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ICAR

वार्षिक प्रतिवेदन
ANNUAL REPORT
2011-12





केन्द्रीय शीतोष्ण बागवानी संस्थान
श्रीनगर, जम्मू एवं कश्मीर

Central Institute of Temperate Horticulture
Srinagar, Jammu and Kashmir

वार्षिक प्रतिवेदन
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Newly released varieties of Walnut (CITH Walnut 6 to 10)

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कार्यकारी सारांश

शीतोष्ण बागवानी फसलों का उत्पादन एवं उत्पादकता बढ़ाने के लिए अनुवांशिक सुधार, उत्पादन, संरक्षण एवं पच्छ तुड़ाव प्रबंधन का अनुसंधान कार्य संस्थान के मुख्य परिसर, श्रीनगर एवं क्षेत्रीय अनुसंधान केन्द्र, मुक्तेश्वर में किया गया और इसके परिणामों का सारांश इस प्रकार है।

फसल सुधार एवं जैव प्रौद्योगिकी

एक अच्छी किस्म उत्पादकता एवं गुणवत्ता बढाने के लिए बहुत महत्वपूर्ण है। अखरोट में 5 किस्में जैसेकि सी. आई. टी. एच. अखरोट–6, सी. आई. टी. एच. अखरोट–7, सी. आई. टी. एच. अखरोट–8, सी. आई. टी. एच. अखरोट –9 एवं सी. आई. टी. एच. अखरोट–10; चैरी मे दो किस्में जिनके नाम सी. आई. टी. एच. चैरी–1 और सी. आई. टी. एच. चैरी–2; सेब मे सी. आई. टी. एच. लोध सेब–1 और लहसुन में सी. आई. टी. एच. लहसुन (मु.)–1, संस्थान की किस्म रीलीज समिति द्वारा जारी की गई। इन किस्मों को बढ़ाकर इनका मूल्यांकन पूरे शीतोष्ण क्षेत्रों में करने के बाद राष्ट्रीय स्तर पर अनुमोदन किया जायेगा।

प्रक्षेत्र जीन बैंक में शीतोष्ण फसलों के 2116 जननद्रव्यों का मूल्यांकन एवं अनुरक्षण किया गया। सेब की स्थानीय किस्म अंबरी से 14 नई किस्में जिला सोफीयां, बारमूला एवं बड़गांव से एकत्रित की गई जो कि वांछिक गुणों में अच्छी पाई गई और इनके मूल्यांकन के लिये इनका संवर्धन किया गया। विभिन्न सेब की किस्मों के मूल्यांकन में कूपर फोर से 29.12 टन/है., रोयाल डिलिसियस से 27.67 टन/है. एवं वैलस्पर से 26.16 टन/है. पैदावार प्राप्त की गई। अखरोट की मूल्यांकित की गई किस्मों में सी. आई. टी. एच. अखरोट–1 से ज्यादा वजन (24.43 ग्राम), गिरी का वजन 13.5 ग्राम तथा गिरी 55.25 प्रतिशत प्राप्त हुई। सी. आई. टी. एच. अखरोट–6 में वजन 23.45 ग्राम, गिरी का वजन 11.86 ग्राम तथा 50.57 प्रतिशत गिरी के अखरोट प्राप्त किये गये।

बादाम में 30 जननद्रव्यों का प्रक्षेत्र जीन बैंक में पैदावार एवं अन्य रूपात्मक गुणों के लिए मूल्यांकन किया गया जिसमें सी. आई. टी. एच. बादाम–12 से 8.56 कि. ग्रा./पौधा पैदावार प्राप्त हुई। इसके अलावा कुछ अन्य किस्मों का भी चयन किया गया जिनकी गिरी प्रतिशत 50 से ज्यादा है और इनका बीजू मूलवृंत पर प्रवर्धन किया गया। खुबानी के 55 जनद्रव्यों का पैदावार एवं गुणवत्ता के लिए मूल्यांकन किया गया जिसमें सी. आई. टी. एच. खुबानी–1 में सबसे ज्यादा 161.35 कि. ग्रा. /पेड़, सी. आई. टी. एच. खुबानी–2 में 134.09 कि. ग्रा./पेड़ पैदावार प्राप्त हुई। सबसे ज्यादा कुल घुलनशील पदार्थ (29.82 °ब्रीक्स) सी. आई. टी. एच. खुबानी–33 में दर्ज किया गया।

चैरी में 21 नये आशाजनक जनद्रव्य चयनियत किये गये जिसमें सी. आई. टी. एच. चैरी–24 एवं 28 गुणवत्ता के आधार पर अच्छी पाई गई। चैरी की आठ किस्मों के मूल्यांकन में स्टैला और ग्वने नवायर हेटिव में सबसे पहले फूल आये तथा प्राकृतिक परिस्थिति में सबसे ज्यादा पैदावार (16.85 कि. ग्रा. /पेड़) वीगेरियो नैपोलियन किस्म से प्राप्त की गई।

आड़ू में फैंटासिया, क्रेस्ट हैवन, रैड ग्लोब और निमला पैदावार की दृष्टि से अच्छी पाई गई। सबसे ज्यादा वजन के फल निमला से एवं सबसे ज्यादा विटामिन सी एलबर्टा किस्म के फलों में दर्ज की। नाशपाती में सबसे ज्यादा वजन (318. 13 ग्राम) और लम्बाई (160.7 से. मी.) के फल विलियम वार्टलैट मे और सबसे छोटे फल (69.71 ग्राम) कोसिया किस्म से प्राप्त हुये तथा सबसे ज्यादा फल दृढ़ता (70.30 पौंड/ईंच) सैवेरेन्टा किस्म के फलों में नापी गई।

प्लम की 25 किस्मों में से 23 ने फल धारण किये और ज्यादा पैदावार कैंटों–5 (26.38 कि. ग्रा./पेड़), मोनारच (25.53 कि. ग्रा./पेड़), सैंटारोजा (20.48 कि. ग्रा./पेड़) एवं ऑ चैरी (20.45 कि. ग्रा./पेड़) में प्राप्त हुई। सबसे ज्यादा कुल घुलनशील पदार्थ ब्लैंक ब्यूटी (21.67 °ब्रीक्स), ब्यूटी (20.90 °ब्रीक्स), करासीविका (19.70 °ब्रीक्स), एवं प्रून (19.40 °ब्रीक्स) के फलों में पाये गये। जैतून में कोरोटीना और पैण्डोलिनों पैदावार की दृष्टि से अच्छी पाई गई। कोरोटीना किस्म में सबसे ज्यादा तेल, गुदा और तेल मे परआक्सीडेज

पाये गये एवं सबसे ज्यादा ऑलिक एसिड, मैसेनीज, सीप्रेसीनो एवं फ्रंटियों के फलों में पाये गये। अनार के आठ जननद्रव्यों में ढोलका, बेदाना एवं कंधारी किस्में पैदावार की दृष्टि से काश्मीर की करेवा स्थिति के लिए अच्छे पाये गये और इनका व्यावसायिक खेती के लिये अनुमोदन किया गया। मूलवृंतो के शोध मे सबसे ज्यादा लम्बाई की जड़े सेब के मूलवृंत एमला–106 एवं सी. आई. टी. एच.–03 में एवं सबसे ज्यादा प्राथमिक जड़े एम एम–106 मे और सबसे कम सी. आई. टी. एच.–05 मे दर्ज की। इसी तरह सबसे ज्यादा दूसरे क्रम की जड़ें सी. आई. टी. एच.–01 और सी. आई. टी. एच.–04 मूलवृंत में पाई गई।

संकरण कार्यक्रम के अन्तर्गत, सेब की 55 किस्मों के बीच संकरीकरण किया गया जिसमें से दस के बीज प्राप्त एवं उत्पन्न हुये जिन्हे मूल्यांकन के लिए पैवन्द किया गया। चैरी की स्टैला किस्म मे सब किस्मों की पराग संगतता से ज्यादा फल धारण हुये। बादाम की सभी किस्मों मे पराग जीव शक्ति ज्यादा पाई गई तथा पैदा होने की क्षमता सबसे ज्यादा वारिस किस्म में तथा सबसे ज्यादा पराग पैदावार क्षमता मरसीड किस्म मे पाई गई।

अखरोट की 100 किस्मों के फूल अध्ययन मे, 27 किस्मों में मादा फूल और अन्यों में नर फूल पहले आये। 25 किस्मों में नर और मादा फूलों मे 7 से 14 दिनों तक मिलाप समय के कारण आशाजनक परागण हुआ।

मिर्च में 270 लाइंस का परीक्षण किया गया जिनमें से 10 आशाजनक जनद्रव्य जिनकी पैदावार 342.29 से 448 कि./है. को चिन्हित किया गया तथा सी. आई. टी. एच. –655–1 से 448 कि./है. पैदावार प्राप्त की गई। सबसे बड़ी मिर्च (15.52 ग्राम) सी. आई. टी. एच. एच पी 1011–2 तथा सबसे ज्यादा मिर्चे (143) सी. आई. टी. एच. एच पी 699–1 से प्राप्त हुई। शिमलामिर्च की 48 लाइंस में से 10 लाइंस चिन्हित की गई जिनकी पैदावार क्षमता 637.28 से 905.43 कि./है. है। शिमला मिर्च एस एच एस पी – 603 (905.43 कि./है.), एस एच एस पी – 706 (818.39 कि./है.) एवं सी. आई. टी. एच. एस पी–1 (815.84 कि./है.) पैदावार की दृष्टि से अच्दी पाई गई। सबसे ज्यादा वजन के फल (94 ग्राम) एस एच एस पी–603 से प्राप्त हुये और सी. आई. टी. एच.–4 मे सबसे ज्यादा 37 फल प्राप्त हुये। इसी तरह बैंगन मे 19 लाइंस का मूल्यांकन किया गया। जिसमे से सी आई टी एच वी (आर) पैदावार (932.59 कि./है.) की दृष्टि से अच्छी पायी गई। सबसे ज्यादा फल (34.33) एवं सबसे ज्यादा वजन के बैंगन (108 ग्राम) क्रमशः सी. आई. टी. एच. वी (एल)–2 एव सी. आई. टी. एच. वी (एल)–11 में पाये गये।

प्याज में 13 नये जननद्रव्यों का मूल्यांकन किया गया जिनसे आशाजनक परिणाम प्राप्त हुए। इन जननद्रव्यों की पैदावार 399.54 कि. से 1061.20 कि./है. प्राप्त हुई तथा सी. आई. टी. एच. प्याज–10 पैदावार (1661–20 कि./है.) की दृष्टि से अच्छी पाई गई। लहसुन मे 5 नये जननद्रव्य लाये गये तथा इसमें सबसे अच्छा सी. आई. टी. एच. जी – 2 जिसकी पैदावार क्षमता 212.25 कि./है. पाई गई।

केसर के मूल्यांकन के आधार पर सी. आई. टी. एच. –125 (4.5 कि.ग्रा./है.), सी. आई. टी. एच.–123 (4.3 कि.ग्रा.), सी. आई. टी. एच.–124 (4.3 कि.ग्रा.), सी. आई. टी. एच.–122 (4 कि.ग्रा.), सी. आई. टी. एच.–12 (4.5 कि.ग्रा.), सी. आई. टी. एच.–121 (3.9 कि.ग्रा./है.), सी. आई. टी. एच. –107 (3.8 कि.ग्रा.), सी. आई. टी. एच.–120 (3.8 कि.ग्रा.) एवं सी. आई. टी. एच.–104 (3.7 कि.ग्रा.) अच्छे पाये गये।

शीतोष्ण फलों में विविधीकरण के लिये, नए फसलों जैसे की कैपगुजबैरी एवं हस्कटोमैटो का मूल्यांकन किया गया। इसके अलावा हैजलनट, पीकान, जापानी फल, चाइनीज बैर एवं फीजोआ के जननद्रव्य भी मूल्यांकन के लिये लगाये गये।

सजावटी, औषधीय एवं सुगंधित पौधों में 50 जरबेरा जननद्रव्यों का मूल्यांकन किया गया जिनमे जी–6, जी–15, जी–16, जी–17, जी–18, जी–19 एवं जी–20 आशाजनक पाये गये। इसके अतिरिक्त अल्स्ट्रोमेरीया, लीलीयम, ग्लेडियोलस एवं गुलदावदी के जननद्रव्य भी मूल्यांकन हेतु लगाये गये।

चैरी व सेब की सूक्ष्म प्रवर्धन तकनीक/प्रोटोकॉल का मानकीकरण किया गया। इसके अलावा प्रान के 10 जन्नद्रव्यों की आनुवांशिक विविधता के आर ए पी डी मार्कर द्वारा परखा गया। इनविट्रो वातावरण में स्त्रीकेसर के तरह सरंचना के विकास हेतू फूलों के भागों को एल. एस. एम एस एवं गेमबोरग मीडिया एवं भिन्न–भिन्न मिश्रण के फायटोहारमोन में उगाया गया और आधे अंडाश्य में स्त्रीकेसर की तरह संरचना दिखाई दी। फूल के भागों से भिन्न–भिन्न फायटोहारमोन के मिश्रण द्वारा भी पुरी स्टिगमा की तरह संरचना का विकास पाया गया।

फसल उत्पादन एवं प्रवर्धन

सेब : सेब में दूसरे तरीकों की तुलना में चीप पेबन्द सबसे उत्तम पायी गयी। अधिक उत्पादन के लिए मध्यम एवं उच्च सघन्ता पौधरोपण क्लोनल मूलवृंत एम एम–106 पर

परीक्षण किया। 2.5 × 2.5 मी. पौधरोपण से सबसे ज्यादा पैदावार 17.49 टन/है. एव 11.92 टन/है. क्रमशः स्टारक्रिमसन व आरीगन स्पर में दर्ज की गई। 2.5 ×3.5 मी. पौध रोपण में सबसे ज्यादा पैदावार (63.91 टन/है.) अम्बरी किस्म से तथा (58.75 टन/है.) मोलीस डिलिसियस से प्राप्त हुई। उसी प्रकार से 3.0 × 3.5 मी. में मोलीस डिलिसियस (40.74 टन/है.) व रेड चीफ में (10.97 टन/है.) प्राप्त हुई। 3.5 × 3.5 मी. में मोलीस डिलिसियस में सर्वाधिक (59.93 टन/है.) प्राप्त हुई। बीजू मूलवृंत पर 4 ×4 मी. की दूरी पर रेड गोल्ड से सबसे ज्यादा उपज (28.61 टन/है.) इसके बाद ऑरगोन स्पर (22.74 टन/है.) तथा स्टारकिंग डिलिसियस (20.21 टन/है.) से प्राप्त हुई। सौर ऊर्जा दोहन एवं अन्य स्रोतों के कुशल उपयोग हेतू एम–9 मूलवृंत पर अलग अलग दूरी पर संधाई प्रकारों का अध्ययन किया गया। मॉडीफाइड सैंट्रल लीडर सधाई प्रकार मे अधिक फूल व फलों की पैदावार विस्टाबिला किस्म में प्राप्त हुई जबकि हेड व स्प्रेड प्रकार से स्टार क्रिमसन किस्म मे, व स्पीन्डल बुश सधाई प्रकारों में लगे 95% फलों में से 90% का रंग अच्छा पाया गया। उसी प्रकार से स्टारक्रिमसन मे हेड एन्ड स्प्रेड सधाई प्रकार में बाहरी, मध्य व आंतरिक केनॉपी में सबसे ज्यादा फलो की रंग गहनत्ता प्राप्त हुई। मॉडीफायड सेट्रल लीडर सधाई प्रकार में मॉलीस डिलिसियस किस्म में सबसे ज्यादा वजन (251.25 ग्राम) के फल प्राप्त हुये। जल संचय तकनीकियों में पूर्ण मून विधि में सबसे ज्यादा तना क्रॉस अनुभागीय क्षेत्र (104.65 सेमी^{2}), केनोपी का फैलाव (1.78 मी.) एवं फलों की पैदावार (22.32 किग्रा/पेड़ एवं 13.33 टन/है.) प्राप्त हुई प्लास्टिक मल्च, तना क्रॉस अनुभागीय क्षैत्र केनोपी फैलाव एवं फल पैदावार की दृष्टि से उत्तम पायी गयी।

सेब की किस्म स्टार क्रिमसन के एकीकृत पोषण प्रबंधन में 5वें, 6वें, 7वें, 8वें एवं 9वें वर्ष में 50 किग्रा गोबर की खाद + 10 किग्रा केंचूआ खाद + 50 ग्रा. नत्रजन + 250 ग्रा. पोटाश और 60 किग्रा गोबर की खाद + 13 किग्रा केंचूआ खाद + 30 ग्राम नत्रजन + 30 ग्रा. फास्फोरस + 225 ग्रा. पोटाश से आशाजनक परिणाम प्राप्त हुए। वसंत, गर्मी और सर्दीयों में सड़े पत्तों एवं काली प्लास्टिक मल्च महत्वपूर्ण पायी गई। केचूआ तथा यह गोबर खाद मिश्रण दिये बिना भी किसी भी तत्व की कमी के रसायनिक खादों की खेप में कमी लायी। विभिन्न फसल पद्धितियों में सेब+मेथी मे सबसे ज्यादा (165.90 कि./है.) पैदावार प्राप्त हुई जबकि सेब उपज, सेब + मसूर (81.54 कि./है.) तत्पश्चात् सेब+लाल तिपतिया घास से प्राप्त हुई। सर्वाधिक (9.80 किग्रा/है.) मृदा नत्रजन, सेब + मसूर फसल पद्विति से तथा सर्वाधिक मृदा पोटाश, सेब + मेथी से प्राप्त हुई सबसे ज्यादा मुनाफा (1:3.71) सेब + मेथी से मिला।

