dignitaries were Dr R.K. Singh, Director, ICAR-IVRI, Mukteshwar and Dr Debajeet Sharma, Director ICAR-DCFR, Bhimtal. Besides these scientist from ICAR-IVRI, IARI and VPKAS, Almora, and staff from line departments also participated. Lectures on various topics pertaining to climate resilient horticulture production were delivered by concerned scientist, chief guest, special guests & guest of honour and questions raised by farmers were well addressed & discussed by concerned officer/ technocrats. Farmers were also made aware about the various

Glimpses of the Apple Day Programme

schemes/subsidies available with the various state departments. In this programme an apple exhibition was also organized. The queries raised by the farmers were also discussed during the interaction session. Farmers were also taken to the field for live demonstration of different apple cultivars, training structures and planting densities. Apart from this, two publications (Pamphlets) of station were also released during the occasion.

16th Research Advisory Committee Meeting

The 16th meeting of RAC was held on 27& 28th December, 2020 at ICAR-CITH, Srinagar under the Chairmanship of Dr. K. R. Dhiman, Former-Vice Chancellor, Dr. YSPUHF, Nauni, Solan. The members of RAC Dr. W. S. Dhillon, Dr. J. C. Rana, Dr. A. Das Munshi, Dr. M. K. Verma, Shri Desh Kumar Nehru, Dr. Desh Beer Singh, Dr. O. C. Sharma and the scientists of ICAR- CITH attended the meeting. On 27th December, 2020, Dr D B Singh, Director CITH made a presentation on action taken report on recommendation of previous RAC followed by presentation by scientists/ PI's of CITH main campus & that of RS Mukteshwar on the progress reports of various research programmes under Crop Improvement, Crop Production, Crop Protection, Post Harvest Management and externally funded projects. On 28th December, 2020, RAC members visited nursery, experimental field, labs and recommendations were discussed and finalized by committee.


Presentation and discussion during RAC meeting

15th Institute Research Council Meeting

The 15th Institute Research Council Meeting was held on 17th &18th September, 2019 under the chairmanship of Dr D B Singh, Director CITH, Srinagar. All the scientists participated in the meeting. Project wise presentations were made by different PI's and results/outcomes along with the activities to be taken up in next year were discussed in details. The presentation on Research


Presentation and discussion during IRC meeting

Projects from Regional Station, Mukteshwar was made by Dr Raj Narayan, Principal Scientist & In charge of the Station. The Chairman gave critical inputs on experimentation for obtaining realistic and reproducible results.

13th Institute Management Committee Meet

ICAR-Central Institute of Temperate Horticulture, Srinagar organized 13th Institute Management Committee Meeting on 28th December, 2019. The meeting was chaired by Dr Desh Beer Singh, Director, ICAR-CITH, Srinagar. During the meeting action taken report of 12th IMC and agenda items for the year 2015-16 to 2018-19 were presented by Dr Javid Iqbal Mir, Member Secretary 13th IMC. Discussion on agenda items including research achievements w.e.f. 2015-16 to 2018-19 was made and suggestions were included in the proceedings.

Presentation and discussion during IMC meeting

Table 27. List of various events organized during the year 2019-20

Sr. No	Event	Date	Organizers/ Coordinators
1.	Interaction visit of Union Minister of State for Agriculture and Farmers Welfare	26th September, 2019	All staff
2.	Workshop cum Apple day	23rd October,2019	Raj Narayan & Arun Kishor
3.	16th Research Advisory Committee meeting	27&28th December, 2029	O C Sharma
4.	15th Institute Research Council Meeting	17th &18th September, 2019	O C Sharma
5.	13th Institute Management Committee Meeting	28th December, 2019	J I Mir
6.	Vigilance Awareness Week	28th October to 2nd November,2019	Anil Sharma, Geetika Malik & K L Kumawat
7.	Hindi Week	21st September to 27th September, 2019	Geetika Malik & K L Kumawat
8.	Inter-institutional Sports Meet	12th to 14th December, 2019	J I Mir
9.	International Yoga Day	21st June, 2019	K L Kumawat
10.	Swachh Bharat Mission 1.Swachhta Hi Seva 2.Swachhta Pakhwada	3rd October to 10th October, 2019 16th December to 31st December, 2019	K L Kumawat & F A Dar W H Raja
11	Kisan Diwas	23rd December, 2019	K L Kumawat

Hindi Week

Hindi Week was observed at ICAR-Central Institute of Temperate Horticulture, Srinagar from 21st September to 27th September, 2019 for compliance of official language policy. To promote the Hindi language, many competition like essay writing, word translation, poster writing, quotation writing and ex tempo competition were organized on different days in which permanent and contractual staff of ICAR-CITH, Srinagar, IGFRI RS Srinagar, NBPGR RS Srinagar participated. In valedictory function, Hindi Committee and Director ICAR-CITH Srinagar highlighted the importance of Hindi and advised the staff to work more in Hindi. The winners of various functions were felicitated with cash prizes. Hindi week was also celebrated at ICAR-CITH, RS Mukteshwar from 14th to 20th September and various programmes were organized.

Vigilance Awareness Week

Vigilance Awareness Week for the year 2019 was observed at ICAR-Central Institute of Temperate Horticulture, Srinagar from 28th October to 2nd

Glimpses of competitions and prize distribution in Hindi week

November, 2019. Various events as per ICAR's directive were organized during the week to create and nurture awareness among employees and workers against corruption and its ill effects in workplace & personal life. Various activities, as decided by committee and Director, were

Oath ceremony *Debate* *Poem*

Essay writing *Valedictory function*

Glimpses of competitions and prize distribution in Vigilance week

organized during the week. Both permanent as well as contractual staff of the institute took part in all events and competitions with enthusiasm and zeal. The play 'Laeji te choer Gaej te choer' was directed and presented by the contractual field workers of the institute. The play highlighted rampant corruption in our society leading to exploitation of the worthy and unfair benefits to undeserving and received immense applaud by the audience. Prizes and certificates were presented in different categories of competitions & events to motivate and appreciate position holders & participants during the closing ceremony that ended with wise words of the Director. The week was also observed at ICAR-CITH, RS Mukteshwar and various events/ programmes were organized by scientists, technical, administrative and field staff.

Fire Service Week

Fire service week was observed at ICAR-CITH, Srinagar from 14th to 20th April, 2019 in collaboration with Air Force Unit, Srinagar. During this week all staff of the Institute was made aware about causes and measures to be adopted for check fire incidences. On 16th April, 2019 lectures were delivered by air force personnel and Director ICAR-CITH, Srinagar followed by demonstration for controlling the fire.

Inter-Institutional Sports meet at Kanpur

ICAR-CITH, Srinagar participated in inter-institutional sports meet organized by IIPR, Kanpur at IIT, Kanpur from 12 to 14th December, 2019. During the event contingent participated in different events like race (s), long jump, high jump, carom, chess, badminton, table tennis, volley ball etc. The performance of the participants was very good. Institute won best team award for March Past during inter institutional sports meet.

ICAR-CITH team with trophy during sport meet

Lecture and demonstration during Fire Service Week

International Yoga day

ICAR-Central Institute of Temperate Horticulture, Srinagar enthusiastically celebrated 5th International Yoga Day on 21st June, 2019. Dr. Manoj Kumar, Programme Coordinator & Head, KVK, Baramulla gave brief talk about the importance and need of yoga invigorating overall mental and physical status of a person. Dr. D.B. Singh, Director, ICAR-CITH gave brief

Glimpses of International Yoga day

talk on positive influences of yoga, how yoga offer a great relief to stressful lives and benefit of different yoga asanas on our physical and mental health. All scientific, administrative, technical & supporting staff of ICAR-CITH, Srinagar, staff of ICAR-NBPGR-RS, Srinagar and ICAR-IGFRI-RS, Srinagar performed different asanas of yoga. Proper scientific instructions were given for all the yoga asanas by Dr. Manoj Kumar & Dr. D.B. Singh and all the participants performed it as per instruction. Various asanas like Vrikshasana, Tadasan, Trikonasana, Paschimottan, Ardha Halasana, Vajrasana, Balasana, Shavasana, Kapalbhati, Pranayama and Butterfly etc. were performed and its uses were told to all. The programme ended with Shanti prayer. All the staff members showed extra zeal and enthusiasm while performing and participating in this great event.

Swachh Bharat Abhiyan

Swachh Bharat Mission was observed at main campus and Regional station, Mukteshwar.

ICAR-CITH Srinagar

Two programmes under Swachh Bharat Abhiyan were organized in the institute during the year 2019-20. One week programme on Swachhta Hi Seva was observed from 3rd October to 10th October, 2019 on the occasion of 150th Birthday of Father of Nation (Mahatama Gandhi) while other 16 days Swachhta Pakhwada was observed from 16th December to 31st December, 2019 at ICAR-CITH, Srinagar. An oath taking ceremony was organized in the campus in the presence of Director before proceeding to the routine Swachhta activities. For foresting healthy competition among the participant's, activities like essay writing, quiz, expert's talks, and a Swachhta related movie was also played to create awareness among the staff members. Swachhta awareness at local level (organizing sanitation campaigns) involving farmers and villagers, technology demonstrations on agricultural waste management and safe disposal of all kinds of wastes were also organized. Kisan Diwas on 23rd December 2019 was also organized involving local farmers to create necessary awareness and progressive farmers were also felicitated in the occasion. During these programmes, all the participants showed great zeal and enthusiasm while performing this duty in making our country cleaner and beautiful. The participants were also felicitated at the end of the programmes.

ICAR-CITH, Regional Station Mukteshwar

Swachhchata Hi Sewa Abhiyan was observed from 11th September to 2nd October, 2019. Day to day cleaning of the station premises was done from 9 to 10 am during all the working days in which roads, channels, temple, water bodies as well as office, laboratories, farm office, surrounding of the residential quarters of the premises were cleaned and collected garbage were disposed off. Besides, awareness was also created on Swachchta, harmful effect of plastic & single use plastic. An emphasis

Pledge and other activities carried out under Swachh Bharat Mission

has been also given on no to single use plastic and Swachchta Abhiyan March was also organized on cleanliness. During the activity conducted under Mera Gaon Mera Garurav in Sunkiya village, awareness on Swachhchta and no to single use plastic was also created. On 2nd October gave ever respect to the Pujya Rastrpita Mahatma Gandhi Ji and Shri Lal Bahdur Shastri Ji to remember their contribution and devotion to the nation. Beside a lecture on clean water, green earth to save life was delivered to create awareness to the staff and workers as well as students & employees of Government High School, Malla Ramgarh. Apart from these activities, awareness among watsapp group/ member were shared through massage on Swachchta and Plastic free India on 2nd October, 2019.

EXTENSION AND OTHER PROGRAMMES

There is a lot of scope for increasing area, production and productivity of quality produce of temperate horticultural crops in different region of country having temperate climatic conditions. A lot of research work has been carried out on temperate horticultural crops for generation of farmer friendly technologies which will boost farm production and ultimately uplift socioeconomic status of farmers. These technologies need to be popularized among the stakeholders through various extension agencies because the adoption of latest technologies by farmers is still not up to mark. The temperate regions of country like J&K, Himachal Pradesh, Uttarakhand and parts of North-Eastern states like Arunachal Pradesh, Sikkim etc. are hub of temperate fruit cultivation. The major challenges in horticulture sector include sustainability, higher levels of production, competitiveness to stay in market, regular production, land, water and more importantly threat of climate change. The Central Institute of Temperate Horticulture, Srinagar and its regional stations are putting continuous efforts to make the farmers/ officers of line departments aware of various new technologies generated in temperate horticultural crops for improving productivity of quality produce. The Institute has tried to disseminate various technologies by organizing number of programs for human resource development. For the quick adoption of technologies, ICAR-CITH is continuously organizing vocational trainings, model training courses, crop days, on campus and off campus trainings as well as demonstrations, kisan ghoshtis, farm visits, diagnostic visits, supply of quality planting material, publication in local languages, participation in farmer fairs, radio talk, TV shows and display of exhibits on various occasions/ farmers fair etc. The details of various programmes organized by ICAR-CITH during 2019-20 are presented under various heads.

Training programmes organized for officers.

The various training programmes organized during 2019-20 for officers and other staff of different line department is summarized in Table 28 and detail is presented programmes wise.

Five days training programme for officers organized.

A five days training programme on Recent Advances in High Density Orchard Management Systems in Temperate Fruit Crops was organized for the officers from Department of Horticulture, Himachal Pradesh w.e.f. 1st August to 5th August, 2019 at ICAR- CITH, Srinagar. In this training

Table 28. List of training programmes organized for officers/ staff of line department

Sr No.	Name of Programme	Venue	Date	No. of Partici-pants	Organizers/ coordinators
1	Recent Advances in High Density Orchard Management Systems in Temperate Fruit Crops for Horticulture officers from Himachal Pradesh	ICAR-CITH, Srinagar	1st to 5th August, 2019	25	O C Sharma, J I Mir, K L Kumawat and W H Raja
2	Vegetative Propagation in Walnut for gardeners from Department of Forest, Uttarakhand	ICAR-CITH, Srinagar	18th to 27th February, 2020	9	O C Sharma, J I Mir and W H Raja
3	Cultivation technology of major exotic vegetable crops	ICAR-CITH, Srinagar	31st December,2019	8	Geetika Malik
4	Walnut Propagation	Magra	5th Feb,2020	44	O C Sharma
5	Walnut Propagation	Sony	7th Feb, 2020	32	O C Sharma
6	Walnut Propagation	Silalekh	9th Feb, 2020	68	O C Sharma
7	Walnut propagation for quality planting material production	Mukteshwar	10th Feb, 2020	30	Raj Narayan, Arun Kishor & O C Sharma
8	Others (Farm visit of AFWWA, Srinagar)	ICAR-CITH, Srinagar	18th April, 2019	120	O C Sharma & Sheeba Verma

programme total 25 officers including SMS, HDO, and HEO participated. During the programme officers were exposed to various technologies generated at ICAR-CITH, Srinagar in fruit crops especially pertaining to recent advances in high density plantation. The training was a good blend of lectures, practical demonstrations and farm visits on various aspects, like canopy architectural engineering in high density plantation, training and pruning, rootstock and varietal diversity, plant protection measures, post harvest management and nursery production etc. Farm visits to various organizations were also organized. The training programmes was largely appreciated by the participants, with the zeal to disseminate these technologies in farmer fields.

Glimpses of training programme for officers

Ten days training programme on vegetative propagation in walnut for forest staff of Uttarakhand

A ten days training programme on vegetative propagation in walnut for staff of forest department of Uttarakhand was organized by ICAR-CITH, Srinagar w.e.f. 18th to 27th February, 2020. Nine gardeners from Deptt of Forest Uttarakhand attended the training programme. The programme

Glimpses of ten days training programme for gardners

was inaugurated by Dr D B Singh, Director ICAR-CITH, Srinagar who highlighted the activities of Institute including different activities going on walnut propagation and production. He urges the participants to learn more in this training programme. The participants were trained on various aspects of walnut like seed sowing, stratification, raising of rootstocks, planting of rootstock, selection of scion wood, grafting techniques and other nursery management techniques. These techniques were theoretically and practically demonstrated by Dr O C Sharma, Dr Danish Bashir, Dr Nida Yusuf and other staff. The progress of learning was also monitored by Sh S K Singh from UFRMP-JICA, Dr N C Nainwal and Range Officers from Uttarakhand from time to time. At the end of the programme the participants become well versed in propagation of walnut and Dr D B Singh, Director monitored their learning skill and provided certificates during valedictory session.

One day training programme on cultivation technology of major exotic vegetable organized.

One Day training programme on cultivation technology of major exotic vegetable crops in Kashmir for extension workers from Deptt of Agriculture, Jammu and Kashmir working at Chadoora, district Budgam (J&K). The cultivation technology of various exotic vegetable crops especially broccoli were demonstrated in detail for its popularization in Kashmir. Eight officers from state department participated in the training programme.