बादाम : बादाम में पौध सघनता को 1600–816 पेड़/है. करने पर तना क्रॉस अनुभागिय क्षेत्र में वृद्धि पायी गई। सर्वाधिक फल संख्या (910), तना क्रॉस अनुभागिय क्षेत्र (115. 04 सेमी^{2}) और उपज (2.41 किग्रा/पेड़) 3.5×3.5 मी. रोपण अंतराल से वारिस किस्म में जबकि इसी किस्म में 2.5×2.5 मी. के अन्तराल में सबसे ज्यादा उपज (2.6 टन/है.) प्राप्त हुई। इसी प्रकार 4×4 मी. रोपण अन्तराल में वारिस किस्म में सर्वाधिक तना क्रॉस अनुभागीय क्षेत्र (181.86 सेमी^{2}) एवमं नट संख्या (940) पायी गयी जबकि सबसे ज्यादा पैदावार (2.62 किग्रा./पेड़) एवं (1.64 टन/है.) प्रनयाज किस्म से प्राप्त हुई। वर्षा जल संचयन पद्धितियों में सबसे ज्यादा तना क्रॉस अनुभागीय क्षेत्र (244.6 सेमी^{2}) एवम नट पैदावार (2.37 किग्रा/पेड़ 1.49 टन/हैं) पूर्ण मून पद्धिति में पायी गयी। विभिन्न मल्चों में प्लास्टिक मल्च में सबसे ज्यादा नमी की मात्रा तथा इसके बाद जैविक मल्च में दर्ज की गयी। एकीकृत नत्रजन प्रबंधन में सर्वाधिक तना क्रॉस अनुभागीय क्षेत्र (125.99 सेमी^{2}) (125%) आर. डी. एफ में मिला जबकि नट संख्या (815), नट वजन (2.75 ग्रा.) व उपज (2.24 किग्रा/पेड़ एवम 1.82 टन/है.) वारीस किस्म में 40 टन गोबर की खाद के उपयोग से प्राप्त हुई। वारीस किस्म में फर्टीगेशन द्वारा दी गयी आर.डी.एफ से सर्वाधिक तना क्रांस अनुभागीय क्षेत्र (64.85 सेमी^{2}) एवं नट संख्या (990/पेड़) प्राप्त हुई जबकि सर्वाधिक नट वजन एवं उपज (2.73 ग्राम, 2.41 किग्रा/पेड़, 2.67 टन/है.) 75% आर डी एफ फर्टीगेशन द्वारा दर्ज किये गये।

चैरी : चैरी में 3×3 मी. पौध सद्यनता में सर्वाधिक पैदावार (6.37 टन/है.) एवं पैदावार क्षमता वेन किस्म में दर्ज की गयी इसी प्रकार 2.5×2.5मी सद्यनता में सर्वाधिक पैदावार क्षमता बीगेरिया नेपोलियन किस्म से प्राप्त हुई।

खुबानी : खुबानी में दो पौध सघनताओं तथा 4 किस्मों के मूल्यांकन में सबसे ज्यादा तना क्रांस अनुभागिय क्षेत्र (123. 59 सेमी^{2}) एवम फल पैदावार (161.34 किग्रा/पेड़) सी. आई. टी. एच.–खुबानी–1 में (400 पेड़/है.) में जबकि सबसे ज्यादा पैदावार प्रति है. (68.40 टन/है.) 816 पेड़/है. की सद्यनता में दर्ज की गयी।

आड़ू : आड़ू में 2.5×2.5मी. पौध सघनता में सर्वाधिक फल वजन (99.97 ग्राम) व पैदावार (34–56 किग्रा/पेड़) ग्लोहेवन किस्म में तथा 3×3 मी में सर्वाधिक पैदावार (38–38 किग्रा/पेड़) रेड ग्लोब किस्म में दर्ज की गई। विभिन्न सधाई प्रकारों में 2.5×2.5 मी. पौध रोपण सघनता में टटुरा ट्रेलिस तथा 3×3 मी. में फोर स्केफोल्ड प्रकार में सर्वाधिक उपज व अच्छी गुणवत्ता के फल फेनटेसिया, ग्लोहेवन व रेड ग्लोब किस्मों में दर्ज किये गये। नेकटरिन में जिंक सल्फेट 200 पी.पी.एम+ जिबरेलिन 50 पी.पी.एम के उपयोग से फल त्वचा रजट्रिग में कमी दर्ज की गयी तथा सबसे अच्छा सधाई प्रकार टटुरा ट्रेलिस पाया गया। जैविक पैदावार की दृष्टि से, केचूआ खाद+ मायकोराइजा, नादीप + माइकोराइजा एवम गोबर की खाद+ माइकोराइजा के परिणाम आशाजनक पाये गये।

स्ट्राबेरी : स्ट्राबेरी में फल उपलब्धता व गुणवत्ता को बढ़ाने हेतु 22 जन्नद्रव्यों को 4 उत्पादन अवस्थाओं में मूल्यांकन के दौरान फल आने की अवधि (203.95 दिन) जल्दी दर्ज की गई तथा फल उपलब्धता 4 सप्ताह (30 दिनों) तक बढ़ी। केटरीन स्वीट के फल पॉली टनल में सबसे पहले परिपक्व हुए तथा सर्वाधिक पैदावार (33.40 कि./है.) स्ट्रा मल्च में दर्ज की गई।

सब्जियों की संरक्षित खेती

टमाटर के 6 संकर किस्मों में सर्वाधिक पैदावार हिमसोना (957.36 कि./है.) इसके बाद सी. आई. टी. एच. –1 (842.76 कि./है.) एवं एस एच –1 (772.88 कि./है.) में पाई गई। खीरा में जापानीज लांग ग्रीन (602.27 कि./है.) पैदावार की दृष्टि से उत्तम पायी गयी। सधाई और पौध अन्तराल के अध्ययन में दो तना तथा 75×50 सेमी (सी. आई. टी. एच–1) टमाटर में, खीरा में जापानीज लॉगग्रीन 120×60 सेमी पौध अन्तराल तथा शिमला मिर्च में (एस एच एस पी एच–2) 20×50 सेमी अन्तराल में अच्छी पायी गयी।

प्याज एकीकृत पोषण प्रबंधन तथा खरपतवार नियंत्रण के अध्यन से पता चला कि स्थानीय सुझाव+बायोफर्टीलाइजर एवं खरपतवार नियत्रण आक्सीफ्लूरोफेन 23.5% ई सी को प्रयोग में उत्तम पाया गया है।

जरबेरा : जरबेरा में डुन, रोसालिन एवं दाना ऐलन दोनो उत्पादन परिस्थितियों में (खुला व संरक्षित) अच्छी पायी गयी।

ट्यूलिप : ट्यूलिप में जिबरेलिन 400 पी. पी. एम के प्रयोग से सबसे जल्दी प्रस्फुटन, सर्वाधिक पौध ऊँचाई, पत्तों की संख्या एवं कंद संख्या/पौध दर्ज की जबकि 12 हफ्ते के कोल्ड स्टोरेज में पत्तों की संख्या व कंद/पौधा में बढ़ोतरी दर्ज की गई। फूलो की सबसे लम्बी वेज लाइफ अवधि 8 एच. क्यू. एस. 300 पी. पी. एम मे दर्ज हुई।

न्यूट्रास्यिूटिकल एवं एन्टीऑक्सीडेन्डस

स्ट्राबेरी, हस्क टोमेटो, केपगुजबेरी, रोजहीपस एवं केल में न्यूट्रास्यिूटिकल व एन्टीऑक्सीडेन्डस की उपलब्धता एवं विविधता का मूल्यांकन किया गया जिसके परिणाम काफी उत्साहजनक है। स्ट्राबेरी में कुल एंटीआक्सीडेन्टस मात्रा की रेंज (203.13–471.10) तथा जबकि केपगुजबैरी में (45.55–94.10%) हस्क टोमेटो मे (42.54–84.64%) रोज हिप्स में (62.10–93.14%) और केल में (46.16–82.16%) एंटीऑक्सीडेट क्षमता की रेंज (अवरोधक प्रतिशतता) पायी गयी।

केसर : केसर की खेती में फव्वारा तथा बूंद बूंद सिचाई पद्धित से पहले फूल आना तथा पौध बढ़वार वर्षा सिंचित की तुलना में अच्छा पाया गया। इसी तरह उभरी हुई क्यारी में (15 लाख/है.) कंद लगाने से सर्वाधिक उपज प्राप्त हुई।

मृदा विज्ञान : सी. आई. टी. एच. श्रीनगर के शीतोष्ण फलों के अनुसंधान प्रक्षेत्रों का मृदा श्रेणीकरण एवं पोषण सर्वेक्षण किया गया जिसमे मृदा पी एच 6.23 से 7.69 तक पायी गयी।

बादाम के पुराने वृक्षों का जीर्णोद्धार : पुराने बादाम के बागों का जीर्णोद्धार के लिए, पुराने वृक्षों की छटाई तथा टाप वर्किंग वारिस किस्म से किया गया तथा साथ में 50 किग्रा. सड़ी गोबर की खाद, 500 ग्राम नत्रजन, फास्फोरस 250 ग्राम, पोटाश 750 ग्रा. प्रति पेड़ और पूर्ण मून जल संचय पद्धित + प्लास्टिक मल्च का परिणाम आशाजनक पाया गया।

पौध स्वास्थ्य प्रबंधन

मिर्च में म्लानि रोग एक प्रमुख समस्या है। अधिकतम रोग शमन (63.05%) ट्राइकोडरमा विरडी, बीज प्राइमिंग, कार्बेन्डाज़िम में मूल डुबोकर तथा मृदा मे मिलाकर सफेद प्लास्टिक से सोलेराइजेशन से किया जा सकता है। केसर के घनकंद विगलन रोग की रोकथाम के लिए कार्बोन्डाज़िम 0.2% प्रभावशाली पाया गया जबकि सेब के चूर्णिल आसिता रोग की रोकथाम के लिए केरोकसीम मीथायल (0.05%) अच्छा पाया गया। बादाम में 5.45% फलों में गमोसिस रोग पाया गया। शीतोष्ण फलों में कीट आबादी की गतिशीलता के अध्ययन के दौरान फ्ली बीटल का गंभीर प्रकोप पाया गया। प्राकृतिक कीट शत्रु के अध्ययन में, 14 प्रजाति के 12 जातियों

से सम्बंधित हिंसक कोकसीनेलीड़स दर्ज किये गये। हरित गृह में उगाये गये टमाटर, खीरा व शिमला मिर्च में महू की रोकथाम के लिए डाइमीथोएट 0.06% प्रभावशाली पाया गया। मधुमक्खी पालन में वेस्प के प्रबंधन के लिए मछली मास वेस्प रिझाने में उपयोगी साबित हुआ।

पच्छ तुडाई प्रबंधन

शिमला मिर्च को सोडियम हाइपोक्लोराइड 100 पी. पी. एम तथा सीट्रीक अम्ल (1% से) द्वारा उपचारित करने के बाद 19 माइक्रोन सेमीपरमीएबल फिल्म से सीलबंद करके 30±2 दिनों तक सामान्य तापमान तथा 45–48 दिनों तक कम तापमान पर न्यूनतम वजन कमी व अधिकतम गुणवत्ता पायी गयी।

चेरी में एलोवेरा जेल का एडिबल कोटिग की 50% सान्द्रता तथा कम तापमान भंडारण (5±1°से., नमी 90%) से सेल्फ लाइफ को 40 दिनों तक बढ़ाया जा सकता है।

स्रिंक रेप्ड फेन्टेसिया नेक्टरिन फल को न्यूनतम तापमान (5±2°से., नमी 90%) पर 40 दिन तक सबसे कम फल वजन में कमी के साथ तथा अच्छी गुणवत्ता से भंडारित किया जा सकता हैं।

सेब किस्म मॉलिस डिलिसियस को (1:1) एलोवेरा जेल से कोटिंग एवं 25 माइक्रोन की फिल्म से स्रिंक रेप्ड करके तथा न्यूनतम तापमान (5±2°से.) पर बिना नुकसान के 68 दिनों तक रखा जा सकता है। इसी प्रकार 25 माइक्रोन की फिल्म से स्रिंक रेप्ड गोल्डन व रेड चीफ को लम्बे समय के भंडारण के लिए उचित पाया गया।

जैतुन में अधिकतम तेल प्राप्ति के लिए अक्टूबर के दूसरे हफ्ते से नवम्बर के दूसरे हफ्ते तक तुड़ाई करना श्रेष्ठ दर्ज किया गया। आड़ू की क्रेस्ट हेवन किस्म को (16 दिनो तक सामान्य तापमान तथा 28 दिनों तक कम तापमान 4°से. तक) ज्यादा समय तक भंडारण के लिए बर्फ का पानी + कैल्सियम क्लोराइड 2% व साइकलिक हीट प्रभावशाली पाया गया है।

उत्पाद विविधकरण के अन्तर्गत नये फलों जैसे की केपगूसबेरी और शहतूत के मूल्यवान उत्पाद बनाये गये। इसी तरह माल्टा (20%) और अदरक (5%) का स्कवेश बनाया गया जोकि 3 महीनें तक भंडारित किया जा सकता है। इसके आलावा रोड़ोडैन्डरोन, काफल, किलमोरा, गलगल और अदरक से विभिन्न शान्द्रता के मूल्यवान उत्पाद भी बनाये गये, जिनमें सबसे अच्छा स्क्वैश रोड़ोडैन्डरोन (15%) + गलगल (5%) + अदरक (5%) के मिश्रण से बनाया गया।

सेब को लम्बे समय तक भण्डारित करने हेतु कैल्शियम प्रभावशाली पाया गया। इसी प्रकार सैलिसिलिक अम्ल आड़ू और नाशपाती की भण्डारण अवधि को बढ़ाने के लिए उपयोगी पाया गया।

संस्थान की भिन्न–भिन्न तकनीको के प्रसार एवं हस्थांनतरण हेतु प्रशिक्षणों, दौरों और खेत प्रर्दशनों द्वारा 4000 किसानों को तकनीकी सहायता एवं परामर्श प्रदान किया गया। संस्थान में अलग–अलग अवधि के 25 प्रशिक्षण पाठ्यक्रम किसानों एवं प्रसार अधिकारियों के लिए आयोजित किए। संस्थान से 17 शोध पत्र, 2 समीक्षा पत्र, 1 पुस्तक, 3 पुस्तक अध्याय प्रकाशित हुए, इसी क्रम में बेहतर तकनीकों को किसानों तक पहुचाने हेतु 11 लोग प्रिय लेख, 14 बुलेटिन/पर्चे/ प्रसार फोल्डरस, विभिन्न भाषाओं में प्रकाशित किये। इसके अलावा किसानों के खेतो पर 122 तकनीकी प्रर्दशन भी लगाये गये ताकि तकनीको को बहुप्रिय एवं खेतो तक पहुचाया जा सके।

Executive Summary

To enhance the production and productivity of temperate horticultural crops, research work carried out in the field of crop improvement, crop production, plant health management and post harvest management during 2011-12 at Central Institute of Temperate Horticulture, Srinagar as well as Regional Station Mukteshwar and the results obtained are briefly summarized here.

Crop Improvement and Biotechnology

A good variety/ genotype is the most important component in enhancing productivity and quality of produce. After rigorous evaluation five varieties of walnut superior in yield and quality namely CITH-Walnut-6, CITH- Walnut -7, CITH- Walnut- 8, CITH-Walnut- 9 & CITH -Walnut -10; two genotypes in cherry viz. CITH- Cherry -1, CITH – Cherry- 2, one in apple namely CITH-Lodh Apple -1 and one in garlic namely CITH Garlic (M)-1 were released by Institute Release Committee. These varieties are now being multiplied and tested in entire temperate region of the country through network centers for release at national level.

A field gene bank consisting 2116 germplasm lines of temperate horticultural crops have been evaluated and maintained. In apple, 14 new Ambri selections were made from Shopian, Baramulla and Budgam district of Kashmir which seems to have superior desirable traits and have been grafted/ budded for further evaluation in future. Among various apple cultivars evaluated, Cooper IV gave maximum yield of 29.22 tons/ha followed by Royal Delicious (27.67 tons/ha) and Well Spur (26.16 t/ha). In walnut, among the evaluated genotypes CITH–W -1 recorded highest inshell nut weight (24.43 g) and kernel weight (13.5 g) with good kernel recovery (55.25%), followed by CITH-W-6 having in shell nut weight (23.45 g), kernel weight (11.86 g) and kernel recovery of 50.57 percent.

In almond, 30 varieties/ genotypes were established in field genebank for evaluation of yield and other morphological traits. Among genotypes, the maximum yield (8.56 kg/tree) was recorded in CITH-Almond-12 whereas; besides evaluation more elite genotypes of almond were also collected having good nut and kernel recovery of more than 50%. The bud wood of all the genotypes have already collected and budded on seedling rootstocks. In apricot, a total 55 germplasm/varieties were evaluated for yield and quality. The highest fruit yield (161.34 kg/tree) was harvested in CITH-Apricot-1 followed by CITH-Apricot-2 (155.35 kg/tree) and CITH-Apricot-3 (134.09 kg/tree). However, maximum total soluble solids (29.82 ^{0}B) was estimated in CITH-Apricot-33 followed by CITH-Apricot-31 (27.97 ^{0}B) and CITH-Apricot-24 (26.67 ^{0}B)

In cherry, 21 new promising cherry clones were identified through extensive survey on the basis of quality attributes, two best selections namely CITH-Cherry-24 and CITH-Cherry-28 were found promising. From evaluation of eight cherry varieties Stella and Guigne Noir Hative flowered early while highest fruit set percent and yield (16.85 kg/tree) in Bigarreau Napoleon under natural conditions. In peach/nectarine, Fantasia, Crest Heaven, Red Globe, Glovheaven and Nimla found very promising with maximum yield/plant. Highest fruit weight recorded in Nimla followed by Glo Heaven and Red Globe, however highest TSS was recorded in Glo Heaven followed by Crest Heaven. Ascorbic acid content was found maximum in Elberta followed by Fertilia and Summerglo. In pear, highest fruit weight (318.13g) was noted in William Bartlett followed by Doyenne-du-Comice (204 g), whereas smallest fruits were found in Coscia (69.71g). Similarly longest fruits were measured in William Bartlett (100.7 cm) where as highest fruit firmness recorded in (74.30 lb/inch) in Severenta.