Dr Geetika Malik demonstrating exotic vegetable cultivation

One day off campus training programmes organized in Uttarakhand.

For promotion of walnut cultivation in Uttrakhand, three one day training programmes were organized at Magara, Sony and Silalekh on 5th , 8th and 9th February, 2020 in collaboration with UFRMP, Dehradun in which 44, 32 and 68 officers from Department of Forest and some progressive farmers participated. Training and demonstrations were given on various propagation methods suitable for walnut multiplication.

Demonstration on grafting during trainings in Uttarakhand

One day training programme on walnut propagation technique organized at Mukteshwar.

A training programme on walnut propagation technique for quality planting was organized at ICAR-RS, Mukteshwar on 10th February,2020 in which total of 41 participants from department of Forest, department of Horticulture and progressive farmers participated. The participants were apprised in detail regarding various propagation aspects like raising rootstock, scion wood selection, propagation methods and time as well as after care of plants.

Glimpses of training programme at ICAR-CITH, Mukteshwar

One day training cum visit programme organized for AFWWA

One day training cum visit programme was organized for AFWWA , Srinagar on 18th April, 2019. During this programme, 105 ladies along with 15 Air Force staff participated in the programme. The participants were made aware of various horticultural crops. The tips for kitchen gardening were also given to the participants for fresh vegetable production. The seedlings of vegetables were also provided to participants.

Glimpses of training programme at ICAR-CITH, Srinagar

Training programme/ students visit.

The well established facilities of experimental orchards of different crops and well equipped labs of various disciplines had made the Institute as center of learning for students from various schools, colleges and universities. During the year 11 visits/ training were organized for students. The details of students visit/ training fron different organizations is presented in Table 29.

Training programme/ farm visits organized for farmers of Himachal Pradesh.

During the year two groups of farmers sponsored by Department of Horticulture, Himachal Pradesh visited the Institute for training and were made aware of various technologies generated at ICAR-CITH. The details of various programmes are presented in the Table 30.

Table 29. List of schools/colleges who visited the ICAR-Central Institute of Temperate Horticulture during the year 2019-2020.

Date	Name of School/ University	No. of Students	Facilitated By
20th April,2019	Hanfia Model Higher Seconday School, Baramulla, district Baramulla (J&K)	50	W H Raja & Geetika Malik
7th June,2019	JAKLI, Rangreth, Srinagar ((J&K)	54	Saima Zahoor, Danish Bashir & Nida Yousuf
17th June, 2019	Foundation World School, Humama ,District Budgam (J&K)	150	W H Raja, Eshan Ahad, Saima Zahoor & Iqra Qureshi
18th June, 2019	Foundation World School, Humama,District Budgam (J&K)	66	W H Raja, Eshan Ahad, Danish Bashir & Ms. Iqra Qureshi
4th July, 2019	S.P. College, Srinagar (J&K)	24	J I Mir
30th September, 2019	PEACE Institute, Karalpora District Budgam (J&K)	11	Saima Zahoor and Danish Bashir
26th November,2019	SKUAST-K, Shalimar, Srinagar (J&K)	3	O C Sharma
20th January,2020	SKUAST-K Shalimar, Srinagar (J&K)	30	Desh Beer Singh, W.H.Raja, Salwee Yasmin & Iqra Qureshi
21st January,2020	SKUAST-K, Shalimar, Srinagar (J&K)	25	J I Mir
25th January,2020	SKUAST-K, Shalimar, Srinagar (J&K)	25	J I Mir
14th February,2020	SKUAST-K, Shalimar, Srinagar (J&K)	25	O C Sharma
18th February,2020	SKUAST-K, Shalimar, Srinagar (J&K)	22	O C Sharma, J I Mir , W H Raja & Shoaib Nisar Kirmani

Table 30. List of training programmes organized for officers/ staff of line department

Sr No.	Name of Programme	Venue	Date	No. of Participants	Organizers/ coordinators
1	Technological interventions in temperate horticultural crops for doubling farmer's income	ICAR-CITH, Srinagar (J&K)	25th to 29th June, 2019	16	O C Sharma, K L Kumawat and W H Raja
2	Training cum exposure visit for progressive orchardist	ICAR-CITH, Srinagar (J&K)	25th July, 2019	25	O C Sharma & J I Mir

Five days training programme for progressive farmers of Himachal Pradesh

A five days training programme on Technological interventions in temperate horticultural crops for doubling farmer's income was organized for the progressive farmers of Bharmour area of district Chamba, Himachal Pradesh w.e.f. 25th to

Glimpses of five days training for progressive farmers of Himachal Pradesh

Visit of various student groups to ICAR-CITH.

29th June, 2019 at ICAR- CITH, Srinagar. Sixteen farmers along with two officers participated in the training programme. During the programme trainees were exposed to various technologies generated at ICAR-CITH, Srinagar in fruit, vegetable and flower crops which could be helpful to double the farmer's income. The training was a good blend of lectures, practical demonstrations and farm visits on various aspects like high density plantation, training & pruning, nursery production, rootstock and varietal diversity, vegetable and flower production etc. Farm visits to various organizations were also organized. The farmers appreciated the training programme and assured to implement various technologies in their field.

One day training cum exposure visit organized for orchardists of Himachal Pradesh.

One day training programme cum exposure visit was organized for the progressive farmers of Rohru and Chirgaon area of district Shimla Himachal Pradesh on 25th July, 2019. The programme was sponsored by Deptt. of Horticulture, Himachal Pradesh. Total 25 progressive farmers participated in the training programme. During the programme trainees were exposed to various technologies generated at ICAR-CITH, Srinagar in temperate fruit crops especially high density. In the programme lectures like high density plantation, training and pruning, nursery production, rootstock and varietal diversity were delivered on various topics followed by practical demonstration and field visit. Farm visits to NBPGR and IGFRI Regional Stations, Srinagar (J&K) were also organized. The farmers appreciated the training programme and assured to implement various technologies in their field especially in apple cultivation.

Glimpses of one day training cum exposure visit for progressive orchardists of Himachal Pradesh

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

During the year, six farmer groups sponsored by various agencies visited the Institute for one day training/ farm visit. The farmers were made aware of various technologies generated at ICAR-CITH in various horticultural crops. The details of various programmes are presented in the Table 31.

Table 31. List of visits organized for farmers at ICAR-Central Institute of Temperate Horticulture during the year 2019-20.

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

Glimpses of varios farmers visits/ trainings

Exhibitions

ICAR-CITH, Srinagar participated in International Day for Biological Diversity -2019 organized by J&K State Biodiversity Board in collaboration with SKUAST-K held at SKUAST-K Shalimar, Srinagar on 22nd May 2019 and displayed exhibits related to biodiversity in various temperate horticultural crops. Dr W H Raja, Dr Selvakumar R and Mr Istiyaq Ahmad Shiekh participated in this exhibition.


Exhibition stalls of ICAR-CITH Srinagar and dignitaries at Institute Exhibition Stall

EXTENSION AND OTHER PROGRAMMES ORGANIZED AT ICAR-CITH REGIONAL STATION MUKTESHWAR

Besides main campus extension activities are regular phenomenon of Regional station,Mukteshwar and lot of programmes were organized for officers, students and farmers. The details of these programmes is presented under various heads below.

Programmes organized for Officers

During 2019-20, four one day training cum visits were organized for Subject Matter Specialist of KVKK's & officers from department of Horticulture and detail of programmes is presented in Table 32.