In plum, among 25 varieties 23 came into bearing with maximum fruit yield (26.38 kg/tree) in Kanto-5 followed by Monarch (25.53 kg/tree), Santa Rosa (20.48 kg/tree) and Au-Cherry (20.45 kg/tree). However, highest total soluble solids (21.67 ^{0}B) was estimated in Black Beauty followed by Beauty (20.90 ^{0}B), Krassivica (19.70 ^{0}B) and Prune (19.40 ^{0}B).

In olive, maximum fruit weight and yield per plant recorded in Coratina followed by Pendolino. In terms of physico-chemical properties, Coratina yielded maximum percentage oil recovery, peroxides value of oil and pulp weight. However maximum oleic acid in fruits was found in Messenese followed by Cipressino and Frontoio.

In pomegranate, among eight genotypes cv. Dholka, Bedana and Kandhari performed better in terms of yield under Karewa conditions of Kashmir valley and recommended for commercial cultivation in the temperate zone.

In a rootstock study of apple, significantly largest root length was recorded in apple rootstock EMLA-106, followed by CITH-03. Number of primary roots were recorded highest in MM-106 and lowest in CITH-05 whereas highest average number of secondary roots were noted in CITH-01 and CITH-04.

In a hybridization programme of apple, 55 cross combinations were attempted involving 5 lines and 11 testers but only 10 crosses germinated which have been top budded/ grafted for further evaluation. Similarly in cherry, Stella gave highest fruit set with all pollen sources. The pollen viability in almond was high in all studied cultivars with highest pollen germination in Waris while pollen production efficiency was highest in Merced. In a floral biology study of 50 walnut genotypes, 27 genotypes were found protogynous and rest all were protandrous with 25 genotypes showing 7-14 days of male and female bloom overlapping, indicating synchrionized flowering for successful pollination.

In chilli, out of 270 lines tested ten promising genotypes were identified with fruit yield ranging from 342.29 to 448.00 q/ha. The genotype CITH-HP -655-1 (448.00 q/ha) was found best followed by CITH-HP -699-1 (438.00 q/ha) and CITH-HP -712-1(398.00 q/ha). Average fruit weight was highest in CITH-HP -1011-2 (15.52 g) followed by CITH-HP-260-2 (14.17 g) and maximum number of fruits per plant (143.0) was recorded in CITH-HP -699-1. In capsicum, out of 48 lines tested, ten promising genotypes were identified with a yield range of 637.28 to 905.43 q/ha. However SH-SP-603 (905.43 q/ha) was found best followed by SH-SP-706 (818.39 q/ha) and CITH-SP-1 (815.84 q/ha). Average fruit weight was highest in SH-SP-603 (94.0 g) followed by CITH-SP-2 (90.33 g) and maximum number of fruits per plant (37.0) was recorded in CITH-SP-4.

In brinjal, 19 lines were evaluated in open field conditions. CITH-B(R)-1 (932.59 q/ha) was found best followed by CITH-B (L)-6 (919.75 q/ha). Average fruit weight was highest in CITH-B(L)-11 (108.0 g) followed by CITH-B(O)-4-6 (100.0 g) and maximum number of fruits per plant (34.33) was recorded in CITH-B(L)-2.

In onion, thirteen new accessions of long day type were collected from onion growing areas of valley and evaluated for higher yield and better quality. All the accessions performed well and produced 100% A grade bulb with yield ranging from 399.54 to 1061.20 q/ha. CITH-O-10 recorded highest yield at the tune of 1061.20 q/ha with highest average bulb weight (392.67g) followed by CITH-O-2 (976.13 q/h), CITH-O-14 (961.70 q/h) and CITH-O-4 (804.94 q/h). In garlic, five collection of long day type have been made and evaluated for various important traits. CITH-G-5 recorded highest plant height (109.75 cm) and number of leaves per plant (8.25). However highest yield was recorded in CITH-G-2 (212.25 q/h) closely followed by CITH-G-1 (202.99q/ha).

In saffron, based on performance, the best genotypes were found CITH-125 (4.5 kg/ha), CITH-123 (4.3 kg/ha), CITH-124 (4.3 kg/ha), CITH-122 (4.0 kg/ha), CITH-12 (4.5 kg/ha), CITH-121 (3.9 kg/ha), CITH-107 (3.8 kg/ha), CITH-120 (3.8 kg/ha) and CITH-104 (3.7 kg/ha) having higher saffron yield in their initial planting years.

In order to diversify the temperate fruits through introduction of new crops, evaluation work was carried out in cape goose berry and husk tomato. Besides these, exotic collections of hazelnut, pecan,

persimmon, chinese ber and feijoa were also planted in field gene bank.

In ornamental, medicinal and aromatic plants, 50 genotypes of Gerbera were evaluated and G-6, G-15, G-16, G-17, G-18, G-19 and G-20 were found promising.The germplasm of some more cut flowers like alstroemeria, lilium, gladiolus and chrysanthemum have been procured for evaluation in ensuing season.

In micro propagation study, protocol for cherry and apple has been standardized. Besides this, genetic diversity in 10 genotypes of Pran was also studied through RAPD markers. For development of stigma like structures under *in-vitro* conditions, floral parts were cultured on LS, MS, and Gamborg media supplemented with different combinations of phytohormones and stigma-like structures appeared on cultured half ovaries. Whole stigma development was also observed with some combinations of phytohormones from floral explants

Crop Production and Plant Propagation

Apple

Chip budding in apple found best compared to other methods. To maximise production, different varities were evaluated under medium and high dentisty plantings on clonal rootstocks MM-106. In 2.5x 2.5 spacing Starkrimson recorded highest yield (17.49 t/ha) followed by Oregon Spur (11.92 t/ha). In 2.5 x 3.5 m spacing cultivar Ambri resulted in highest yield (63.91 t/ha) followed by Mollies Delicious (58.75 t/ha). Similarly cultivar Mollies Delicious in 3.0 x 3.5 m spacing recorded highest yield (40.74 t/ha) followed by Red Chief (10.97 t/ha) but yield efficiency was less than Cooper IV.In 3.5 x 3.5 m spacing cultivar Mollies Delicious resulted highest yield (51.93 t/ha) followed by Starkrimson. In 4.0 x 4.0 m spacing on seedling rootstocks Red Gold resulted highest in yield (28.61 t/ha) followed by Oregon Spur (22.74 t/ha) and Starking Delicious (20.21 t/ha).

To harness natural light energy and efficient utilization of other resources, different training systems were tried at different spacings on M-9 rootstcoks. Vista Bella in modified central leader registered highest number of flower and fruits per plant. Starkrimson on head and spread and spindle bush training systems resulted 95% fruits having more than 90% colored skin fruit. Similarly on the surface, middle and inner canopy, maximum color intensity was recorded in Starksimson on head and spread training system. Fruit weight was registered highest 251.25g/fruit in Mollies Delicious on modified centre leader training system. Cultivar Spartan on espalier training system resulted in highest fruit and percentage of fruits having more than 90% colored fruits. Highest fruit weight was recorded in Granny Smith on single axis training system.

In water harvesting techniques, maximum trunk cross sectional area (104.65 cm^2), canopy spread (1.78 m) and fruit yield (22.32 kg/tree and 13.33 t/ha) were recorded in full moon water harvesting system in apple. Among mulches, plastic mulch gave better results in respect to TCSA, canopy spread and fruit yield under rainfed conditions.

Among integrated nutrient management in apple cv Starkrimson various treatments FYM 50 kg/plant + vermi-compost 10 kg/plant +50g N + 75 g P_2O_5 + 250 g K_2O and FYM 60 kg/plant + vermi-compost 13 kg/plant +30g N + 80 g P_2O_5 + 225 g K_2O were found best irrespective of black polythene or leaf mould mulching during 5^{th}, 6^{th},7^{th} , 8^{th} and 9^{th} years. Mulching with leaf mould or black polythene was found to be very crucial during the late winter, spring and summer season. Vermicompost and FYM combination has significantly reduced the load of inorganic fertilizers without any reduction in the total requirement of elemental form of N, P and K.

Among the cropping sequences, treatment consisting of apple + methi recorded highest apple equivalent yield (165.90 q/ha) Highest apple yield was observed with apple + lentil cropping system (81. 54 q/ha) followed by apple +red clover. Whereas, maximum soil nitrogen gain was observed in apple +lentil cropping system (9.80kg/ha). The treatment apple + methi , recorded maximum soil potassium gain and maximum cost benefit ratio (1:3.71).

Almond

In almond, trunk cross-sectional area of tree increased with decreasing the planting density from

1600 to 816 tree/ha. Maximum trunk cross sectional area of tree (115.04 cm^2), nut number (910) and nut yield (2.41 kg/tree) were recorded at 3.5 m x 3.5m spacing in Waris. Whereas, highest yield per hectare (2.68 t/ha) was recorded in Waris variety of almond at 2.5 m x 2.5 m spacing.

In a spacing of 4 m x 4 m, maximum trunk cross-sectional area of almond tree (181.85 cm^2) and nut number (940) were recorded in Waris. Whereas, nut yield (2.62 kg/tree and 1.64 t/ha) were recorded in Pranyaj variety of almond.

The results of rain water harvesting and conservation indicated that maximum trunk cross sectional area of tree (244.6 cm^2) and nut yield (2.37 kg/tree and 1.49 t/ha) were recorded in full moon water harvesting system. Among mulches, plastic mulch retained more moisture followed by organic mulch and minimum in control.

In an integrated nitrogen management study in almond, maximum trunk cross sectional area of tree (125.99 cm^2) was recorded through the application of 125% of RDF. Whereas, nut number (815), nut weight (2.75 g) and yield (2.24 kg/tree and 1.82 t/ha) were recorded in treatment of 40 t / ha farm yard manure in almond variety Waris.

In a fertigation study in almond variety Waris, maximum trunk cross sectional area of tree (64.85 cm^2) and nut number (990 /tree) were recorded by applying RDF through fertigation. Whereas, maximum nut weight and yield (2.73 g and 2.41 kg/tree and 2.67 t/ha) were recorded in 75% RDF through fertigation (applied N:K in the ratio of 2/3 N:1/3K at nut set to nut development and 1/3 N:2/3 K at nut development to maturation stage),and minimum in control.

Walnut

The higher grafting success were recorded by using rootstock of 25-30 mm and scion of 15-20 mm thickness through wedge grafting during middle of march.

Cherry

In cherry different planting densities were compared in which cultivar Van planted at 3.0 x 3.0 m spacing gave highest yield (6.37 t/ha) and yield efficiency. In 2.5 x 2.5 m spacing Bigarreau Napoleon (Double Gilas) resulted highest in yield and yield efficiency.

Apricot

Among two densities (816 plant /ha and 400 plant/ha) and four varieties (CITH-Apricot-01, CITH-Apricot-02, Harcot and Erani) highest trunk cross sectional area of tree (123.59 cm^2) and fruit yield (161.34 kg/tree) were recorded in CITH-Apricot -01 at the planting density of 400 plant/ha. Whereas, highest yield per hectare (68.40 t/ha) was recorded at plant density of 816 plant /ha.

Peach

In peach high density planted at 2.5 x 2.5 m gave maximum fruit weight (99.97g) and yield (34.56 kg) were recorded in cv. Gloheaven. However, under medium high density plantation on seedling rootstock at a spacing of 3 x 3 m accommodating 1111 trees per hectare, the maximum yield per tree was recorded in cv. Red Globe (38.38 kg). On the basis of performance and fruit quality of peach/nectarine genotypes it was observed that cultivars, Gloheaven and Red Globe are promising under high and medium high density respectively in the initial years.

In peaches among different training systems, maximum fruit set, fruit yield per tree, fruit yield/ha and fruit quality recorded in tatura trellis system of training in 2.5x2.5 m planting density however under 3x3m planting density in all the varieties maximum fruit set, fruit yield per tree, fruit yield/ha and fruit quality recorded in four scaffold (Fantasia, Gloheaven and Red Globe). While maximum light penetration in the canopy at different heights was recorded in tatura trellies training system followed by four scaffold system.

To minimize the skin russeting in nectarine minimum fruit skin russeting was recorded with $ZnSO_4$ 200 ppm+ GA_3 50ppm. However among training systems tatura trellis was found best. Fruit quality (TSS, ascorbic acid, acidity) was found best in tatura trellis training system with the treatment of GA_3 50 ppm as compared to control.

In organic production of peach, vermi-compost+ mycorrhiza, Nadep + mycorrhiza and FYM + mycorrhiza performed better over other treatments. The organically produced fruits were by and large found superior in quality attributes than control (inorganically produced).

Strawberry

To extend the availability span with superior fruit quality and higher yield, 22 varieties were evaluated under 4 growing conditions. The earliest harvesting was obtained under poly tunnel (203.95 days). The period of availability was enhanced up to 4 weeks (30 days) by using different growing conditions. Earliest maturing varieties under poly tunnel were Katrian Sweet, Dilpasand and Elastha (173days) while the highest yield was obtained respective of varieties under straw mulch (33.40q/ha). The variety Brighton recorded highest yield among all the tested varieties.

Protected cultivation of vegetables

In tomato, among 6 hybrids, Heemsona (957.36q/ha) followed by CITH-TH-1(842.77q/ha) and SH-TH-1 (772.88q/ha) were found best. While among three levels of pruning, double stem recorded highest yield (878.39q/ha) than single stem or natural. However average fruit weight was highest in single stem (41.97g) and fruit number in double stem (85.96). Among two spacing's, the spacing 75x50cm recorded highest yield of (843.38q/ha) than wider spacing 90x45cm. Considering all the three factors genotypes, pruning systems and planting densities, the highest yield was recorded in CITH-TH-1 (1094.23 q/ha.) pruned to double stem at the spacing of 75x50 cm.

In cucumber, variety Japanese Green Long (602.27q/ha) was found best while in hybrids, SH-CH-1(819.38q/ha) was the best having high yield and quality. Among pruning levels double stem recorded highest yield(759.94q/ha) than single stem or natural. However average fruit weight was highest in single stem (329.703g) and fruit number in double stem (17.77). Among spacing's the spacing 120x60cm recorded highest yield (712.01q/ha) than wider spacing 100x75. Considering all the three factors genotypes, pruning systems and planting densities, the highest yield was recorded in JGL (981.42q/ha.) pruned to double stem at the spacing of 120x60 cm.

In capsicum, SH-SP-706 with 701.90q/ha fruit yield performed better. However, among hybrids NS-281(946.54q/ha), Bombay (896.90q/ha), Shalimar capsicum hybrid-1(Y) (793.94q/ha) and Shalimar capsicum hybrid -2 (R) (764.97q/ha) were found best. While among pruning levels double stem recorded highest yield (846.53q/ha) than single or natural unpruned plants and the number of fruits were highest in double stem (10.84). Among spacings the spacing of 20x50cm recorded highest yield of (880.98 q/ha) than wider spacing of 30x50cm, however average fruit weight was highest in single stem(99.10g). Considering all the three factors genotypes, pruning systems and planting densities, the highest yield was recorded in SH-SPH-2 (1154.29 q/ha.) pruned to double stem at the spacing of 20 x 50 cm.

Onion

To increase the productivity, integrated nutrient management and weed management modules for long day onion were tried. Among various treatments the local recommendation with bio fertilizer recorded highest average bulb weight (248.11g) and total yield (97.54t/ha). While maximum weed control efficiency was observed with Oxyflurofen 23.5 %EC Goal) application before planting and second application after 30 days of transplanting.

Gerbera

In both polyhouse and field conditions, cultivar Dune, Rosalin and Dana Ellen yielded maximum flowers per plant. While the plant height and stalk length was found maximum in Dune (41.76 cm and 63.23 cm). The quality of flower with respect to flower size, stalk length and vase life was found superior under polyhouse condition as compare to open field conditions.

Tulip

In tulip the blooming period was enhanced involving PGRs and different storage period of bulb. GA3 at 400 ppm caused early sprouting (77.52 days) and increased plant height (36.20 cm), no. of leaves (4.84) and bulb (4.44) per plant as compare to control. It also induced early flowering (140.40 days) with improved flowering duration (26.76 days), flower size (6.57 cm) and stalk diameter (6.83 cm). While GA3 200 ppm resulted in longest flowering duration (27.86 days). CCC and MH delayed sprouting and reduced plant height, but improved no. of leaves and bulbs per plant. CCC and MH

induced late flowering and increased flowering duration, but reduced flower size and flower stalk diameter with their increasing concentration in comparison to control. The cold storage treatment of tulip, 12 week storage at 5^0C caused early sprouting (77.61 days) with improved plant height (37.51 cm), no. of leaves (5.08) and bulb (4.56) per plant as compared to control. It also induced early flowering (142.16 days) with improved flowering duration (26.45 days) and flower size (8.31cm). The longest vase life (10.1 days) was recorded in treatment 8-HQS 300 ppm followed by treatment of Alumunium sulphate 300 ppm (8.9 days) and treatment 8-HQS 200 ppm (8.8 days) as compare to control (5.4 days).

Nutraceuticals and antioxidants

In a nutraceuticals and antioxidants study the availability and variability of bioactive compounds and antioxidants in minor temperate horticultural crops, have been done in the different genotypes of strawberry, husk tomato, capegoosebrry, rose hips and kale. The results are very encouraging with total antioxidents value ranging from 203.13-471.10 (mg of AAE /100 gm of fresh weight) in starwberry and antioxident capacity (% inhibition) varied from 45.55-94.10 in capegooseberry, 42.54-84.64 in husk tomato, 62.10-93.14 in rose hips and 46.16-82.16 in kale respectively.