Table 32. List of training cun visits organized for officers

Sr No.	Name of programme	Venue	Date	Participants	Coordinators	Organizer/
1	Exposure visit for SMSs of KVKs of ICAR-ATARI Zone VII Umiam, NEH Region	ICAR-CITH RS, Mukteshwar	06.11.2019	21	Raj Narayan & Arun Kishor	Dr N.K. Hedau, ICAR-VPKAS, Almora
2	Exposure visit for SMSs of KVKs of ICAR-ATARI Zone VII Umiam, NEH Region	ICAR-CITH RS, Mukteshwar	17.11.2019	14	Raj Narayan, & Arun Kishor	Dr Sher Singh, ICAR-VPKAS, Almora
3	Exposure visit-cum training for horticulture officers on orchard management of Temperate fruit crops to the Horticulture officials	ICAR-CITH RS, Mukteshwar	18.11.2019	16	Arun Kishor	Chief Horticulture Officer, Almora
4	Exposure visit for SMSs of KVKs of ICAR-ATARI Zone VII Umiam, NEH Region	ICAR-CITH RS, Mukteshwar	13.02.2020	17	Raj Narayan & Arun Kishor	Dr N.K. Hedau, ICAR-VPKAS, Almora

Training programme/ students visit

During the year, three training/ visits for students were organized at ICAR-CITH, RS Mukteshwar and details of programmes is presented in the Table 33.

Table 33.Visits/ training organized for students ICAR-CITH, RS Mukteshwar

Date	Name of School/ College/ University/ Institute	Number	Facilitated By
14th November,2019	M. Sc. (Hort.) students from Deptt. of Hort., COA, GBPUAT, Pantnagar	09+2	Raj Narayan & Arun Kishor
19th November,2019	B.Sc. (Ag.) students of SHUATS, Naini, Prayagraj (UP)	90+5	Raj Narayan & Arun Kishor
29th February,2020	B.A. (H) Geography students of Shyama Prasad Mukherji College for Women (University of Delhi)	44	Ahkil Thukral & Puran Chandra

Farmer Visit

Two groups of farmers visited ICAR-CITH, RS Mukteshwar and were made aware of various technologies in temperate horticultural crops. The list of of these visits is presented in Table 34.

Farmers Training, Demonstration and awareness programmes

ICAR-CITH, RS Station Mukteshwar has organized number of training programmes (on & off campus) for farmers of different areas of Uttarakhand. The list of various programmes is presented in Table 35.

Table 34. List of farmers visits organized at ICAR-Central Institute of Temperate Horticulture , Rs Mukteshwar

Date	Department/ Organization	Zone/ District	Number	Facilitator/ Coordinator
25th May,2020	Exposure visit-cum training on water management on the occasion of Jal Diwas	Nainital	10	Raj Narayan & Arun Kishor
1st June,2019	Exposure visit-cum training on scientific techniques of temperate fruit and protected vegetable cultivation	Nainital	10	Raj Narayan & Arun Kishor

Table 35. Training, Demonstration, awareness programmes performed at RS, Mukteshwar

Training/Demonstration/Day etc.	Date	Venue	No of Participants	Facilitator/ Coordinator
Kisan Goshthi on IFS and Organic Farming	17th June,2019	Sunkiya Naveen	12	Raj Narayan,
Training-demonstration on Scientific way of planting and cultivation of garlic	26th September, 2019	Sunkiya	14	Arun Kishor & Vinod Chandra
Demonstration on Scientific method of garlic planting.	7th October,2019	Jurkafun	13	Arun Kishor
FAP on Scientific way of pea cultivation	13th November,2019	Jurkafun	07	Raj Narayan
Training on Sanrakchhit kheti ke vividhikaran ke liye takniki vikalp	30 November,2019	ICAR-CITH RS, Mukteshwar	70	Raj Narayan & Arun Kishor
FAP on Scientific method of organic vegetable cultivation and training and pruning in apple and peach fruit trees.	18th December,2019	Sunkiya	18.	Raj Narayan & Arun Kishor
Awareness programme on the occasion of Swachhata Pakhwada	23th December,2019	Kasiyalekh	18	Raj Narayan & Arun Kishor
Training on Training, pruning and propagation of temperate fruit crops	3rd January,2020	ICAR-CITH RS, Mukteshwar	23	Arun Kishor
Training on Training, pruning and propagation of fruit crops	4th January,2020	ICAR-CITH RS, Mukteshwar	39	Arun Kishor
FAP on Training, Pruning and propagation of Temperate fruit crops	21st January,2020	ICAR CITH RS, Mukteshwar	12	Arun Kishor
Collaborative training – demonstration on propagation of horticultural crops and animal health management	22nd January,2020	Jurkafun	12	Arun Kishor & C. Jana (IVRI, Mukteshwar)
FAP on Training, pruning in temperate fruit crops and scientific method of potato cultivation	1st February,2020	Sunkiya	12	Raj Narayan & Arun Kishor
Training on Gunvatta ropan samagri hetu akhrot pravardhan taknik	10th February,2020	ICAR-CITH RS, Mukteshwar	41	Raj Narayan, Arun Kishor & O.C. Sharma

Training on Sabji phasal utpadan mein vividhikaran taknikiyan	12th February,2020	ICAR-CITH RS, Mukteshwar	60	Raj Narayan
Training on Lagat anurup sabji phasal evam paudh utpadan taknikiyan	13th February,2020	ICAR-CITH RS, Mukteshwar	68	Raj Narayan
FAP-Demonstration on Potato planting and cultivation	24th February,2020	Sunkiya Naveen	24	Arun Kishor
ATMA collaborative training on Fruit and vegetable cultivation techniques	4th March2020	Kanarkha, Sarna	25	K.K. Pant (ATMA, Nainital), Raj Naraya & Arun Kishor
Training cum demonstration on training and pruning of temperate fruit crops	21st March,2020	Amaravati	11	Arun Kishor, Vinod Chandra & Puran Chandra

Glimpses of programme on training and pruning

Exhibitions

For quick dissemination of technologies ICAR-CITH, RS Mukteshwar has participated in various occasions and demonstrated various technologies by putting exhibits. The list of these exhibitions is given in Table 36.

Table 36. List of exhibitions displayed during various occasions

Occasion	Venue	Organizing agency	Date	Participating staff
Jal Shakti Abhiyan	Vikas Bhawan, Bhimtal, Nainital (UK)	KVK, Jeolikot, Nainital (GBPUAT, Pantnagar (UK))	3rd September,2019	Arun Kishor & Narayan Singh
106th Kisan Mela	GBPUAT, Pantnagar, U.S. Nagar (UK)	GBPUAT, Pantnagar, U.S. Nagar (UK)	27 to 30th September, 2019	Arun Kishor, Vinod Chandra & Narayan Singh
Apple Day/ Exhibition-Workshop	ICAR-CITH Regional Station, Mukteshwar, Nainital (UK)	ICAR-CITH Regional Station, Mukteshwar, Nainital (UK)	23October,2019	Raj Narayan, Arun Kishor, Vinod Chandra, Narayan Singh, & Shabir Ahmad Mir
Kisan Mela	ICAR-VPKAS, Habalbagh, Almora (UK)	ICAR-VPKAS, Habalbagh, Almora (UK)	15th November,2019	Raj Narayan, Arun Kishor & Narayan Singh

ICAR-CITH, Regional Station, Dirang

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

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

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

Workshop cum Training Programme at Tribal Region of Poonch

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

Workshop on PPV & FRA at Poonch

distributed among the tribal farmers of the region to improve their livelihood.

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

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

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

Demonstration of CITH walnut varieties and distribution of planting material under tribal farmers at Poonch

Demonstration of ten walnut varieties (CITH-W-1, CITH-W-2, CITH-W-3, CITH-W-4, CITH-W-5, CITH-W-6, CITH-W-7, CITH-W-8, CITH-W-9 & CITH-W-10) was laid on farmer's field at Poonch. Four tribal farmers of Poonch were identified by Dr Javid Iqbal Mir, Senior Scientist, ICAR-CITH, Srinagar and Dr Wasim Hassan Raja, Scientist, ICAR-CITH, Srinagar in coordination with Dr Muzaffer Ahmad Mir, SMS (Fruit Science), KVK, Poonch for laying down the demonstrations in walnut varieties on 21st February, 2020. On the same date planting material of apple, apricot, pear and cherry were distributed among forty tribal farmers of district Poonch under TSP scheme. Training and awareness about planting, orchard management and canopy management was provided to 40 tribal farmers on 21st February, 2020.