Saffron

Among various irrigation methods, sprinkler and drip irrigation caused early sprouting; early flowering with increased plant height and more no. of leaves and flowers/plant as compared to control (rain fed). Stigma fresh weight, stigma dry weight, stigma length and saffron yield per hectare were improved in sprinkler and drip irrigation as compared to control. Raised beds resulted in early sprouting; early flowering with increased plant height and more number of leaves and flower/plant as compared to ridge & furrow and flat bed systems. During Second year, planting density 15 lakh corm/ha resulted in significant improvement in saffron yield (6.32 kg/ha) in raised bed system with drip irrigation as compared to planting density 10 lakh corm/ha (4.94 kg/ha.) and planting density 5 lakh corm/ha (3.38 kg/ha.) in raised bed system.

The pistil fresh weight and dry weight (100 flowers) was recorded maximum 4.28 g and 805 mg in treatments drip irrigation with raised bed planting method with 5 lakh corm/ha. There was also significant effect of irrigation regimes and planting method and their interaction on saffron yield (dry pistil weight).

Soil science

For characterization of soil and nutritional survey of temperate fruit crop, preliminary depth wise soil analysis (with incremental depth of 0-15, 15-30, 30-60, 60-100 cm) of apple, almond, walnut and vegetable blocks of CITH was carried out. Soil pH showed a varying trend in different fruit and vegetable growing blocks, and it ranged between 6.23 to 7.69. In apple block, the pH increased with increasing depth and same ranged between 6.23 (0-15cm depth) to 6.84 (60-100cm depth) .While in almond block pH decreased up to the 2nd depth (15-30 cm) and then again an increasing trend was noticed in third and subsequent depth . In walnut block pH increased up to the second depth and afterwards remained somewhat static till the 3rd depth (30-60 cm) and again increased pH was observed in subsequent depth.

Rejuvenation of old, unproductive almond orchards

In a rejuvenation programme of almond the highest yield (1.94 Kg/tree) of in-shelled nut was recorded in first order pruning level with 50 kg FYM, 500g urea + 250g P_2O_5 + 750g K_2O , full moon water harvesting technique and Waris variety ($P_1F_1W_1V_1$). The canopy area (2.85 m^2) which was 81.42% of control canopy was noted in third pruning level with 50 kg FYM, 500g urea + 250g P_2O_5 + 750g K_2O , full moon water harvesting technique and Waris variety ($F_1W_1V_1$).

Plant Health Management

The maximum chilli wilt mitigation i.e. 63.05 percent was recorded with *T. viride* seed priming, carbendazim root dip and soil drenching and solarization with transparent polythene. It was followed by 59.41 percent disease mitigation by use of *T. viride* seed priming, ridomil MZ root dip and soil drenching and solarization with transparent polythene.

For management of corm rot in saffron, maximum plant stand i.e. 82.50 percent was recorded in carbendazim 0.2% followed by 77.50 percent plant stand through captan 0.3% with 83.33 percent and 72.22 percent, with respective enhancement in healthy plants over check giving 45.00 percent healthy plant stand. The flowering was also recorded to be maximum by applying carbendazim 0.2% i.e. 24.22 percent followed by 23.00 percent flowering in in corms treated with carbendazim 0.1% and 22.52 percent through captan (0.3%) as compared to 16.80 percent flowering in check.

For the control of powdery mildew in apple, maximum disease mitigation i.e. 76.28 percent was recorded in by spraying 0.05 percent kresoxim methyl spray with minimum percent disease index of 17.28 percent as compared to 72.88 percent disease index in check and 38.40 percent disease index of powdery mildew in rootstock plants sprayed with 0.05 percent hexacanazole

For gummosis and its management**,** the trees of almond varieties planted at the experimental farm exhibited less than four gum droplets per fruit. The maximum gum exudation i.e. 5.45 per cent fruits with 2-3 droplets and 14.12 percent fruits with one droplets were recorded in almond variety Merced. Maximum unblemished fruits with nil exudation during 2011 were recorded in almond variety Shalimar.

In insect population dynamics on different varieties/genotype of apple, almond and apricot**,** flea beetles infestation was very severe, attacking almost all the fruit crops. The infestation was very high in apricot and Red Fuji of apple, respectively. In case of almond, it was severe in Waris and IXL. A very high population of European red mite was also recorded in almond (high density) as well as in apple. In addition, aphids, leaf hopper and white grubs infestation were also recorded.

In case of natural enemies concerned, a total of 14 species belonging to 12 genera of predatory Coccinellids were recorded. Among these, three species namely, *Halyzia sanscrita* Mulsant, *Illeis confusa* Timberlake and *Serangium* sp. are new record to Jammu and Kashmir fauna and one species *Stethorus aptus* Kapur is new to India. The *Stethorus aptus* was recorded feeding on European red mite, *Panonychus ulmi*. This predatory beetle would be a one of the potential natural enemy for the management of European red mite.Survey undertaken to identify the diapausing place for coccinellids during winter, it was found that, coccinellids prefer to diapause more on cracks of trees compare to in soil or fallen leaves. Percent survival was also more in beetle diapausing on cracks of trees during winter.

The efficacy of different treatments against aphids in cucumber, tomato and capsicum under polyhouse conditions revealed significantly highest mean reduction of pest population by dimethoate (0.06%) with mean number of 15.40, 11.40 and 19.68 aphids over untreated check 353.73, 79.33 and 81.09 per 5 leaves on cucumber, tomato and capsicum, respectively. However, neem oil (3%) and *Beaveria bassiana* proved least effective and were found more effective after 10 days of application.

For management of the asian hornet *Vespa* sp. in apiary, different types of food lures, namely meat, fish, fresh apple, rotten apple, and apple juice were used for attracting the *Vespa* sp. Among these, fish attracted more number of wasps compared to other food lures. The trap was also designed for mass trapping of wasps, which needs further improvement for effective trapping.

Post Harvest Management

The study of effect of sanitizing agents, antioxidants and shrink wrapping of capsicum for quality maintenance and storage in cultivar Nisanth indicated that when capsicum fruits were treated with sodium hypochloride (100 ppm), citric acid (1%) and shrink wrapping of fruits in 19 µ semi permeable film and stored at low temperature found effective in storing capsicum fruits as for 30 ± 2 days at room temperature and 45-48 days at low temperature showing significantly minimum loss in weight and retaining maximum inherent colour, firmness and desirable quality.

In cherry, coating of aloevera gel of 50% concentration and stored at low temperature (5±1°C) extended the shelf life upto 40 days with least PLW (2%) compared with control (7.8%, maximum firmness of fruit (28) compared to 20.0 in control, maximum TSS (17.0^{0}B)compared to 13.5 ^{0}B in

control, maximum ascorbic acid (12.2 mg /100g) at 40 days of storage compared to 7.8 mg/100g at 20 days of storage.

The shrink wrapping in fruits of nectarine var. Fantasia showed enhancement in storage life compared to control in both the storage conditions. However the nectarine fruits shrink wrapped in 19 µ film and stored at low temperature (5 ± 2°C) showed least PLW (1-2%) compared to control (11.4 %), retained quality and firmness (27.8) compared to control (29.0) up to 40 days of storage compared to control where fruits started deteriorating after 24 days of storage. The treated and shrink wrapped fruits at room temperature retained their quality and firmness up to 10 days compared to that of control where it was retained up to 4 days only.

To extend the shelf life of apple cultivars Mollies Delcious, the fruits were coated with 50% *Aloe vera* gel and shrink wrapped in 25 µ film and stored at low temperature (5 ± 2°C). The fruits under this treatment were stored up to 68 days showing least PLW, maximum retention of quality and appeal, firmness (36.1) compared to control (30.9). In case of variety Red Chief, shrink wrapping of fruits with semi permeable film, 19 and 25 µ films were equally effective to reduce the physiological loss in weights, retain maximum quality parameters, firmness (20.1 and 21.7 resp) compared to control (12.3). In Golden Delcious, shrink wrapping with 25 µ film increased the shelf life significantly (110-120 days) with least PLW (1.78%) compared to control (8.0%) and maximum retention of quality in terms of TSS, acidity, ascorbic acid and fruit firmness (24.3).

In olive, the maturity indices for getting maximum oil yield showed that olives harvested from second week of Oct. to first fortnight of Nov. found best to get higher oil percentage in Coratina, Leccino and Pendolino however in Messenese, Cipressino and Picholine from second fortnight of Oct to end of Oct. found suitable.

In peach cv. Crest Heaven, different cooling treatments applied with different storage (at ambient and low temp (4^0C). Pre-cooled with ice water retained higher firmness, pectin content, bio-chemical properties than normal tap water treatments under both the condition. In addition $CaCl_2$ 2% to ice water along with cyclical heat treatment during storage increased firmness up to 40% and reduced degradation of the ascorbic acid and pectin hydrolysis and minimized PLW loss up to 25% . Shelf life increased with better quality fruits up-to 16 days in ambient condition and 28 days at 4^0C with treatment of ice water containing $CaCl_2$ 2% as compared to normal water treatment 9 days and 15 days (4^0C) respectively.

Under product diversification, processing technology was developed for making novel value added products of cape gooseberry and mulberry. The squash prepared from malta (20%) and ginger (5%) was found to be the best at the time of preparation and after three months storage. The acidity, ascorbic acid and reducing sugars were found to reduce whereas the total soluble solids and total sugars increased during storage of the products. Further, products prepared by blending major and minor temperate fruit juices viz., rhododendron, *kapha*l, *kilmora*, *galgal* and ginger in different ratios, the best squash was prepared from rhododendron (15%) + *galgal* (5%) + ginger (5%) among various combinations.The apricot available locally was evaluated for various physico-chemical characteristics and it was found that the local varieties are not suitable for drying as the TSS is very low.

Enhancement of shelf life of different temperate fruits through post harvest chemical showed that the fruits treated with bio-regulators had significantly better firmness throughout the storage as compared to control. Further, Red June cultivar of peach from different locations was also evaluated for various physico-chemical characters and it was found that there was significant difference in various characters because of altitude.The storage study of three cultivars of apple *viz.*, Fanny, Golden Delicious, Vance Delicious after treating with salicylic acid (200 ppm) and calcium (0.4%) along with control was also carried out and Ca treated fruits had better storage life as compared to others and among the varieties Fanny was found to be the best. Similarly, different chemicals like salicylic acid were also found effective for extending shelf life in peach and pear.

In extension, technical advisory services were provided for about 4000 farmers of the J&K and other parts on country through various trainings, visits, on farm demonstrations etc. Institute has

organized 25 training courses of varied duration for farmers and extension personals of the line departments. The Institute has published 17 research papers, 2 review papers in reputed journals, one book and three book chapters. To dessimainiate the technology at field level institute has published 11 popular articles and 14 bulletien/ pumplet/ extension folders in various languages for the benefits of farming community of the country. In addition, total 122 field demonstrations also have been taken up at farmer's field for popularization, adoption and transfer of technology to field level.

Introduction

India is the second largest producer of fruits and vegetables in the world is bestowed with diversified congenial agro-climatic conditions where large number of horticultural crops can be grown in one or the other region. During the past few years horticulture has shown some economic prosperity in the temperate hilly region but it is deprived of the modern technologies to boost the production. Presently the temperate fruits and vegetables in the country are low to meet the normal dietary requirements and country is still spending a lot of hard earned foreign exchange for import of many temperate fruits and nuts and the productivity of temperate horticultural crops is much lower than the developed countries, although tremendous increase in area has occurred during last two decades. Although few technologies have been generated during past to enhance the productivity but their impact in farmer's field is yet to be realized. Considering the enormous wealth of natural resources and keeping in view the low productivity and quality of crop as compared to advanced countries, lot of technological intervensions and varieties suited to the region are to be developed to boost production and productivity of various crops to overcome the production constraints the research on temperate horticultural crops is being concentrated at Central Institute of Temperate Horticulture, Srinagar and at its Regional Station, Mukteshwar (Uttarakhand) with the following mandates and objectives

Staff Position (2011-12)

Category	Sanctioned	Filled	Vacant
Scientific	22+1 RMP	16+1 RMP	06
Administrative	14	11	03
Technical including driver	13	13	-
Supporting	15	8	07
Total	64+1RMP	48+1RMP	16

Financial Statement during 2011-12

S.No.	Sub-Head (In lakhs)	Plan (In lakhs)	Non-Plan
1.	Establishment Charges	20.10	230.15
2.	T.A	6.75	3.00
3.	HRD	5.00	0.00
4.	Contingency	26.67	115.50
5.	Equipment	61.76	4.50
6.	I.T	1.40	0.50
7.	Works	105.32	3.00
8.	Library	22.00	0.50
9.	Furniture and Fixture	6.00	1.00
10.	Network project	25.00	--
11.	Pension	--	10.00
12.	Loans and advances	--	5.00
	Total	280.00	373.15

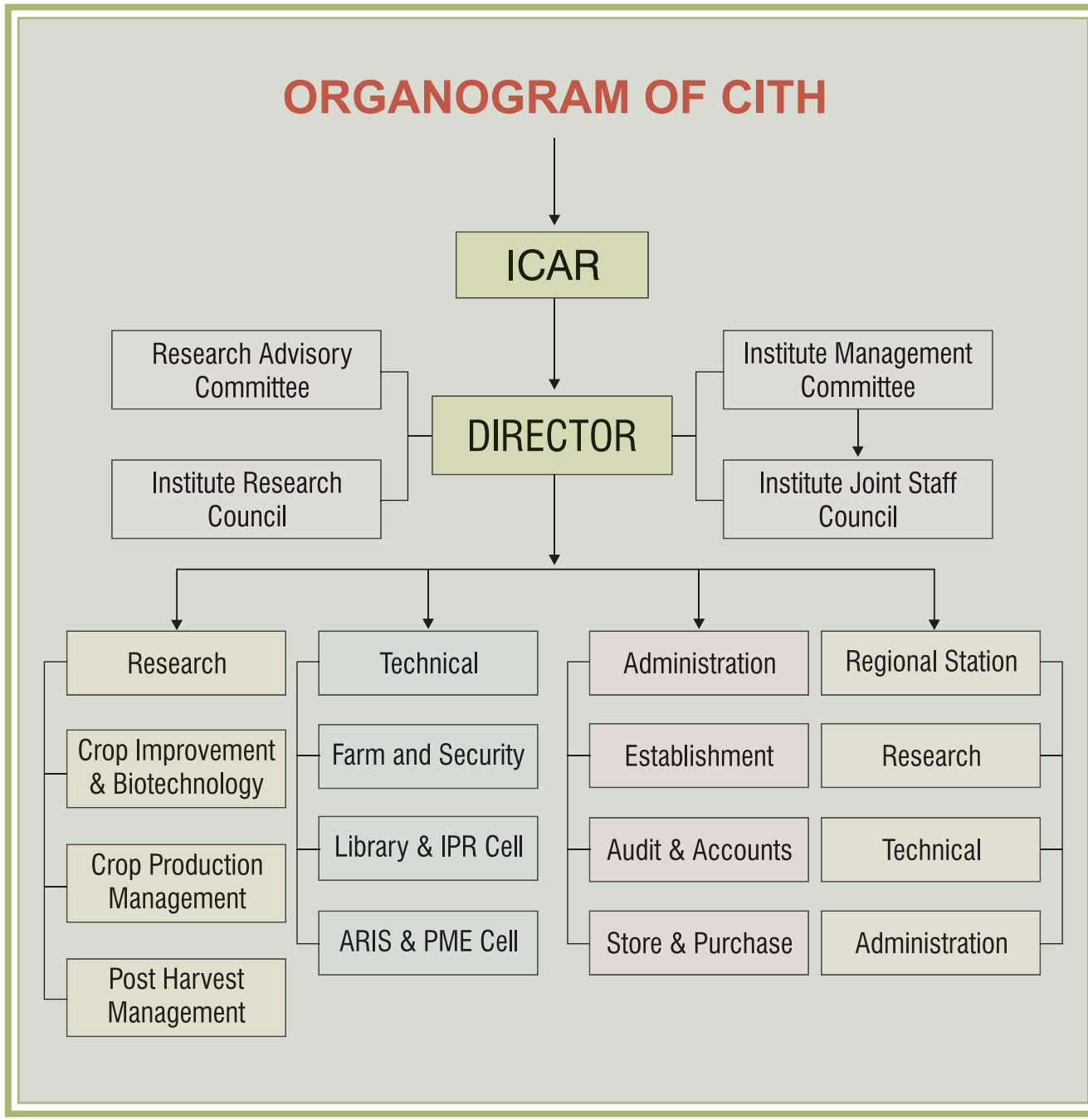
Mandate

- 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 & transfer of technology.

Major Objectives

- To augment the existing germplasm with superior genotypes from indigenous as well as from exotic sources having resistance to biotic and abiotic stresses.
- To devise efficient propagation and cost effective production technologies for increasing productivity and improving quality of temperate horticultural crops including intercropping and cropping systems for orchards.

- To develop eco-friendly disease/pest management techniques including mitigation of post harvest spoilage.
- To reduce post-harvest and storage losses to minimum level and generate more income through value addition and processing.
- To increase foreign exchange earnings through export and to reduce import of items.



I. CROP IMPROVEMENT AND BIOTECHNOLOGY

Institute released high yielding and superior quality walnut, cherry, apple and garlic varieties

Five genotypes of walnut superior in yield and kernel quality namely CITH-Walnut-6, CITH-Walnut-7, CITH-Walnut-8, CITH-Walnut-9, CITH-Walnut-10, two genotypes in cherry, one genotype each in apple and garlic were released by Institute Variety Release Committee. These varieties are now being multiplied and tested in entire temperate region of the country for release at national level.