Distribution of walnut varieties for demonstration

Implementation of Mera Gaon Mera Gaurau Programme

Jammu & Kashmir / Anantnag

For implementation of Mera Gaon Mera Gaurav programme planting material of apple, apricot, almond, cherry, plum and pear were distributed among 100 beneficiaries at Hatigam village of district Anantnag, Jammu & Kashmir on 9th March, 2020. Team comprised of Dr Javid Iqbal Mir, Dr Wasim Hassan Raja and other staff members of ICAR-CITH, Srinagar implemented this programme at Hatigam village under which various visits were made during 2019-20 for generating awareness among the farmers of the village about MGMG scheme. On 9th March, 2020 team distributed 1500 apple plants on clonal rootstock, 750 apple plants on seedling rootstock, 300 almond plants, 200 pear plants, 200 cherry plants, 250 plum plants and 350 plants of apricot among the 100 beneficiaries.

Planting material distribution under MGMG

Uttarakhand, Mukteshwar

The village Sunkiya was adopted under Mera Gaon Mera Gaurav by the Mukteshwar center in 2015-16. Geographically it is situated at 1750 meter above mean sea level (29° North latitude and 79° East longitudes) in Dhari tehsil of Nainital district. The village is predominating in Horticulture based farming system. Hence, Horticulture based Integrated Farming System Model was developed at the 2 farmers fields, one in Sunkiya and another in Sunkiya Naveen villages in association with ICAR-IVRI, Mukteshwar, ICAR-DCFR, Bhimtal, ICAR-VPKAS, Almora and ICAR-IISWC, Dehradun during 2017-18 and 2018-19. The farmers were provided with training/ demonstration of scientific/ technical knowhow of different components of IFS model like cultivation of different horticultural crops such as fruits (apple, peach, plum, apricot, malta, kagzi lime, kiwi fruit, walnut); vegetables (tomato, capsicum, chinense cabbage, lettuce, broccoli, cucumber, pea, French bean, onion garlic, potato); medicinal and aromatic plants (rosemary and lemon grass); animal husbandry (cow and goat); poultry (hen breed RIR and Uttara Fowl), bee keeping (Apis indica), fish farming (Silver carp, Grass carp and Common carp), vermicomposting (*Eisenia foetida*) and water harvesting. Various components of Integrated Farming Systems namely poultry, goatry, cattle, cold water fisheries, vermi-composting, water harvesting bee keeping, protected cultivation, gravity irrigation, solar energy harvesting etc. were also demonstrated in association with ICAR-IVRI, Mukteshwar, ICARVPKAS, Almora, ICAR-DCFR, Bhimtal, ICAR-IISWC, Dehradun and State Line Departments and NGOs. Total of 13 field visits, 04 awareness programmes, 02 kisan goshties, 03 training programmes were organized. Besides this, developed linkages with 10 agencies and distributed 04 technical leaflets to the farmers of the villages. Also provided 15 mobile based advisory to the 25 farmers of the village as and when approached. Apart from this, conducted 49 demonstrations on various horticultural crops and technologies such as long day onion & garlic, potato, training pruning in temperate fruits and production of tomato and capsicum in polyhouse.

Glimpses of Activities undertaken in MGMG at Sunkiya

The planting materials of long day garlic cv. CITH-M-G-1 (10kg to 14 farmers), onion cv. VL Piyaz 3 (9000 seedlings to 15 farmers) and potato cv. Kufri Girdhari (100kg to 20 farmers) were distributed and laid out demonstration at 49 farmers field during the year 2019-20. Conducted Swachchhta Abhiyan and waste decomposition, clean horticulture, green India awareness programme and also created awareness on Climate change, its impact on temperate horticulture and demonstrated climate resilient technologies. Institute also provided technical guidance for year round vegetable cultivation under polyhouses, nursery management. Also suggested insect pest, disease and nutrient management in important fruits and vegetable crops to the 49 farmers in the villages during various training and awareness programmes organized during year 2019-20. Besides, suggested and demonstrated scientific ways of orchard management in already established temperate horticultural crops .

Radio/ TV Talks

To disseminate the technologies through mass media for their adoption in larger scale, scientists of ICAR-CITH, Srinagar and its Regional Station are continuously delivering need based talks on various topics beneficial for farmers and line departments. Total 28 talks were delivered by various scientists/ technicals during the year is presented in Table 37 .

Table 37. Radio/ TV talks delivered by scientist during 2019-20

Sr No	Name of Scientist	No. of talks
1	Dr D B Singh	2
2	Dr O C Sharma	1
3	Dr J I Mir	2
4	Dr Geetika Malik	6
5	Dr K L Kumawat	3
6	Dr W H Raja	10
7	Sh Sajad Un Nabi	1
8	Dr S N Kirmani	2
9	Dr Muneer A Sheikh	1
	Total	28

TRAININGS AND CAPACITY BUILDING

ICAR- CITH is continuously deputing its staff to attend various training programmes organized by various organizations to upgrade their knowledge and skill. During 2019-20, three scientists and one Sr. technical officer were deputed for below mentioned trainings and have successfully completed the trainings.

Trainings attended by Scientific Staff

Dr K L Kumawat, Scientist (Fruit Science)

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

Dr Selvakumar R, Scientist (Vegetable Science)

- Attended winter school on Breeding and Genomic Tools for Stress Resistance in Vegetable Crops organized by ICAR-IARI, New Delhi w.e.f. 23rd October to 12th November 2019.

Mr. Sajad Un Nabi, Scientist (Plant Pathology)

- Attended 10 days training programme on Genome based Diagnosis of Viruses, Viroids and Phytoplasmas organized by Division of Plant Pathology, ICAR-IARI, New Delhi from 15th to 24th October, 2019

Trainings attended by Technical Staff

Dr Shoaib Nissar Kirmani, Senior Technical Officer

- Attended two weeks training programme on General Management Programme for Scientists held at Administrative Staff College of India, Billa Vista, Hyderabad sponsored by Department of Science and Technology, GOI, New Delhi w.e.f. 24th February to 6th March, 2020

Table 38. HRD Fund Allocation and Utilization

Head	Allocation	Expenditure (Rs in Lakhs)
Unified Budget	0.18	0.18

AWARDS/ REWARDS/ RECOGNITION

Dr D B Singh, Director

- Received Dr Gautam Kallo Award for Excellence in Horticulture Research for the year 2018 during Indian Horticulture Summit organized by Society for Horticulture Research and Development (SHRD held at Chitrakoot (M P) from 14 to 16th February, 2020 .

Dr Raj Narayan (Principal Scientist)

- Received Best Oral Paper Presentation Award for the paper entitled Technological Interventions for Sustaining Hill Horticulture under Changing Climate during Progressive Horticulture Conclave-2019 held at ICAR-IISR, Lucknow (UP) w.e.f. 08 to 12th December, 2019.

Dr Anil Sharma (Principal Scientist)

- Received Gold Medal during International Conference on Soil and Water Resource Management for Climate Smart Agriculture, Global Food and Livelihood Security organized by Soil Conservation Society of India, World Association of Soil and Water Conservation & International Soil Conservation Organization held at New Delhi w.e.f 5th to 9th November, 2019.
- Received Best paper award for paper entitled Reducing Nitrogen losses accountable for environmental degradation in saffron growing soils during International Conference on Soil and Water Resource Management for Climate Smart Agriculture, Global Food and Livelihood Security held at New Delhi w.e.f, 5th to 9thNovember, 2019.
- Received Best paper award for paper entitled Influence of zinc oxide nanoparticles on soil nutrient compositions and yield of Crocus sativus L during International Conference on Soil and Water Resource Management for Climate Smart Agriculture, Global Food and Livelihood Security held at New Delhi w.e.f, 5th to 9thNovember, 2019.

Dr Arun Kishor (Scientist)

- Received Young Scientist Award in the International Conference on Global Perspective in Agricultural and Applied Sciences for Food and Environmental Security (GAAFES-2019) organized by Agricultural & Environmental Technology Developmental Society (AETDS) held at, Kumaun University, Nainital, UK from 1st to 2nd December, 2019.

Sh. Sajad Un Nabi Naingroo (Scientist)

- Received Best Oral Presentation award for paper presentation on Morpho-molecular characterization of Diplodia spp. associated with apple canker disease during IPSCONF 2020 held at ICAR-IARI, New Delhi from 16 to 20th January, 2020.

Sh. Fayaz Ahmad Dar (AF & AO)

- Received ICAR-Cash Award Scheme- 2018 (for Administrative Category) during Foundation day of ICAR held at ICAR, Pusa New Delhi on 16th July, 2019.

Others

- Received Best Team Award– March Past during Inter Institutional Sports meet at IIT – Kanpur held from 12th to 14th Decembe, 2019 (Team Award)
- Received best poster presentation award for the paper entitled Development and Valdation of DUS testing guidelines in olive (Olea europaea L) by O C Sharma, D B Singh, J I Mir, Nida Yousuf (poster presenter), Danish Bashir, Saima Zahoor, W H Raja and I Qureshi during International Conference on Advances and innovations in agriculture and Allied Science (AIAAS) held at Jawaharlal Nehru University Convention Centre, New Delhi from 31st January to 1st February, 2020.
- ICAR-CITH, Srinagar got protection (PATENT-Sui Generis system) for four walnut varieties viz. CITH-W-1, CITH-W-2, CITH-W-3 & CITH-W-4 from PPV&FRA.

PUBLICATIONS

Research Papers (International/ National)

- Akbar S A, Nabi S U, Mansoor S and Khan K A 2019. Morpho-molecular identification and a new host report of Bactrocera dorsalis (Hendel) from the Kashmir valley (India) International Journal of Tropical Insect Science (https://doi.org/10.1007/s42690-019-00083-w)
- Debnath S, Attri B L, Kumar A, Kishor A, Narayan R, Sinha K, Bhowmik A, Sharma A and Singh D B. 2020. Influence of peach (*Prunus persica* Batsch) phenological stage on the short-term changes in oxidizable and labile pools of soil organic carbon and activities of carbon-cycle enzymes in the North-Western Himalayas. Pedosphere. 30(2): 1–13.
- Debnath S, Narayan R, Kumar A, Kishor A and Singh DB 2020. Are horticulture-based land uses benign for fertility and health of soils in mid to high hills of the north-western Himalayan region?. Soil Science and Plant Nutrition (DOI:10.1080/00380768.2020.1753110)
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- Mir J I, Naqash S, Rashid M, Singh D B, Sharma O C, Sharma A, Kumawat K L, Raja W H, Nabi S U, Masoodi L, Sheikh M A and Kirmani S N 2019. Distinctiveness, uniformity and stability testing of apricot genotypes based on morphological traits. Indian J. Hort. 76(4): 590-595
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- Nabi S U, Raja W H, Mir J I, Sharma O C, Singh D B, Sheikh M A, Yousuf N and Kamil D 2019. First report of *Diplodia bulgarica* a new species causing canker disease of apple (*Malus domestica* Borkh) in India. Journal of Plant Pathology (https://doi.org/10.1007/s42161-019-00445-w)
- Nabi S U, Baranwal V K, Yadav M K and Rao G P 2020. Association of Apple necrotic mosaic virus (ApNMV) with mosaic disease in commercially grown cultivars of apple (*Malus domestica* Borkh) in India. 3 Biotech, 10 (3): 1-9. (https://doi.org/10.1007/s13205-020-2117-6)
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- Selvakumar R, Kalia, P and Raje R S 2019. Genetic analysis of nutritional traits in tropical carrot (*Daucus carota* L.). Genetika 51(2): 641-660
- Shah U N, Mir J I, Ahmed N, Fazili K M 2019. Genetic diversity analysis of walnut (*Juglans regia* L.) from Kashmir valley using RAPD and ISSR Markers. Agrotechnology 8 (1) No:185
- Sheikh A A, Jabeen N , Yousuf N, Rasool A, Sofi P A, Nabi S U and Bhat T A 2020. Stability analysis in French bean genotypes for different traits under temperate conditions of Kashmir valley. The Pharma Innovation Journal 9(1): 230-234.
- Sheikh P, Samuna B and Nabi S U 2019. Ectomycorrhizal diversity in Zabarvan forest range of north western Himalaya. International Journal of Current Microbiology and Applied Sciences 8(5):2312-2323 (10.20546/ijcmas.2019.805.273).
- Teotia Deepa , Gaid Mariam, Saini Shashank S, Verma Aparna, Yennamalli Ragothaman M. , Khare Satyajeet P, Ambatipudi Kiran, Mir Javid Iqbal, Beuerle Till , Hansch Robert, Roy Partha, Agrawal Pawan Kumar , Beerhues Ludger and Sircar Debabrata 2019. Cinnamate-CoA ligase is involved in biosynthesis of benzoate-derived biphenyl phytoalexin in *Malus x domestica* 'Golden Delicious' cell cultures. The Plant Journal 100 (6): 1176-1192

Review Papers

- Malik G, Dhatt A S and Malik A A 2020. A review of genetic understanding and amelioration of edible Allium species. Food Reviews International DOI: 10.1080/87559129.2019.1709202
- Nabi S U, Yadav M , Raja W H , Sidharthan Kavi, Dubey S, Kumar M and Jaiswal D 2019. Apple Mosaic Disease: Potential Threat to Apple Productivity. EC Agriculture 5 (10): 619-623
- Shafi S M, Sheikh,M A, Nabi S U, Mir M A, Ahmad N, Mir J I, Raja W H, Rasool R and Masoodi K Z 2019. An Overview of Apple Scab, its Cause and Management Strategies. EC Microbiology 15(4):283-287

Papers in Proceedings

- Narayan R, Kishor A and Singh D B 2019. Technological interventions for sustaining hill horticulture under changing climate. Proceedings of Progressive Horticulture Conclave (PHC)-2019 on Futuristic Technologies in Horticulture, held at ICAR-IISR, Lucknow (UP) from 8th to 10th December, 2019
- Kirmani S N, Singh D B, Mir J I, Raja W H and Nabi S U 2019. Nanotechnology: A novel way for enhancing horticultural crop productivity. Proceedings of 5th International Conference on Nanotechnology for Better Living (NBL-2019) organized by NIT Srinagar and IIT Kharagpur held at SKUAST, Shalimar, Srinagar from 7th to 11th April, 2019. Published by Applied science Innovations Pvt Ltd, Pune (Maharastra), pp 474-475

Books

- Desh Beer Singh, O C Sharma and J I Mir 2020. Post harvest handling and value addition of temperate fruits and nuts. Daya Publissing House, Astral International Pvt Ltd, New Delhi
- J I Mir, D B Singh, O C Sharma, K K Srivastava, N Ahmed, W H Raja, K L Kumawat, G Malik, S U Nabi, S Yasmeen, L Masoodi, S Naqash, S N Kirmani and M A Sheikh 2020. Morphological description of apple varieties under agro climatic conditions of Jammu and Kashmir (Part-1). Published by Director, ICAR-CITH, Srinagar,
- S P Kanaujia C S Maiti and R Narayan 2020. Text Book of Vegetable Production (2nd Edition). Today and Tommorow's Printers and Publishers, Dariyaganj, New Delhi,442p.

Book chapters

- Shahid Ali Akbar, Sajad Un Nabi, G Mahendran and Wasim H Raja 2019. Pests of temperate fruits. In: Integrated Pest Management. Biotech Books New Delhi, pp 139-174 (ISBN No.978-81-7622-461-1).