CITH-Walnut-6: It is a high yielding variety which is single plant chance seedling selection. The variety is having superior nut quality traits along with higher shelling percentage (51%). It is suitable for growing under entire temperate region of North Western Himalayan agro-eco system. Shoot, leaf and rachis are pubescent with broad ovate nut shape, light shell & kernel colour, plumpy kernel, well filled, rough shell texture and intermediate shell seal. Nut weight is 23.99g. Tree vigour is intermediate, semi-erect, intermediate branches, well apart, dense, stout, brown to grey and healthy. Plants are protandrous, bears heavy catkin and stigma is green in colour. Variety is having field tolerance to moisture stress and low temperature. Harvesting starts after 160-165 days from the date of full bloom at P.T.B stage. Fruit yield is 30kg/tree at 15 years of age. The plant commences bearing from 3rd year onwards.

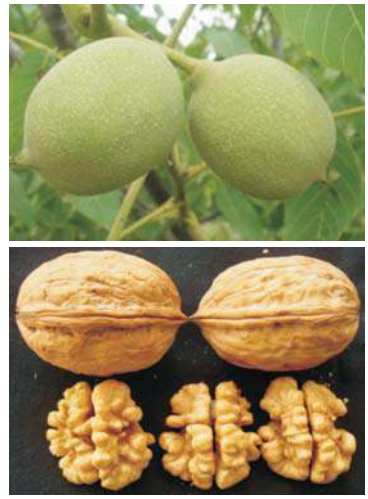
CITH-Walnut-6

CITH-Walnut-7: It is a high yielding from a is single plant chance seedling selection. The variety is having superior nut quality traits along with higher shelling percentage (50%). It is suitable for growing under entire temperate region of North Western Himalayan agro-eco system. Shoot, glabrous, leaf and rachis are pubescent. Nuts are large (24.71g) with elliptic nut shape, medium shell & light amber kernel colour, plumpy kernel, well filled, rough shell texture and strong shell seal. Vigorous trees growth, semi-erect, intermediate branches, well apart, dense, stout, brown to grey and healthy. Plants are protandrous, bears heavy catkin & green stigma colour. Variety is having field tolerance to moisture stress and low temperature. Harvesting starts after 155-160 days from the date of full bloom at P.T.B stage. Fruit yield is 30kg/tree at 20-25 years of age. The plant commences bearing from 3rd year onwards.

CITH-Walnut-7

CITH-Walnut-8: A high yielding variety, which is single plant chance seedling selection. The variety is having superior nut quality traits along with higher shelling percentage (54.10%). It is suitable for growing under entire temperate region of North Western Himalayan agro-eco system. Leaf and rachis are pubescent with narrow elliptic leaflet, yellow rachis colour and long trapezoid nut shape. Light shell and kernel colour, plumpy kernel, well filled,

rough shell texture and intermediate shell seal. Nut weight is 20.35g. Trees are semi vigorous, semi-erect, intermediate branches, well apart, dense, stout, brown to grey and healthy. Plants are protandrous, intermediate catkin abundance, stigma is green in colour. Variety is having field tolerance to moisture stress and low temperature. Harvesting starts after 148-154 days from the date of full bloom at P.T.B stage. Fruit yield is 50kg/tree at 20 years of age. The plant commences bearing from 3rd year onwards.

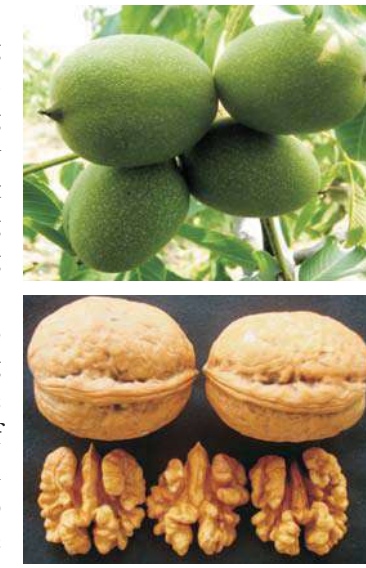


CITH-Walnut-8

CITH-Walnut-9: A high yielding variety from a single plant chance seedling selection. The variety is having superior nut quality traits along with higher shelling percentage (50.9%). It is suitable for growing under entire temperate region of North Western Himalayan agro-eco system. Leaflets are elliptic with glabrous shoot, round nut shape and rough shell texture. Light shell and kernel colour, well filled, plumpy kernel, rough shell texture and intermediate shell seal. Nut weight is 21.23g. Trees are vigorous and spreading type dense branches, well apart, dense, stout, brown to grey and healthy. Plant are protogynous, heavy catkin abundance, stigma is green in colour. Variety is having field tolerance to moisture stress and low temperature. Harvesting starts after 160-165 days from the date of full bloom at P.T.B stage. Fruit yield is 50kg/tree at 20 years of age. The plant commences bearing from 3rd year onwards.

CITH-Walnut-9

CITH-Walnut-10 : A high yielding variety which is single plant chance seedling selection. The variety is having superior nut quality traits along with higher shelling percentage (55.50%). It is suitable for growing under entire temperate region of North Western Himalayan agro-eco system. Leaflets are narrowing elliptic with dark green leaf and long trapezoid nut shape. Light shell and kernel colour, plumpy kernel, well filled, rough shell texture and intermediate shell seal. Nut weight is 19.95g. Trees are vigorous, semi-erect, intermediate branches, well apart, dense, stout, brown to grey and healthy. Plant are protandrous, intermediate catkin abundance, stigma is green in colour. Variety is having field tolerance to moisture stress and low temperature. Harvesting starts after 152-158 days from the date of full bloom at P.T.B stage. Fruit yield is 30kg/tree at 20 years of age. The plant commences bearing from 3rd year onwards.



CITH-Walnut-10

CITH-Cherry-01: Tree semi spreading, precocious, regular and prolific bearing cultivar selected from Bigarreo Napoleon (Double Gilass) cherry orchard. Fruits are large, ovoid in shape, attractive, dark red colored with long pedicels. Fruits have good acid /sugar balance and high in TSS. Average yield 9.35 t/ha at 7-8 years of age under high density planting.

CITH-Cherry-01

CITH-Cherry-02: Tree upright, precocious , prolific and regular bearer selected from Local Mishri. High yielding (18.2 t/ha) after 7-8 years of age under high density planting. Fruits are large with attractive card red and high in TSS as compared to Mishri and mature 10 days earlier than 'Mishri'

CITH Cherry-02

CITH-Lodh Apple-1: Clonal selection from Red Delicious. It is regular, precocious, self fruitful, high yielding and high quality variety. Tree intermediate in vigor, drooping and spreading. Fruits are medium to large, globosely, oblong, conical shape, very firm and fine in texture; sweet and juicy with TSS (12.5-13.6 ^{0}B). variety is early to mid maturing suitable for mid hills of North- Western Himalayan Region.

CITH-Lodh Apple-1

CITH-Garlic (M)-1: The variety has been identified by Variety Release Committee of Central Institute of Temperate Horticulture, Srinagar on the basis of high yield and superior quality in station evaluation trials and multilocation trial. Variety is long day early maturing type and suitable for growing under entire temperate region of North Western Himalayan agro-eco system. Its bulbs and cloves are very large and bulbs are round with light purplish pigmentation on outer skin. It has light moderate pungency with better quality and wider acceptability. It takes 200-220 days to mature after planting and yield up to 200q/ha. Variety can tolerate severe frost and snow.

CITH-Garlic (M)-1

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

The genetic enhancement largely depends upon its germplasm wealth. The collection of germplasm of elite genotypes in various horticulture crops and its characterization for its direct or indirect use as well as its conservation for future use is therefore most important especially in perennial fruit crops. Under genetic resources management 2116 germplasm of different horticultural crops have been collected, maintained and its characterization is going on at morphological as well as at molecular level.

Table 1. Germplasm collection and conservation at CITH

S.No.	Crop/Group	Total collection
1.	Fruits	870
	Pome fruits	295
	Stone fruits	145
	Nuts	297
	Others	137
2.	Vegetables	948
3.	Ornamental	273
4.	Medicinal & aromatic plants	25
	Total	2116

In apple, ambri is most important local cultivar famous for its high quality and shelf life. But due to its alternate bearing habbit and susuceptibility to scab, its cultivation has decearsed and its identity is being lost. To revive this valuable genotype during the current year 14 Ambri selections were made from Shopian, Baramulla and Budgam districts of Kashmir having superiority for desirable traits. The selection CITH-A-36 among selections was found superior for fruit weight (197.53g), fruit length (78.15mm), fruit diameter (77.11mm) and T.S.S (15^0 B). The scion wood of all the selections has been grafted/ budded for further evaluation in future. In evalautuion of apple cultivars (spur type), Cooper IV gave maximum yield of 29.22 t/ha followed by Royal Delicious (27.67 t/ha), Well Spur (26.16 t/ha) and Oregon Spur (22.70t/ha) at 4x4 m spacing (Table 2).

Table 2. Performance of spur type apple varieties (2011)

Variety	Total fruit/plant	Fruit weight (g)	Yield/ plant (kg)	Yield t/ha	Per cent fruits (90% color surface)	A grade fruit (%)
Vance Delicious	25.00	194.33	4.89	4.72	64.33	87.00
Red Chief	31.00	186.66	5.80	3.62	83.00	81.33
Hardiman	169.00	211.00	35.63	22.27	88.00	92.00
Starking Delicious	241.66	157.66	44.28	27.67	72.00	72.66
Cooper IV	261.66	204.66	46.75	29.22	78.33	84.33
Silver Spur	219.00	142.33	26.46	16.53	85.00	74.33
Well Spur	193.66	245.00	42.01	26.16	74.66	75.66
Red Spur	112.66	216.00	26.49	16.60	89.66	91.33
Top Red	18.66	153.66	2.87	4.82	61.66	78.66
Oregon Spur	231.67	158.33	36.39	22.74	95.66	65.66
Gold Spur	20.33	170.66	3.42	3.14	90.33	90.00
CD (5%)	*60.22*	*33.52*	*13.18*	*8.31*	*7.78*	*5.97*
CV (%)	*25.34*	*10.53*	*30.73*	*30.08*	*5.65*	*4.28*

Promising Ambri selections from various parts of Kashmir

Top budding of promising cherry selctions

In walnut among the evaluated genotypes CITH-W-1 recorded highest inshell nut weight (24.43 g) and kernel weight (13.5 g) with good kernel recovery (55.25%), light shell colour, long trapezoidal in shape and very easy to remove kernel halves followed by CITH-W-6 having inshell nut weight (23.45 g), kernel weight (11.86 g) and kernel recovery of 50.57 percent (Table 3).

In almond, 30 varieties/ genotypes were evaluated for yield and other morphological traits. Among genotypes, the maximum yield (5.35 t/ha)

Table 3. Performance of 25 elite walnut genotypes with respect to nut characters

S.No.	Genotype	Inshell nut weight(g)	Kernel percentage	Kernel colour	Nut shape	Ease of removal of shell
01.	CITH-W-1	24.43	55.25	Light	Long trapezoid	Very easy
02.	CITH-W-2	16.10	48.16	Light	Ovate	Easy
03.	CITH-W-3	19.47	50.39	Light	Ovate	Moderate
04.	CITH-W-4	20.48	53.23	Light	Long trapezoid	Easy
05.	CITH-W-5	19.47	53.61	Extra light	Broad ovate	Moderate
06.	CITH-W-6	23.45	50.57	Light	Broad ovate	Easy
07.	CITH-W-7	21.42	50.51	Light amber	Elliptic	Easy
08.	CITH-W-8	20.00	54.71	Light	Long trapezoid	Easy
09.	CITH-W-9	21.77	49.48	Light	Round	Easy
10.	CITH-W-10	19.83	55.25	Light	Round	Very easy
11.	CITH-W-12	17.91	59.24	Light amber	Board ovate	Easy
12.	CITH-W-14	18.56	54.66	Light	Round	Easy
13.	CITH-W-15	19.86	57.91	Extra light	Long trapezoid	Moderate
14.	CITH-W-16	18.40	55.07	Light	Ovate	Easy
15.	CITH-W-17	20.83	53.76	Light amber	Elliptic	Easy
16.	CITH-W-19	18.46	54.88	Light	Board ovate	Easy
17.	CITH-W-25	20.60	54.8	Light	Board ovate	Easy
18.	CITH-W-27	17.83	52.98	Light amber	Long trapezoid	Moderate
19.	Hamdan	17.30	52.64	Light	Round	Easy

S.No.	Genotype	Inshell nut weight(g)	Kernel percentage	Kernel colour	Nut shape	Ease of removal of shell
20.	Nugget	12.57	50.74	Light	Cordate	Easy
21.	Opex Caulchery	11.61	50.65	Light	Round	
22.	Sulaiman	17.75	49.70	Extra light	Round	Easy
23.	Tutle	9.04	56.42	Light	Round	Easy
24.	Cheinovo	13.20	50.00	Light	Ovate	Easy
25.	Franquette	7.23	53.92	Light	Elliptic	Moderate
	CD (5%)	*1.625*	*1.951*			
	SE(m)	*0.515*	*0.815*			

was recorded in CITH-Almond-12 whereas among recently surveyed and collected genotypes of almond most of the genotypes have more than 50 % kernel recovery except CITH-A-25. The bud wood of all the genotypes have been already collected and budded on seedling rootstocks.

CITH-Almond-22

CITH-Almond-23

CITH-Almond-24

CITH-Almond-25

Kernels of newly collected genotypes of almond

In apricot, a total 55 germplasms/varieties were evaluated for yield and quality. Data on top 10 varieties/ genotypes have been presented in Table 4. The results revealed that highest fruit yield (161.34 kg/tree) was harvested in CITH-Apricot-1 followed by CITH-Apricot-2 (155.35 kg/tree) and CITH-Apricot-3 (134.09 kg/tree). However, maximum total soluble solids (29.82 ^{0} Brix) was estimated in CITH-Apricot-33 genotype followed by CITH-Apricot-31 (27.97^{0} B) and CITH-Apricot-24 (26.67^{0} B)

Table 4. Evaluation of apricot varieties / genotype for yield and quality traits (Top ten)

S. No.	Varieties / genotype	Fruit yield (kg/tree)	Varieties / genotype	T.S.S. (^{o}B)
1.	CITH-AP-1	161.34	CITH-AP-33	29.82
2.	CITH-AP-2	155.35	CITH-AP-31	27.97
3.	CITH-AP-3	134.09	CITH-AP-24	26.67
4.	Communis	81.30	CITH-AP-21	25.70
5.	Erani	76.70	CITH-AP-29	24.40
6.	Afghani	62.86	CITH-AP-37	23.53
7.	Balcota	52.97	CITH-AP-12	22.88
8.	CITH-AP-09	36.73	Afghani	22.33
9.	Chinese Apricot	30.41	CITH-AP-14	21.40
10.	Tokpopa Nimu	21.65	CITH-AP-35	21.30
	CD at 5%	*35.12*	*CD at 5%*	*2.12*

Excellent fruiting in apricot (CITH A-1)

In cherry, 21 new promising clones superior in yield and quality have been identified through extensive survey, out of which two best selections namely CITH-Cherry-24 and CITH-Cherry-28 were found promising. The bud woods of these collections have been top budded on grown up seedling root stock for further evaluation.

The field evaluation of eight cherry varieties for quality and growth attributes indicated that Stella and Guigne Noir Hative are the first to initiate flower where as Lapinus, Bing and Lambert flowerd late (Table 5). But period of full bloom in all the evaluated varieties were almost same with 2-3 days variation. Fruit set per cent was recorded highest under natural condition in Bigarreau Napoleon which was statistically at par with Bigarreau Noir Grossa, Guigne Noir Hative and Van. Highest yield /tree (16.85 kg/tree) after 8-9 years of age was recorded in Bigarreau Napoleon, followed by Van. Similarly yield efficiency was recorded highest (4.44 kg/cm^2) in Bigarreau Napoleon followed by Van (2.01 kg/cm^2).

CITH-Cherry-24

CITH-Cherry-25

CITH-Cherry-28

Promising cherry selections with intense color and high TSS

Table-5. Growth and yield attributes of cherry varieties

Variety	Date of flower initiation	Date of full bloom	Fruit set %	Fruit weight (g)	Fruit length (mm)	Fruit dia. (mm)	T.S.S (°B)	DFBH	TCA (cm^2)	Yield Efficiency (kg/cm^2)	Yield / Plant (kg)	Trunk Girth (mm)	Annual extension growth(cm)	Tree growth habit
Bigarreau Noir Grossa (Mishri)	06.04.2011	17.04.2011	70.98	4.16	22.50	20.26	12.53	47.0	5.00	0.88	4.60	7.95	56.66	upright
Bigarreau Napolean (Double)	29.03.2011	15.04.2011	79.95	5.00	20.78	19.61	11.56	49.0	3.79	4.44	16.85	6.90	56.33	spreading
Guigne Noir Hative (Makhmali)	30.03.2011	17.04.2011	78.30	4.33	20.07	20.86	12.03	46.0	2.95	0.59	1.52	6.09	83.67	spreading
Van	02.04.2011	16.04.2011	74.10	4.33	21.57	19.41	15.50	49.0	2.70	2.01	5.45	5.82	59.00	upright
Lapinus	09.04.2011	17.04.2011	57.53	5.20	22.04	20.73	10.60	45.0	7.24	0.44	2.08	9.54	67.67	spreading
Lambert	08.04.2011	17.04.2011	26.94	5.50	21.61	21.70	13.63	32.0	8.28	0.09	0.73	10.00	76.00	upright
Bing	09.04.2011	16.04.2011	54.20	5.83	23.40	22.01	12.93	43.0	8.36	0.20	1.67	10.25	82.00	spreading
Stella	30.04.2011	16.04.2011	59.35	4.66	20.94	19.99	11.67	47.0	7.05	0.60	4.28	9.41	82.33	spreading
CD (5%)	—	—	*12.41*	*0.45*	*N.S.*	*1.59*	*1.07*	—	*3.06*	*1.3*	*3.5*	*3.62*	*9.95*	—

Table 6. Yield and qualitative traits of different genotypes of peach/nectarine

No. of Genotypes (Density 2.5 × 2.5)	Fruit weight(g)	Fruit length (mm)	Fruit diameter (mm)	TSS (°B)	Acidity (%)	Ascorbic acid (mg/100g)	Yield per tree (kg)	Fruit yield (t/ha)
Fantasia	74.32	51.12	52.15	13.83	0.311	6.26	22.66	36.2
Crest Heaven	83.92	53.08	54.16	15.30	0.321	5.78	24.13	38.61
Red Globe	86.32	44.70	53.06	14.40	0.284	6.53	28.05	44.88
Gloheaven	99.97	61.46	63.10	15.60	0.254	5.90	34.56	55.29
Nimla	107.52	61.85	62.92	12.26	0.248	4.60	31.32	50.11
Kanto-5	70.08	55.29	48.26	14.27	0.233	5.14	14.33	22.93
Early Red June	59.52	48.92	48.47	10.10	0.226	4.10	10.57	16.91
CITH P-1	41.04	38.22	33.42	13.47	0.213	4.90	10.72	17.15
CD (5%)	*16.73*	*14.99*	*11.72*	*0.869*	*0.013*	*1.29*	*5.54*	*7.52*

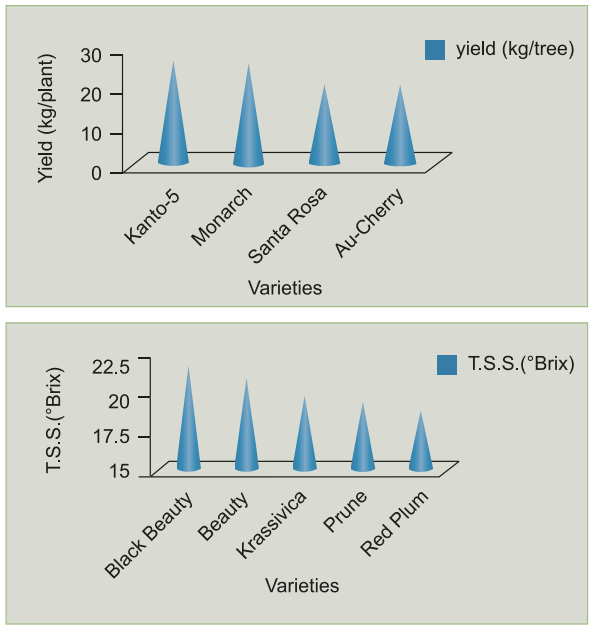
In peach/nectarine, a total of 33 exotic and indigenous cultivars conserved and evaluated in the field gene bank. Among these 21 flowered and fruited, out of which Fanatasia, Crest Heaven, Red Globe, Glovheaven and Nimla found very promising with maximum yield/plant. Highest fruit weight recorded in Nimla followed by Glo Heaven and Red Globe, however highest TSS was recorded in Glo Heaven followed by Crest Heaven (Table 6).

Promising Kashmiri nakh selections

Diverse pear collections at CITH, Srinagar

In plum, total 25 varieties both indigenous and exotic were evaluated for yield and quality characters. Out of which 23 varieties came into bearing. Evaluation result indicated that maximum fruit yield (26.38 kg/tree) was recorded in Kanto-5 followed by Monarch (25.53 kg/tree), Santa Rosa (20.48 kg/tree) and Au-Cherry (20.45 kg/tree). However, highest total soluble solids (21.67 ^{0}B) was estimated in Black Beauty followed by Beauty (20.90 ^{0}B), Krassivica (19.70 ^{0}B) and Prune (19.40 ^{0}B).

Heavy fruiting in Kanto-5



Evaluation of plum varities for yield and quality

Promising olive varieties in fruiting

In olive, out of 25 varieties, seven came in to bearing and whose morphological, physico-chemical and yield attributes recorded. Maximum fruit weight and yield per plant recorded in Coratina followed by Pendolino. Coratina followed by Pendolino and Cipressino yielded maximum percentage oil recovery, peroxides value of oil and pulp weight. However maximum oleic acid in fruits was found in Messenese followed by Cipressino and Frontoio (Table 7). The chromatic characterization on fruit color basis at harvest stage also done which indicated that all cultivars differ significantly from each other.

In pomegranate, eight genotypes were evaluated under spacing of 2.5x2.5 m accommodating 1600 plants/ha. The data were recorded at the age of 6, 7, 8 and 9 years. The results indicated that the cv.

Table 7. Morpho-physico-chemical and yield attributes of olive varieties

Variety	No. of fruit/ inflorescence	No. of fruit per plant	Fruit length (mm)	Fruit breadth (mm)	Fruit weight (g)	Yield/ plant (kg)	Stone weight (g)	Pulp weight (g)	Stone %	Acidity (Oleic acid %)	Oil %
Messenese	10	1200	19.21	15.05	2.62	3.14	0.66	1.96	25.19	0.96	23.65
Pendolino	12	2160	21.85	16.58	2.7	5.83	0.69	2.01	25.55	0.35	28.96
Coratina	16	2024	27.35	18.87	3.77	7.63	1.18	2.59	31.29	0.65	30.21
Leccino	12	1728	22.26	2.61	2.45	4.23	0.63	1.82	25.71	0.47	22.36
Frontoio	8	400	10.80	8.97	1.22	0.48	0.12	1.10	9.83	0.78	18.97
Cipressino	10	1040	19.28	13.72	2.34	2.43	0.56	1.78	23.93	0.88	25.65
Picholine	9	810	20.36	16.58	2.62	2.12	0.78	1.84	29.77	0.37	20.36
CD (5%)	*4.2*	*1002.67*	*12.16*	*8.6*	*1.23*	*3.42*	*0.05*	*0.19*	*2.98*	*0.20*	*1.22*

Dholka, Bedana and Kandhari performed better in terms of yield under karewa conditions of Kashmir valley and recommended for commercial cultivation in the temperate zone.

Collection and evaluation of temperate fruit crops at Regional Station Mukteshwar

In apple among the cultivars evaluated, the following varities were identified under different groups as (i) Low chilling apple cultivars viz., Schlomit, Michal and Mayaan, (ii) early maturing apple cultivars are Prima, Summer Red and Mollies Delicious apart from pollinizers like Tydeman's Early Worcester, (iii) Spur type cultivars viz., Oregon Spur, Well Spur, Red Chief, Starkrimson and Spur type Red Delicious (Red Spur Delicious), (iv) Colour strain cv. Skyline Supreme. Apple germplasm like Aztec, Jonagold, Gala, Red Fuji, Firdous, Shireen, Maharaji, Chamura, Benoni, June Eating, Silver Spur, Granny Smith etc. are also being maintained in the germplasm block. Cultivars Cooper 4, Vermont Spur Gala Must, Gloster and Bright-N-Early were also found promising. In peach cvs. Red June, Red Nectarine, Flavour Top, Glove Heaven, Fantasia, Aishwarya, Paradelux, Fla-1633, Florida Sun, Florida Red and Sharbati. In plum cvs. Satsuma, New Plum, First Plum, Methley, Monarch and Santa Rosa etc. In apricot cvs. Harcot, Iranian, Chaubattia Madhu; St. Ambroise, CITH-1, 2 & 3 etc., In almond cvs. Merced, Waris, IXL, American. In pear cvs. Red Bartlett, Starkrimson, Bagugosha, Zirhania Nakh , Bartlett, Max Red Bartlett, local selections were maintained in the germplasm block. In strawberry also Camarosa, Osograndy, Blackmore, Chandler, Gorella, Addie, Shasta, Bl-13, Jeolikote Local, Corona, Ofra, and Maxima were maintained at germplasm block. Few local selections of chestnut have been also evaluated. In walnut: Suleiman, CITH -Walnut- 1, CITH -Walnut-2, CITH-Walnut-3, CITH -Walnut - 4, CITH- Walnut- 5, CITH- Walnut-6, CITH- Walnut-7 etc. added in field gene bank and evaluation is progress.

Apple rootstocks

Among various clonal and *Malus baccata* root stocks of apple, quiance and *Prunus tommentossa* studied during the year. Significantly the largest root length was recorded in EMLA-106 followed by CITH-03. Number of primary roots were recorded highest in MM-106 and lowest in CITH-05 whereas highest average number of secondary roots were noted in CITH-01 and CITH-04 (Table 8).

Table 8. Characterization of rootstocks for various traits

Root stock	Primary root length(cm)	No. of primary roots	Av. No. of secondary roots	Secondary root length (cm)	Internodal Length (cm)	Knot character	Leaf area (mm)	Leaf petiole length(cm)	Petiole color	Leaf altitude to the shoot
MM-106	15.31	93.00	49.00	9.40	2.07	Present	27.73	2.56	Pink	Out ward
MM-111	11.23	70.00	30.00	3.00	2.43	Present	25.20	2.73	Pink	Out ward
M-9	6.51	55.00	40.00	2.70	2.60	Present	24.69	2.16	Pink	Out ward
B-9	11.48	51.33	42.00	2.60	3.06	Present	27.18	2.90	Dark Red	Upward
M-27	13.31	60.00	71.33	12.33	2.76	Present	29.46	2.46	Pink	Out ward
M-26	14.47	65.00	74.00	7.20	2.76	Present	26.38	2.46	Pink	Out ward
Emla-106	19.36	46.66	60.33	3.63	2.36	Present	28.71	2.83	Pink	Out ward
USA- 106	11.31	91.00	60.00	2.46	1.86	Present	23.38	2.46	Pink	Out ward
ALNARP	3.78	38.00	16.00	1.46	3.00	Absent	14.37	2.66	Pink	Out ward
CITH-01	14.47	16.33	90.00	7.10	2.10	Absent	13.61	2.67	Pink	Out ward
CITH-03	16.48	33.66	61.00	4.23	2.53	Present	14.28	2.70	Pink	Up ward
CITH-04	8.34	40.33	75.00	3.30	2.50	Present	19.47	2.10	Pink	Out ward
CITH-05	13.38	8.00	40.00	6.07	2.43	Present	14.36	2.33	Pink	Out ward
CITH-09	11.68	40.00	65.00	6.47	1.96	Present	26.42	2.80	Pink	Out ward
CITH-10	13.58	34.00	48.00	6.23	2.00	Absent	22.29	2.43	Pink	Out ward
Quince	6.41	30.00	44.00	5.43	2.10	Present	13.36	2.50	Pink	Out ward
Prunus tomentosa	13.47	60.00	76.00	10.17	2.13	Absent	11.48	2.53	Pink	Out ward
CD (%5)	*1.52*	*2.24*	*1.79*	*1.01*	*N.S.*	——	*0.93*	*N.S.*	———	————

Intervarietal hybridization for development of superior cultivars/hybrids in apple and cherry

During 2011, a total 55 cross combinations in apple were attempted involving11 line and 5 testers of diverse characters. The crossed seeds were extracted and sown in nursery. Of the successful crosses, seeds of only 10 crosses germinated. These F_1 seedlings are being maintained for top budding in August and grafting in February for further evaluation (Table 9).

Table 9. Successful intervarietal cross combinations in apple

Cross combinations	Fruit set %
American Apirouge x Maharaji	40.293
Mollies Delicious x Red Delicious	26.933
Oregon Spur x Golden Delicious	10.000
Prima x Ambri	31.067
Prima x Golden Delicious	14.393
Prima x Mahriji	40.000
Prima x Red Delicious	36.000
Prima x Top Red	36.000
Royal Delicious x Golden Delicious	5.000
Jonica X Ambri	12.08

Top budding of hybrid seedlings of apple on M-9 root stock

In cherry highest fruit set per cent (84.08) was recorded in Bigarreo Napolean in natural pollination condition followed by Van (80.78%). Where as when Bing crossed with Lambert resulted in high fruit set (79.06%). Guigne Pourppera Prececa with Bigarreo Naepoleon and Bigareo Noir Grossa resulted in very poor fruit set 3.52 % and 4.20% respectively. Cultivar Stella with all the pollen source (Van, Lapinus, Bigarreo Napoleon, Bigarreo Napolean, Bigarreo Noir Grossa and Lambert) registered highest fruit set percent than other cross combinations. Further the pollen source had direct impact on fruit size and weight (Table10).

Table 10. Fruit set and quality attributes as influenced by diverse pollen source in cherry

Cross combinations	Fruit set (%)	Fruit dia. (mm)	Fruit length (mm)	Fruit weight(g)	Fruit pulp weight(g)	Stone weight(g)	TSS (^{0}B)
				2011			
Van x Stella	23.33	21.13	21.45	4.7	4.36	0.33	16.53
Van x Lapinus	**27.05**	**20.77**	**23.90**	**5.5**	**5.16**	**0.26**	**11.2**
Van x Lambert	33.00	20.64	21.83	4.8	4.53	0.26	11.56
Van x Guigne Pourpera Prececa	6.66	23.59	22.38	6.23	5.76	0.46	17.46
Van80.78	19.41	21.57	4.33	3.9	0.26	15.5	
CD (5%)	*5.85*	*1.85*	*1.91*	*NS*	*6.53*	*0.45*	*3.17*
Stella x van	50.00	22.68	22.47	6.66	6.3	0.36	12.73
Stella X Lapinus	44.11	21.87	20.43	4.4	4.03	0.36	11.73
Stella x Guigne Pourpera Prececa	60.64	21.81	22.74	6.46	6.1	0.36	14.2
Stella x Bigarreo Napoleon	74.83	20.88	21.95	6.2	5.83	0.36	11.96
Stella x Biggareo Napoleon	74.83	21.29	22.41	5.86	5.36	0.36	10.66
Stella x Bigarreo Noir Grossa	57.69	21.08	21.32	5.2	4.93	0.26	12.83
Stella x Lembert	43.07	19.71	18.9	3.8	3.5	0.26	11.53
Stella	*66.40*	*19.99*	*20.94*	*4.66*	*4.2*	*0.36*	*11.67*
CD (5%)	*6.81*	*1.73*	*1.83*	*0.78*	*0.51*	*0.71*	*2.21*
Lapinus x Van	17.14	21.52	20.29	5.2	4.43	0.5	15.33
Lapinus x Guigne Pourpera Prececa	10.66	21.20	21.31	4.7	4.2	0.5	15.1
Lapinus x Bigarreo Napoleon	8.33	21.75	22.13	5.7	5.26	0.43	13.23
Lapinus	64.76	20.73	22.04	4.8	4.1	0.53	10.6
CD (5%)	*4.08*	*1.30*	*1.18*	*N.S*	*0.33*	*0.21*	*2.03*
Lambert x Van	20.00	18.93	17.63	3.4	3.06	0.33	13.53
Lambert x Stella	8.57	21.25	20.56	5.23	4.8	0.43	19.26
Lambert x Lapinus	32.00	20.77	19.29	4.23	3.96	0.26	14.2

Cross combinations	Fruit set (%)	Fruit dia. (mm)	Fruit length (mm)	Fruit weight(g)	Fruit pulp weight(g)	Stone weight(g)	TSS (^{0}B)
Lambert x Bigarreo Noir Grossa	7.69	20.37	20.50	4.6	4.06	0.53	15.56
Lambert	30.98	21.7	21.61	5.2	4.7	0.4	11.16
CD (5%)	*5.23*	*2.30*	*2.17*	*NS*	*0.51*	*0.32*	*3.14*
Guigne Pourpera Prececa. x Lambert	58.03	21.39	19.10	4.46	3.83	0.63	13.76
Guigne Pourpera Prececa. x Bing	63.63	22.58	19.25	5.1	4.33	0.76	13.36
Guigne Pourpera Prececa. x Biggareo Napoleon	3.52	21.06	17.73	4.73	3.8	0.73	14.86
Guigne Pourpera Prececa. x Bigarreo Noir Grossa	4.28	21.43	17.35	4.4	3.66	0.73	14.46
Guigne Pourpera Prececa. x Van	24.28	22.11	19.11	5.3	4.86	0.43	13.46
Guigne Pourpera Prececa x Stella	13.68	21.86	19.15	4.8	4.3	0.5	15.06
Guigire Pourpera Prececa	71.81	19.87	17.87	3.92	3.2	0.63	11.33
CD (5%)	*4.60*	*2.11*	*2.02*	*0.37*	*0.87*	*0.17*	*1.81*
CITH-Cherry-01 x Stella	17.64	21.25	22.35	6.3	5.86	0.43	18.86
CITH-Cherry-01 x Lambert	20.63	17.47	20.53	4.43	4.2	0.23	18.5
CITH-Cherry-01 X Bing	15.29	20.8	22.50	5.46	5.23	0.26	19.93
CITH-Cherry-01 x Bigarreo Noir Grossa	64.13	20.74	21.88	5.8	5.53	0.26	15.6
CITH-Cherry-01 x Lapinus	39.09	20.78	21.57	5.13	4.86	0.23	17.3
CITH – Cherry- 01	60.68	20.04	21.64	5.13	4.33	0.6	11.03
CD (5%)	*5.80*	*2.30*	*2.05*	*0.39*	*0.91*	*0.21*	*2.13*
Bing x Stella	63.33	22.13	26.7	7.3	6.96	0.33	16
Bing x Lambert	79.06	21.41	22.68	6.7	6.26	0.33	16.3
Bing x Guigne Pourpera Prececa	21.25	20.89	24.13	6.23	6.0	0.43	15.2
Bing x Bigarreo Napoleon	37.5	24.37	26.15	8.03	7.6	0.43	17.2
Bing	77.55	22.01	23.4	5.83	5.10	0.5	12.9
CD (5%)	*5.41*	*1.91*	*2.02*	*0.41*	*0.91*	*0.27*	*1.75*
Bigarreo Noir Grossa x Van	43.82	21.32	21.61	5.8	5.53	0.26	12.8
Bigarreo Noir Grossa x Stella	9.56	21.39	23.6	4.76	4.5	0.26	11.7
Bigarreo Noir Grossa x Lambert	11.66	23.15	23.63	7.03	6.7	0.33	18.8
Bigarreo Noir Grossa x Guigne Pourpera Prececa	25.00	19.59	21.06	4.7	4.33	0.36	12.73
Bigarreo Noir Grossa x Bigarreo Napoleon	25.21	19.61	20.14	4.1	3.76	0.33	11.9
Bigarreo Noir Grossa x Bing	27.11	19.4	19.66	3.9	3.63	0.3	19.2
Bigarreo Noir Grossa x Bigarreo Noir Grossa	20.00	18.17	18.19	3.53	3.43	0.43	19.53
Bigarreo Noir Grossa	79.07	20.26	22.50	4.16	3.6	0.36	12.53
CD (5%)	*6.01*	*1.81*	*2.03*	*0.41*	*1.12*	*0.31*	*1.87*
Bigarreo Napoleon x Lapinus	13.63	22.31	22.84	6.3	6.06	0.23	22.06
Bigarreo Napoleon x Awal No.	33.84	19.02	19.80	3.7	3.36	0.33	15.23
Bigarreo Napoleon x Van	22.85	20.46	23.06	4.6	4.33	0.26	13.36
Bigarreo Napoleon	84.08	19.61	21.86	5.4	4.9	0.4	11.56
CD (5%)	*4.63*	*1.64*	*1.17*	*0.36*	*0.43*	*0.11*	*1.04*

Assessment of pollen viability, germination and tube growth in almond cultivars

The highest pollen viability (%) of commercial almond cultivars were obtained with acetocarmine staining in all the cultivars. Morphological similarity was maximum in Waris followed by Makhdoom, Pranyaj, Primroskij, Shalimar, IXL, California Paper Shell and Merced respectively. In hanging drop pollen germination method, maximum pollen germination was obtained in Waris followed by Makhdoom, Pranyaj, Primroskij, Shalimar, IXL, California Paper Shell and Merced respectively with 10% sucrose solution however maximum tube growth length recorded in Merced at 15% sucrose concentration. Pollen production efficiency was highest in Merced than Makhdoom, Pranyaj,

Primroskij, Shalimar, IXL, California Paper Shell respectively.