Technical bulletins/ pamphlet/folders

- Selvakumar R, Geetika Malik, Alima Shabir, Sajad Un Nabi, Javid Iqbal Mir and D B Singh, Anil Sharma 2020. Practical manual on hybridization systems in temperate root vegetable crops. Published by Director, ICAR-CITH, Srinagar, 48p.
- Selvakumar R, Geetika Malik, Alima Shabir, Javid Iqbal Mir, D B Singh, Anil Sharma and Sajad Un Nabi 2019. Floral biology, pollination mechanism, selfing and crossing techniques in temperate root vegetables. Published by Director, ICAR-CITH, Srinagar,2folds
- Selvakumar R, Geetika Malik, Alima Shabir, Sajad Un Nabi, Javid Iqbal Mir, Singh D B and Anil Sharma 2019. Seed production systems in temperate root vegetable crops. Published by Director, ICAR-CITH, Srinagar, 2fold.
- Selvakumar R, Sajad Un Nabi, Geetika Malik, Alima Shabir Javid Iqbal Mir, D.B. Singh, Anil Sharma and 2019.Plant protection practices in temperate vegetable root crops. Published by Director, ICAR-CITH, Srinagar,2 folds
- K L Kumawat, W H Raja, D B Singh, O C Sharma, J I Mir and S U Nabi 2019. Production of feathered apple nursery plants. Published by Director, ICAR-CITH, Srinagar, 2fold
- A Kishor, R Narayan, M S Mer, and V Chandra 2019. Seb mein saghan bagvanipadhwati: mahatva evam laabh. Published by Director, ICAR-CITH, Srinagar (ICAR-CTH Regional Station, Mukteshwar), Leaflet No. 03/2020.
- A Kishor, R Narayan, M S Mer, and V Chandra 2019. Sheetoshna phal vrikshon ka chhatrak (canopy) prabandhan. Published by Director, ICAR-CITH, Srinagar (ICAR-CTH Regional Station, Mukteshwar),Leaflet No. 04/2020.
- A Kishor, R Narayan, R.K Singh and V Chandra 2020. Akhrot pravardhan ki vanaspatik. vidhiyan. Published by Director, ICAR-CITH, Srinagar (ICAR-CTH Regional Station, Mukteshwar), Leaflet No. 05/2020.

Popular articles

- R Narayan, M Mer, R K Singh and A Kishor 2020. Sabji matar ki vaigyanik kheti. Phal Phool (March-April), 26-28.
- Selvakumar R, A Nagaraja, Neelam Patel, R B Tiwari and D B Singh. 2020. Nutritive and medicinal properties of fruits and vegetables. Kerala Karshakan: 21-26.
- Selvakumar R, Neelam Patel and D B Singh 2020. Cabbage Cousin's Kale: Powerful Superfood for Future. Kerala Karshakan : 42-45.
- Selvakumar R. 2019. Self-Pruning Gene: Dwarf by nature. Kerala Karshakan : 25-28.

PARTICIPATION IN WORKSHOPS/ CONFERENCE/ MEETING

Dr D. B. Singh, Director

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

Dr Raj Narayan, Principal Scientist (Horticulture)

- Attended 7th Group Discussion of ICAR-ACIRP on Fruits at Punjab Agricultural University, Ludhiana w.e.f. 16 to 19th January, 2020.
- Attended SAC meeting of KVK, Bageshwar, ICAR-VPKAS, Almoa (UK) on 8th May,2019
- Attended Field Day on Stone Fruits at ICAR-NBPGR Regional Station, Shimla (HP) on 7th June, 2019
- Attended PMRC Meeting of DIBER DRDO, Gora Parav, Haldwani, Nainital (UK) as Subject Expert Member on 12th September, 2019.
- Attended Workshop on Economic and Social Transformation through GPDP in Himalayan States on 10th & 11th October, 2019 at Parmarth Niketan, Rishikesh, Haridwar (UK)
- Attended NMSHE Review meeting at Vigyan Bhawan, New Delhi on 22nd November,2019
- Attended Progressive Horticulture Conclave-2019 held at ICAR-IISR, Lucknow (UP) from 8th to 12th December, 2019.

Dr J I Mir, Sr Scientist (Plant Biotechnology)

- Attended TAG (Technical Advisory Committee) meeting, survey and inspection of columnar apple from 11th to 15th September, 2019 at Champawat, Uttarakhand.
- Attended Annual review meeting for rabi crops under DUS at NASC Complex, New Delhi on 25th & 26th April, 2019
- Attended Meeting for Development of roadmap for increasing production in almond and walnut under the Chairmanship of Horticulture Commissioner at Krishi Bhawan, New Delhi on 4th September, 2019
- Attended Meeting for Development of roadmap for increasing production in almond and walnut" under the Chairmanship of Horticulture Commissioner at Krishi Bhawan, New Delhi on 4th October, 2019
- Attended review meeting on AICRP at NASC Complex, New Delhi on 30th October, 2019
- Attended review meeting on Hybridization programme at ICAR-CITH, Srinagar at KAB-II, Pusa New Delhi on 16th December, 2019.
- Attended meeting on Germplasm exchange with Uzbekistan at NBPGR, New Delhi on 21st January, 2020.

Dr Arun Kishore, Scientist (Fruit Science)

Attended International Conference on Global Perspective in Agricultural and Applied Sciences for Food and Environmental Security (GAAFES-2019) held at Kumaun University, Nainital organized by Agricultural & Environmental Technology Developmental Society (AETDS) U.S. Nagar, Uttarakhand on 1st & 2nd December, 2019.

- Attended conference on Himalaya Matters in a Changing World (a conference to celebrate the international mountain day) organized by G.B.P.N.I.H.E.S.D. Kosi Katarmal Almora Uttarakhand from 9th to 11th, December, 2019.

Sh.Sovan Debnath, Scientist (Soil Science)

- Attended one day workshop on Farm mechanization for small-holding farms held at Mohanpur, Bidhan Chandra Krishi Viswavidyalaya on 22nd June, 2019.
- Attended National workshop on Soil organic carbon (SOC) under resource conservation technology (RCT) held at Kalyani, Bidhan Chandra Krishi Viswavidyalaya on 2nd November, 2019.

Dr Geetika Malik, Scientist (Vegetable Science)

- Attended 10th Annual Group Meeting of AINRPOG at IARI, New Delhi from 31st May, to 2nd June, 2019.
- Attended 37th Annual Group Meeting of AICRP- Vegetable at TNAU, Coimbatore from 22nd to 25th June, 2019.

Dr K L Kumawat, Scientist (Fruit Science)

- Attended 15th Scientific Advisory Committee Meeting of Krishi Vigyan Kendra, Srinagar (SKUAST-K) on 11th April, 2019.
- Attended N.F.D.B. sponsored Skill development/training programme organized by Krishi Vigyan Kendra, West Kameng as Guest of Honour at Chug village on 28th February, 2020.

Dr W H Raja, Scientist (Fruit Science)

- Attended meeting at Krishi Vigyan Kendra, Baramati organized by National Horticulture Board for drafting the training module for the beneficiaries of NHB schemes on 5th to 6th August, 2019.
- Attended the meeting as a member of site selection committee for the establishment of Additional Krishi Vigyan Kendra at Border area Gurez, District Bandipora from 24th to 25th June 2019.
- Attended SAC meeting of KVK, Budgam (SKUAST-K) on 2nd May 2020.
- Deputed as member of an Expert grading committee (member of NHB) for the procurement of apple at MSP by NAFED under Market Intervention Scheme 2019-20 at Fruit Mandi Sopore, District Baramulla from 21st September 2019 to 7th January, 2020

Sh Sajad Un Nabi, Scientist (Plant Pathology)

- Attended 7th International conference on Phytopathology in achieving UN Sustainable Development goals from 16th to 20th January, 2020 at New Delhi.
- Attended VIROCON 2020-International conference evolution of viruses and viral diseases at INSA New Delhi from 18 to 20th February, 2020
- Attended workshop on Virus Diagnostics and Metagenomics For Virus Discovery at ACPV, ICAR-IARI New Delhi from 21st to 22nd February 2020

Dr Shoaib Nissar Kirmani, STO (T-6)

- Attended 5th International Conference on Nenotechnology for better living held at SKUAST-K Shalimar, Srinagar w.e.f. 7th to 11th April, 2019
- Deputed as member of an Expert grading committee (member of NHB) for the procurement of apple at MSP by NAFED under Market Intervention Scheme 2019-20 at Fruit Mandi Batengo - Anantnag, District Anantnag from 21st September 2019 to 9th October, 2019

Dr Muneer Ahmad Sheikh, Technical officer (T-5)

- Deputed as member of an Expert grading committee (member of NHB) for the procurement of apple at MSP by NAFED under Market Intervention Scheme 2019-20 at Fruit Mandi Batengo - Anantnag, District Anantnag from 14th October 2019 to 13th January, 2020 and Fruit Mandi Parimpora, Disrict Srinagar from 14th January to 2nd March,2020.