Floral biology and pollinizer studies in walnut

A detailed floral biology of 50 elite genotypes of walnut was carried out to find out the synchronous period of pollination during 2011-2012. It was found that out of 50 genotypes, 27 were protogynous and rest were protandrous with 25 genotypes showing 7-14 days of male and female bloom overlapping and there by indicated synchronized flowering in most of the genotypes for successful pollination. Genotype CITH-W-40 showed maximum synchronizing phase of 14 days followed by CITH-W-37 and Nugget of 13 days. While genotype CITH-W-10, CITH-W-19, CITH-W-24 and CITH-W-48 showed non-synchronization with respect to male & female blooming period indicating need for pollinizer varieties (Table 11).

Table 11. Floral biology study in walnut genotypes

S. No.	Genotypes	Periodicity of male bloom	Periodicity of female bloom	Dichogamy	Blooming synchronization (days)
1.	CITH-W-1	08 -20 Apr	2-17 Apr	Protogynous	10 days
2.	CITH-W-2	09 -21 Apr	2-18 Apr	Protogynous	10 days
3.	CITH-W-3	09-19 Apr	3 -17Apr	Protogynous	9 days
4.	CITH-W-4	02-11Apr	09 -21 Apr	Protandrous	3 days
5.	CITH-W-5	17 -28 Apr	09 -20 Apr	Protogynous	4 days
6.	CITH-W-6	09-20Apr	03- 17Apr	Protogynous	9 days
7.	CITH-W-7	03-12Apr	09-21Apr	Protandrous	4 days
8.	CITH-W-8	03-12Apr	10 -21 Apr	Protandrous	3 days
9.	CITH-W-9	9-19 Apr	3-16 Apr	Protogynous	8 days
10.	CITH-W-10	3-16 Apr	17-30 Apr	Protandrous	-
11.	CITH-W-11	04-13Apr	12 -23Apr	Protandrous	2 days
12.	CITH W -12	11-25Apr	02-18Apr	Protogynous	8 days
13.	CITH-W-13	3-18 Apr	18-26 Apr	Protandrous	1 day
14.	CITH-W-14	3-12 Apr	10-23 Apr	Protandrous	3 days
15.	CITH-W-15	20-29 Apr	23 Apr-11 May	Protandrous	7 days
16.	CITH-W-16	8-21 Apr	3-16 Apr	Protogynous	9 days
17.	CITH-W-17	9- 20Apr	3-17 Apr	Protogynous	11 days
18.	CITH-W-18	3-16 Apr	10-26 Apr	Protandrous	7 days
19.	CITH-W-19	4-16 Apr	17-28 Apr	Protandrous	-
20.	CITH-W-23	2-11 Apr	8 -24 Apr	Protandrous	4 days
21.	CITH-W-24	5-18 Apr	23 Apr- 03 May	Protandrous	-
22.	CITH-W-25	04-13Apr	13 -24 Apr	Protandrous	1 day
23.	CITH-W-26	15-26 Apr	7-19 Apr	Protogynous	5 days
24.	CITH-W-27	9-20 Apr	2-17 Apr	Protogynous	9 days
25.	CITH-W-31	17-27 Apr	6-22 Apr	Protogynous	6 days
26.	CITH-W-32	2-17 Apr	17-28 Apr	Protandrous	1 day
27.	CITH-W-33	2-12 Apr	12-22 Apr	Protandrous	1 day
28.	CITH-W-34	6-13 Apr	13-22 Apr	Protandrous	1 day
29.	CITH-W-35	18-29 Apr	12-23 Apr	Protogynous	6 days
30.	CITH-W-36	16-25 Apr	21 Apr- 4 May	Protandrous	5 days
31.	CITH-W-37	7-19 Apr	1-20 Apr	Protogynous	13 days
32.	CITH-W-38	18-24 Apr	13-23 Apr	Protogynous	6 days
33.	CITH-W-39	10-23 Apr	3-20 Apr	Protogynous	11 days
34.	CITH-W-40	9-22 Apr	7-22 Apr	Protogynous	14 day
35.	CITH-W-41	12-26 Apr	4-19 Apr	Protogynous	8 days
36.	CITH-W-42	3-16 Apr	10-24 Apr	Protandrous	7 days
37.	CITH-W-43	13-21 Apr	2-20 Apr	Protogynous	8 days
38.	CITH-W-44	12-23 Apr	7-20 Apr	Protogynous	9 days

S. No.	Genotypes	Periodicity of male bloom	Periodicity of female bloom	Dichogamy	Blooming synchronization (days)
39.	CITH-W-45	2-11 Apr	9-25 Apr	Protandrous	3 days
40.	CITH-W-46	9-20 Apr	2-16 Apr	Protogynous	8 days
41.	CITH-W-47	3-13 Apr	12-21 Apr	Protandrous	2 days
42.	CITH-W-48	2-11 Apr	18-29 Apr	Protandrous	-
43.	CITH-W-49	13-24 Apr	4-19 Apr	Protogynous	7 days
44.	Hamdan	10-20 Apr	2-20 Apr	Protogynous	11 days
45.	Sulaiman	09-20 Apr	03-18 Apr	Protogynous	10 days
46.	Opex Caulchery	06-16 Apr	14-25 Apr	Protandrous	3 days
47.	Nugget	10-22 Apr	04-22 Apr	Protogynous	13 days
48.	Cheinova	20-30 Apr	08-26 Apr	Protogynous	7 days
49.	Tutle	11-24 Apr	4-21 Apr	Protogynous	11 days
50.	Franquette	17-26 Apr	23 Apr-11 May	Protandrous	4 days

Breeding for development of superior varieties / hybrids in solanaceous crops

To develop and isolate high yielding varieties and hybrids in chilli, capsicum and brinjal suitable for temperate region, 270 lines of chilli, 48 lines of capsicum and 19 lines of brinjal were evaluated in open field conditions.

In chilli, out of 270 lines tested ten promising genotypes ((Table 12) were identified with fruit yield range of 342.29 to 448.00 q/ha. The genotypes CITH-HP -655-1 (448.00 q/ha) was found best followed by CITH-HP -699-1 (438.00 q/ha) and CITH-HP -712-1(398.00 q/ha). Average fruit weight was highest in CITH-HP -1011-2 (15.52 g) followed by CITH-HP-260-2 (14.17 g) and maximum number of fruits per plant (143.0) was recorded in CITH-HP -699-1.

Table 12. Promising lines of chilli

Programme	No. of lines tested	Promising genotypes on the basis of fruit yield and other traits
Evaluation of chilli lines	270	CITH-HP-773 CITH-HP-1011-2 CITH-HP-699-1 CITH-HP-260-2 CITH-HP-688-1 CITH-HP-712-1 CITH-HP-655-1 CITH-HP-1016 CITH-HP-210-1 CITH-HP-612-1

In capsicum, out of 48 lines tested, ten promising genotypes (Table 13) were identified with a yield range of 637.28 to 905.43 q/ha. The genotypes SH-SP-603 (905.43 q/ha) was found best followed by SH-SP-706 (818.39 q/ha) and CITH-SP-1 (815.84 q/ha). Average fruit weight was highest in SH-SP-603 (94.0 g) followed by CITH-SP-2 (90.33 g) and maximum number of fruits per plant (37.0) was recorded in CITH-SP-4.

Table 13. Promising lines identified in capsicum

Programme	No. of lines tested	Promising genotypes on the basis of fruit yield and other traits
Evaluation of Capsicum lines	48	CITH-SP-1 CITH-SP-2 CITH-SP-3 CITH-SP-4 CITH-SP-5 CITH-SP-6 SH-SP-706 SH-SP-603 CITH-SP-9 CITH-SP-10

In brinjal, 19 lines were evaluated (Table 14) in open field. CITH-B (R)-1 (932.59 q/ha) was found best followed by CITH-B(L)-6 (919.75 q/ha) which was at par with CITH-B(o)-4-11-1-cluster (919.51 q/ha) and CITH-B(o)-4-6-1 (909.63 q/ha). Average fruit weight was highest in CITH-B(L)—11 (108.0 g) followed by CITH-B(o)-4-6 (100.0 g) and maximum number of fruits per plant (34.33) was recorded in CITH-B(L)-2.

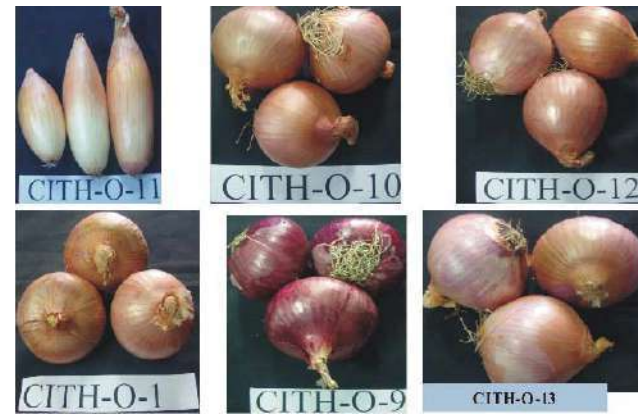
Table 14. Promising lines identified in brinjal

Programme	No. of lines tested	Promising genotypes on the basis of fruit yield and other traits
Evaluation of brinjal lines	19	CITH-B(o)-4-6 CITH-B(L)-8 CITH-B(R)-1 CITH-B(L)-10-1 CITH-B(L)-6 CITH-B(o)-4-11-1-cluster CITH-B(o)-4-6-1 CITH-B(o)-4-5 CITH-B(L)-2 CITH-B(L)-11

Elite chilli genotypes CITH-HP-655-1 and CITH-HP-699-1

Elite brinjal genotypes

In onion, thirteen accession of long day onion were evaluated for higher yield and better quality. All the accessions performed well and produced 100% A grade bulbs with yield ranging from 399.54 q/ha to 1061.20 q/ha (Table 15). CITH-O-10 recorded highest yield of 1061.20 q/ha with highest average bulb weight (392.67g) followed by CITH-O-2 (976.13 q/ha), CITH-O-14 (961.70 q/ha) and CITH-O-4 (804.94 q/ha).



Promising onion selections

In garlic, five collections of long day type have been made and evaluated for higher yield and better quality (Table 16). CITH-G-5 recorded highest plant height (109.75 cm) and number of leaves per plant (8.25). However highest yield was recorded in CITH-G-2 (212.25 q/h) closely followed by CITH-G-1 (202.99q/ha).

Table 15. Performance of onion germplasm under temperate Kashmir conditions

Accessions	Plant height (cm)	No. of leaves/ plant	Polar dia. (cm)	Equi. dia. (cm)	Neck thickness (cm)	% Bolters	% Marketable bulb	Total yield (q/ha)	Av. bulb wt. (g)	Bulb colour
CITH-O-2	61.00	11.00	9.44	8.00	1.70	2.46	97.54	976.13	361.17	Red
CITH-O-3	64.66	10.66	7.97	6.55	1.74	5.55	94.45	538.29	199.17	Red
CITH-O-4	66.00	10.00	9.54	6.89	1.80	3.70	96.30	804.94	297.83	Red
CITH-O-5	73.00	12.00	8.65	6.99	2.00	2.46	97.54	681.54	252.17	Red
CITH-O-6	78.00	11.66	8.42	6.42	2.00	0.00	00.00	630.62	233.33	Red
CITH-O-7	70.00	10.33	7.30	5.24	1.40	7.40	92.60	363.05	134.33	Yellow
CITH-O-8	63.00	8.000	7.83	6.78	1.40	1.85	98.15	610.35	225.83	Red
CITH-O-9	73.00	9.66	8.88	7.11	1.90	0.00	00.00	704.05	260.50	Red
CITH-O-10	76.66	12.00	9.87	8.46	2.30	1.85	98.50	1061.2	392.67	Red
CITH-O-11	69.00	9.66	7.71	7.12	2.00	1.23	98.77	551.81	204.17	Red
CITH-O-12	71.00	10.66	7.73	6.88	1.70	1.85	98.50	534.24	197.67	Yellow
CITH-O-13	76.00	15.00	5.00	12.3	1.60	0.00	100.00	399.54	147.83	Yellow
CITH-O-14	83.00	14.00	9.57	8.18	2.10	0.00	100.00	961.70	355.83	Red
CD (5%)	*1.86*	*1.45*	*0.41*	*0.21*	*0.17*	*0.06*	*0.22*	*0.17*	*0.40*	-
SE(m)	*0.64*	*0.50*	*0.14*	*0.07*	*0.06*	*0.02*	*0.08*	*0.06*	*0.14*	-

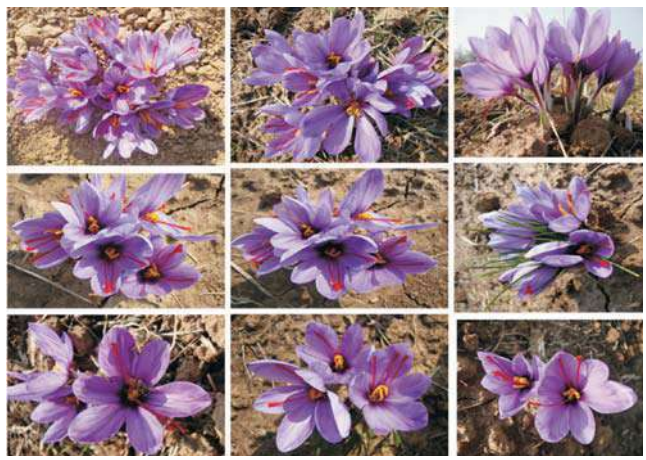
Table 16. Performance of garlic genotypes

Genotypes	Plant height (cm)	No. of leaves/ plants	Leaf length (cm)	Leaf width (mm)	Pseudo stem length (cm)	Polar diameter (cm)	Equatorial diameter (cm)	Av. bulb wt.(g)	No. of cloves/ bulb	Average weight of 50 cloves (gm)	Total yield (q/h)
CITH-G-1	88.75	6.50	49.75	2.12	10.00	59.28	51.61	75.99	11.50	318.78	202.99
CITH-G-2	58.25	6.75	43.50	1.32	9.00	60.32	53.97	79.21	10.75	377.61	212.25
CITH-G-3	67.75	6.25	34.25	1.65	9.25	56.36	44.22	59.47	13.50	235.75	159.90
CITH-G-4	81.00	6.50	44.50	2.40	10.25	58.91	47.45	66.89	14.00	258.86	178.24
CITH-G-5	109.75	8.25	38.00	4.17	22.54	64.31	57.45	69.1	79.90	296.98	176.95
CD(5%)	*5.32*	*1.03*	*6.35*	*N.S*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*

Promising garlic clones G-1 and G-2

Saffron improvement

In saffron, a total of 32 elite clones were evaluated for economic traits such as fresh weight of pistil, dry weight, stigma/style length and weight. Based on performance, best clones having high saffron yield/ha were identified. They include CITH-125 (4.5 kg/ha), CITH-123 (4.3 kg/ha), CITH-124 (4.3 kg/ha), CITH-122 (4.0 kg/ha), CITH-12 (4.5 kg/ha), CITH-121 (3.9 kg/ha), CITH-107 (3.8 kg/ha), CITH-120 (3.8 kg/ha) and CITH-104 (3.7 kg/ha) having higher saffron yield in their initial planting years. All these clones are maintained in field and being multiplied for further utilization.



Saffron clonal selections in flowering

Diversification in temperate fruit production through introduction of new fruit crops

Introduction and evaluation of husk tomato

Introduction and adaptations of new crops contribute to increase in diversity, offer new alternatives to farmers and consumers, with crops that may have a high value. Keeping its importance and scope in consideration 10 accessions from NBPGR Regional Station, Shimla evaluated for their adaptation under temperate region grown in summer season. These genotypes showed significant variation in terms of plant height (70.33 cm in EC-467446 to 168.33 cm in EC-467459), time taken to bud burst (21 days in EC-467435, EC-467446 to 29 days in EC-467459), yield per plant (3.52 kg in EC-467449 to 9.69kg in EC-467459), average fruit weight (20.00 g in EC-467449 to 37.67 g in EC-467459) and ascorbic acid of 24.27 mg/100g in EC-467459 followed by 20 mg /100gm in EC-467450.