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 (CITH-01)
2.	Breeding for development of superior varieties/hybrids in solanaceous vegetables (CITH–07)
3.	Development of superior cultivars/ hybrids in temperate fruits through conventional and non conventional methods (CITH-40)
4.	Characterization and diversity analysis of flowering related gene/ genes in almond (CITH-72)
5.	Development of CMS lines in long day onion [Allium cepa L] (CITH-70)
6.	Breeding of nutrarich varieties or hybrids in root vegetable crops. (CITH-74)
B. Project: Crop Production and Propagation **Sub projects**	
1.	Development of almond based saffron inter cropping system (CITH 11)
2.	Enhancing feathering through plant growth regulators for high quality nursery production in apple (CITH-71)
3.	Standardization of integrated nutrient management of vegetables as intercrop in apple orchard (CITH-57)
4.	Standardization of growing /nutrients media and growing conditions for the cost effective production of quality vegetables and their seedlings (CITH-65)
5.	Development of diversification technology for round the year vegetable crops under mid and high hills of Uttrakhand (CITH-66)
6.	Pre harvest fruit drop management in apple (CITH-78)
C. Project: Crop Protection **Sub projects**	
1.	Diagnosis and prognosis of apple viral diseases – Spatial and temporal variation in virus infection in apple
D. Project: Post Harvest Management **Sub projects:**	
1.	Refinement of process technology and up-scaling of product for demonstrations and exhibitions

E. Ongoing externally funded projects Sub projects	
1.	Network project on onion and garlic (co-operation centre)
2.	All India Coordinated Research Project (Vegetable Crops)
3.	Intellectual property management and transfer/ commercialization of agricultural technology scheme (NAIF)
4.	National innovations on climate resilient agriculture (NICRA)
5.	Challenge programme on canopy management and plant architectural engineering in temperate fruits
6.	National mission for sustainable Himalayan ecosystem (TF-6)
7.	DUS testing centre for temperate fruits
8.	Development of an electronic nose sensor to determine the optimum harvesting time for apple and papaya
9.	Walnut propagation for production of quality planting material
10.	Validation and development of DUS testing guidelines for olive

RESEARCH REVIEW AND MANAGEMENT COMMITTEES

RESEARCH ADVISORY COMMITTEE OF ICAR-CITH, SRI-NAGAR (10TH MARCH, 2017 TO 10TH MARCH, 2020)

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

INSTITUTE MANAGEMENT COMMITTEE (IMC)

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

DISTINGUISHED VISITORS

- Union Minister of State for Agriculture and Farmers Welfare, Sh. Kailash Choudhary visited ICAR-Central Institute of Temperate Horticulture, Srinagar on 26th September, 2019 and was appraised about the new technologies developed by Institute to uplift the socio-economic status of farming community.



Planting of sapling and visit of Union Minister of State for Agriculture and Farmers Welfare, Sh. Kailash Choudhary to technology park and field

- Dr R.M. Sundarm (IAS), Secretary Horticulture, Govt. of Uttarakhand, Dehradun (UK) visited ICAR-Regional Station, Mukteshwar on 28th September,2019 and was made aware about various technologies generated at station for the benefit of farmers.
- Dr Punjab Singh, Former Secretary DARE & Director General ICAR, New Delhi and Former Vice Chancellor, BHU Varanasi, Prof. (Dr) Arbind Kumar, Vice Chancellor, RLBCAU, Jhanshi (UP) & Former Dy. Director General (Education, ICAR, New Delhi visited ICAR-Regional Station, Mukteshwar on 21st July, 2019 and were made aware of various research activities going on at Station

Besides above mentioned distinguished visitors, many high level dignitories from army, air force and other organizations visited the institute/ regional station during the year 2019-20.

PERSONNEL

ICAR-CITH HEAD QUARTER, SRI-NAGAR

RMP

- Dr. Desh Beer Singh, Director

Scientific

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

Administrative

- Sh. Fayaz Ahmad Dar, FAO
- Smt. Shahida Rafiq, P.A. to Director
- Sh. Showkat Ahmad Mir, Assistant
- Sh. Reyaz Ahmad Mir, Assistant
- Sh. Mukhtar Ahmad, Assistant
- Sh. Tariq Ahmad Mir, Jr. Stenographer
- Sh. Mehraj-ud-Din Meer, UDC
- Sh. Mohd. Muzafer Lone, LDC
- Sh. Rouf Ahmad Sheikh, LDC
- Sh. Khushi Ram, LDC

Technical

- Dr. Shoaib Nissar Kirmani, Senior Technical Officer (T-6)
- Sh. Eshan Ahad, Tech. Officer (T-5)
- Dr. Muneer Ahmad Sheikh, Technical Officer(T-5)
- Sh. Mehraj-ud-Din Bhat, Sr. Technical Assistant (T-4,Driver)
- Sh. Farman Ali, Sr. Technical Assistant (T-4, Driver)
- Sh. Mohammad Ramzan Wani, Technical Assistant (T-1-3.)
- Smt. Mubeena, Sr. Technican (T-2, Computer / Data Operator)
- 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 (KVK, Baramulla)
- 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. Raj Narayan, Principal Scientist (Horticulture)
- Dr. Arun Kishor, Scientist (Fruit Science)
- Dr. Sovan Debnath, Scientist (Soil Science)

Administrative

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

Technical Staff

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

Skilled Supporting Staff

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

TRANSFERS/ PROMOTIONS/ PROBATION CLEARANCE

TRANSFERS

- Dr Anil Sharma, Principal Scientist transferred from ICAR-CITH, Srinagar to ICAR-CPRI, Shimla on 30th November, 2019(A/N).
- Dr Selvakumar R, Scientist (Vegetable Science) transferred from ICAR-CITH, Srinagar to ICAR-IARI, New Delhi on 30th November, 2019(A/N).
- Sh. Mukul Raj Singh, Administrative Officer transferred from ICAR-CITH, Srinagar to ICAR-NISHAO, Bhopal on 30th September, 2019(A/N).
- Sh. Puran Chandra, Technical Assistant transferred from ICAR-CITH, Srinagar to ICAR-CITH Regional Station Mukteshwar on 30th September, 2019(A/N).
- Sh. Ramesh, AAO transferred on promotion to the post of Administrative Officer at ICAR-CIAH, Bikaner on 7th August, 2019 (A/N)

PROMOTIONS

- Dr J I Mir, Sr Scientist promoted under CAS in Level 13-A, pre revised RGP of Rs 9000 w.e.f. 27th June, 2018.
- Dr Arun Kishor, Scientist ICAR- CITH RS, Mukteshwar promoted under CAS in Level 11, pre revised RGP of Rs 7000 w.e.f. 27th April,2015.
- Sh Sovan Debnath, Scientist ICAR- CITH RS, Mukteshwar promoted under CAS in Level 11, pre revised RGP of Rs 7000 w.e.f. 1st January,2018
- Dr Geetika Malik, Scientist promoted under CAS in Level 11, pre revised RGP of Rs 7000 w.e.f. 1st July,2017.
- Dr K L Kumawat, Scientist promoted under CAS in Level 11, pre revised RGP of Rs 7000 w.e.f. 1st July,2018.
- Sh Fayaz Ahmad Dar, AF&AO promoted to FAO w.e.f. 6th March, 2020.
- Sh Khushi Ram, SSS promoted to LDC w.e.f. 21st December,2019.

PROBATION CLEARANCE

- Dr Selvakumar R, Scientist cleared his probation w.e.f.1st July,2017
- Dr Sajad Un Nabi, Scientist cleared his probation w.e.f.5th July,2018
- Sh.Mohd Nuzafer Lone, LDC cleared his probation w.e.f.13th April, 2017
- Sh.Rouf Ahmad Sheikh, LDC cleared his probation w.e.f.16th April, 2017