Husk tomato in fruiting

Introduction and evaluation of cape gooseberry

Twenty cape gooseberry genotypes/collections were evaluated. The result revealed significant variation for all the growth and yield attributes. Maximum plant height was recorded in CITH-CGB S13, whereas, maximum number of fruits per plant was observed in CITH-CGB S16 (73). Maximum fruit weight (19.10g) and fruit length (29.82 mm) was recorded in CITH-CGB S3, however, fruit firmness estimated maximum in CITH-CGB S13. Fruit yield per plant was recorded highest in CITH-CGB 20 (1145.03 g). Among quality traits maximum total soluble solids were recorded in CITH- CGB1 (9.71^{0}B). The maximum ascorbic acid estimated in CITH-CGB Sel-6 (24 mg/100g) and maximum carotene content was recorded in CITH-CGB S10 (1.72 mg/100g). The genotypes CITH-CGB S20, CITH-CGB S3, CITH-CGB S12, CITH-CGB S1, and CITH-CGB S6 can be used as elite selections for the temperate region.

Collection of other minor temperate fruits

Germplasm of some other minor fruits such as of hazel nut, persimmon , feijoa, pecan, chinese ber, black currants, *Ribes,Rubus*, sea buck thorn, fig and black berry were collected and added to the field gene bank.

Collection and evaluation of gerbera genotypes under protected conditions and refinement of technologies for production

A total, 50 genotypes were evaluated for different parameters such as plant growth and cut flower qualities. Genotypes viz., G-6, G-15, G-16, G-17, G-18, G-19 and G-20 were found very promising with respect of plant growth and flower qualities. Other promising genotypes were G-4, G-5, G-6, G-7, G-8, G-9, G-10, G-11, G-13, G-14, G-15, G-16, G-17, G-18, G-19 and G-20. Experiment on effect of plant spacing and fertilizer dose with spacing: S1= 30 x 30, S2= 30 x 40 and S3= 40 x 40 and fertilizer doses: F1= 10:15:20 NPK/m^2/month, F2= 10:15:30 NPK/m^2/month and F3= 15:10:30 NPK/m^2/month showed that treatment combination (T_5) of plant spacing of 30 x 40 cm and fertilizer dose of 10:15:30 NPK/m^2 was very much effective for better plant and quality flower production (Table 17) .

Elite Gerbera genotype (G-18)

In-vitro micropropagation for cherry

Root stock propagation in cherry is the major problem owing to difficulty in rooting. In order to overcome the difficulties in conventional vegetative propagation, a micropropagation method was tried with cherry root stock Mazzard (*Prunus avium* L), which is very difficult to root under *in vivo* conditions. Different phytohormone combinations were tried to optimize the best combination for development of fast and efficient micropropagation protocol. Meristem was cultured on MS medium supplemented with different concentrations of BAP+

Table 17. Effect of plant spacing and fertilizer dose on plant growth and flower quality of gerbera

Genotype	Plant Height (cm)	No. of leaves	Stem length (cm)	Flower diameter (cm)	Vase-life winter (days)	Vase-life summer (days)	Yield/m^2 (No. of flowers)
T_1	13.98	11.87	33.7	10.5	14	10	200.8
T_2	15.74	14.85	35.23	12.7	17.7	13	263
T_3	16.85	18.65	40.25	13.0	23	15	300
T_4	15.7	16.85	38.3	11.6	13.6	15	250
T_5	20.89	23.5	51.25	14.41	27	19	337
T_6	20.54	21.52	45.33	13.44	25	18	330
T_7	15.5	17.8	39.3	12.6	14.6	16	253
T_8	20.0	23.0	51.2	13.0	24	17	300
T_9	19.5	21.5	50.5	12.7	22	15	285

IBA, BAP + GA_3 and IBA + NAA for shoot initiation, shoot multiplication and rooting respectively. Medium containing BAP (2 mg l^{-1}) + IBA (0.5 mg l^{-1}) proved to be best medium for initial establishment. Maximum number of shoot (32) and length of shoots (10 cm) was observed on MS media supplemented with BAP (1mg l^{-1}) + GA_3 (0.5 mg l^{-1}) .Maximum number of roots (18.8) and length of roots (9.6 cm) was obtained on MS media containing IBA (1.5 mg l^{-1}) + NAA (0.5 mg l^{-1}) and IBA (2.0 mg l^{-1}) + NAA (0.5 mg l^{-1}) respectively (Table 18) . Further growing shoots during the rooting phase, conditioning the plantlets for a good survival and quality, rooted plantlets were transferred to moist cotton for 10-15 days and then transferred to vermiculite for acclimatization, for a period of four weeks, and further on soil. An average of 60% acclimatized plantlets survived after three months of transferring into the soil.

Table 18. Effects of different BA and IBA concentrations on rooting in *Mazzard*

NAA (mg l^{-1})	IBA (mg l^{-1})	Root length (cm)	No. of roots
0.5	1.0	2.50e^{f} ±0.92	14.00c^{d}±1.05
0.5	1.5	4.60^{d} ±0.62	18.80^{b}±0.66
0.5	2.0	9.60^{a} ±0.87	22.60^{a}±0.93
0.5	2.5	8.60^{b} ±0.39	17.80^{b}±0.37
0.2	1.0	7.40^{c} ±0.36	15.80^{c}±0.37
0.2	1.5	4.60^{d} ±0.90	13.60^{d}±0.93
0.2	2.0	5.20^{d} ±0.36	10.00^{e}±0.32
0.1	1.0	3.20^{e} ±0.20	8.40^{e}±0.24
0.1	1.5	2.60e^{f} ±0.39	6.40^{e}±0.51
0.1	2.0	2.30^{f} ±0.26	6.40^{f}±0.24

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

Apical bud explants were cultured on different nutrient media supplemented with various concentrations of plant growth regulators. Micro-corm formation was observed on all the media combinations. Maximum number (10) and weight (1.54 g) of microcorms development was observed on MS media supplemented with BAP (2 mg/l) + NAA (0.5mg/l) + paclobutrazol (1.5 mg/l). Maximum number of shoot (11.6) and length of shoots (11.4 cm) was also observed on MS media supplemented with NAA (21.6µM) + BAP (22.2µM). Maximum number of roots (11) and length of roots (11.4 cm) were obtained on G-5 media containing NAA (21.6µM) + BAP (22.2µM). For development of stigma like structures under *in-vitro* conditions, floral parts were cultured on LS, MS, and Gamborg media supplemented with different combinations of phytohormones, stigma-like structures appeared on cultured half ovaries. Maximum number (120 indirectly and 20 directly) and size (5.2 cm) of SLS were obtained in G-5 medium supplemented with 27 µM NAA and 44.4 µM BA followed by 100 indirectly and 20 directly and 4.5cm long on LS medium supplemented with 27 µM NAA and 44.4 µM BA. Whole stigma development was also observed with some combinations of phytohormones from floral explants (Table 19 & 20).

In -vitro micropropagation of cherry

Table 19. *In- vitro* corm multiplication in saffron from apical buds

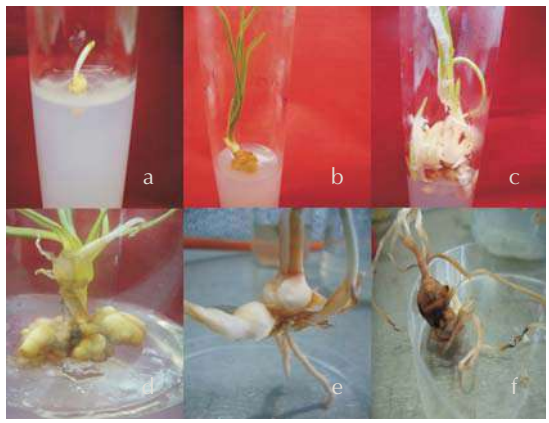
Medium	BAP mgl^{-1}	NAA mg l^{-1}	Paclo-butrazol mg l^{-1}	No. of microcorms	Weight of corm (g)
MS	1.0	0.1	1.0	8.4^{abc}±0.56	0.96^{bc}±0.12
	1.0	0.5	1.5	8.4^{abc}±0.25	0.6^{cd}±0.35
	2.0	0.5	1.5	10.2^{a}±0.40	1.54^{a}±0.11
	2.0	1.0	2.0	7.6^{bc}±0.25	0.48^{cd}±0.02
G-5	1.0	0.1	1.0	6.2^{c}±0.48	0.72^{cd}±0.10
	1.0	0.5	1.5	7.2^{bc}±0.18	0.48^{cd}±0.02
	2.0	0.5	1.5	8.8^{ab}±0.36	1.34^{ab}±0.11
	2.0	1.0	2.0	6.0^{c}±0.38	0.34^{d}±0.02

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

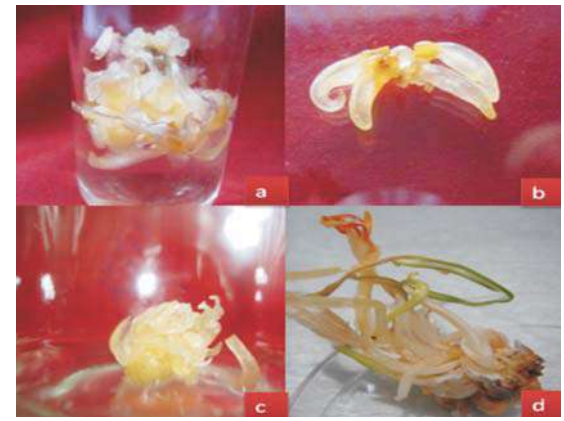
Table 20. *In-vitro* root and shoot regeneration in saffron from apical buds

Medium	NAA (µM)	BA (µM)	Shoot length (cm)	No. of shoots	Root length (cm)	No. of roots
MS	27	44.4	10.8^{ab}±0.53	10^{ab}±0.57	7.6^{c}±0.43	7.4^{bc}±0.53
	21.6	22.2	11.4^{a}±0.51	11.6^{a}±0.64	10^{ab}±0.38	9.8^{ab}±0.43
	16.2	4.4	10.0^{abc}±0.35	8.8^{abc}±0.69	8.4^{bc}±0.20	7^{bc}±0.35
	10.8	2.22	6.8^{de}±0.43	6.6^{bc}±0.56	7.2^{c}±0.18	5.8^{c}±0.36
G-5	27	44.4	8.4^{bcd}±0.25	8^{abc}±0.57	10.2^{ab}±0.43	11.0^{a}±0.89
	21.6	22.2	10.4^{abc}±0.37	10^{ab}±0.52	11.40^{a}±.46	11.4^{a}±0.53
	16.2	4.4	08^{cde}±0.35	6.8^{bc}±0.55	10.0^{ab}±0.22	8.8^{abc}±0.53
	10.8	2.22	5.6^{e}±0.37	5.4^{c}±0.49	8.8^{bc}±0.18	7.4^{bc}±0.37

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



Corm multiplication in saffron a) Apical bud as an explants b&c) Shoot elongation from corm d) Microcorm multiplication e & f) developed microcorm



Development of stigma like structures in saffron a) Initiation of SLS development b & c) SLS development from saffron explants d) stigma development in saffron

In-vitro propagation of apple clonal root stock MM-106

The protocol for micropropagation of apple root stock MM-106 was standardized using meristem as an explant. Different phytohormone combinations were tried to optimize the best combination for development of fast and efficient micropropagation protocol (Table 21&22). Meristem was cultured on MS medium supplemented with different concentrations of BAP alone and in combination with IBA, phloroglucinol and GA_3 for shoot formation, multiplication and rooting. Best initial establishment was done on MS media supplemented with BAP (2 mg/l) + IBA (0.5 mg/l) + Phloroglucinol (100mg/l). Maximum number of shoots (13.0), length of shoots (9.67 cm), leaf length (3.47cm) and leaf number (15.3) was observed on

Table 21. Effects of different BA and GA_3 concentrations on shoot proliferation in apple

GA_3 (mg/l)	BA (mg/l)	Shoot length (cm)	No. of shoots	Leaf length	No. of leaves
0.5	0.5	2.73^{g}±0.37	4.33^{de}±0.71	1.53^{ef}±0.18	6.0^{e}±0.5
0.5	0.75	3.30^{egf}±0.21	6.67^{dc}±0.97	1.80^{ed}±0.12	7.0^{ed}±0.5
0.5	1	4.10^{edf}±0.21	10.33^{b}±0.71	2.43^{cb}±0.10	8.3^{ed}±0.3
0.5	1.5	5.87^{cb}±0.46	10.0^{b}±0.47	2.83^{b}±0.07	11.7^{b}±0.7
0.5	2.0	9.67^{a}±0.60	13.0^{a}±0.47	3.47^{a}±0.12	15.3^{a}±0.7
1	0.1	6.77^{b}±1.03	9.33^{b}±0.71	2.20^{cd}±0.12	11.3^{cb}±0.7
0.1	0.2	5.27^{cd}±0.50	7.00^{c}±0.47	1.73^{e}±0.12	12.0^{b}±0.5
1	0.5	4.30^{ed}±0.25	5.00^{cde}±0.47	1.53^{ef}±0.12	9.3^{cd}±0.7
1	1	3.17^{eg}±0.16	4.67^{cde}±0.71	1.23^{f}±0.12	7.7^{ed}±0.7
1	1.5	2.23^{g}±0.12	3.00^{e}±0.46	1.10^{f}±0.05	7.0^{ed}±0.5

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

MS media supplemented with BAP (1mg/l) + GA_3 (0.5 mg/l). Maximum number (16.3) and length of roots (10.20 cm) was observed on MS media containing IBA (3 mg/l). Acclimatization of rooted plants was observed on moist cotton for 10 -12 days followed by vermiculite for four weeks. About 70% of plants survive after 6 months of transfer to the soil under polyhouse house conditions.

Table 22. Effects of different IBA concentrations on rooting in apple

IBA (mg/ l)	Root length (cm)	No. of roots
0.5	2.56^{f}±0.12	3.0d±0.5
1	3.43^{ef}±0.18	4.3d±0.7
1.5	4.10^{e}±0.17	7.0c±0.9
2	5.86^{d}±0.42	9.0c±0.5
2.5	6.93^{cb}±0.42	12.3b±0.7
3.0	10.20^{a}±0.21	16.3a±0.7
3.5	7.73^{b}±0.42	14.0b±0.5
4	7.83^{b}±0.10	12.0b±0.5
4.5	6.50^{cd}±0.20	9.0c±0.5
5	5.90^{d}±0.05	8.0c±0.5

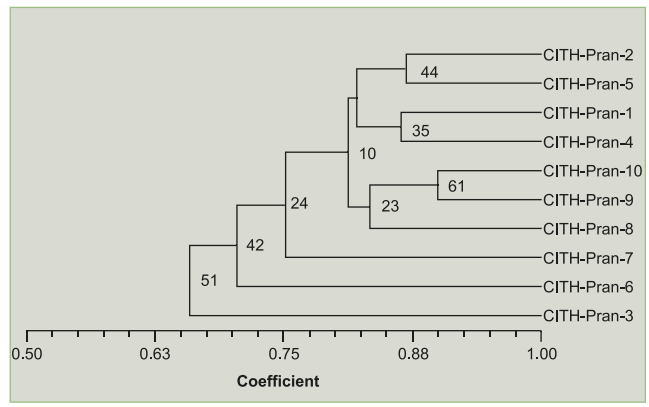
Means followed by the same letter within the columns are not significantly different (P= 0.05) using Duncan's multiple range test

Effect of bio-regulators and physiological maturity of micro-shoots of apple rootstock MM 111 on rooting under *in vitro* condition

Explant of MM 111 was collected from forced shoots under culture room environment and established in MS media supplemented with BAP (0.5 mg/L) + IBA (0.1 mg/L). After establishment of the explants, elongation and subsequent proliferation was achieved in MS media supplemented with BAP (0.5 mg/L) + IBA (0.1 mg/L) + Kinetin (0.5 mg/L) for production of micro-shoots. Micro-cuttings were collected from proliferated micro-shoot culture at different intervals 3, 6 and 9 weeks after the date of inoculation of the elongated shoots in the proliferation media. Micro-cuttings at three physiological growth stages were inoculated in the half MS media supplemented with IBA and NAA in different concentrations and kept for one week under dark condition. All these IBA/ NAA treated micro-cuttings were inoculated in full MS blank (without any growth regulators) media for root initiation and elongation. Initial observation showed that the higher concentration of IBA (6 mg/ L) alone or in combination with NAA (1 or 2 mg/ L) induced early and more callus and poor rooting. Whereas, low concentration of IBA (1.5 mg/L) alone or in combination with NAA (1 or 2 mg/L) induced less callusing and poor rooting. The treatments having IBA at 3mg/L alone or in combination with 1mg/L NAA resulted in minimum callus intensity and higher rooting. Micro-cuttings taken after 6 and 9 week growth stage were found to be physiologically better responsive to rooting in comparison to 3 week growth stage. Further experimentation is in progress.

Genetic diversity of Pran (*Allium cepa var. prolliferum*)

The pran genotypes maintained at CITH, Srinagar were evaluated using RAPD markers to determine the genetic relationships among genotypes showing morphological variations. Fourty three decamer primers were used in this study. Genetic diversity in the genotypes was analyzed using several variability parameters. A dendrogram based on UPGMA analysis grouped the ten genotypes into two main clusters. Genotypes representing cluster-I are superior over genotypes in cluster-II with respect yield attributes. Some genotypes did not show any similarity with either cluster, depicting their diverse nature. The grouping that was obtained with the RAPD analysis was at par with the morphological grouping based on yield attributes. The results of Principal co-ordinate (PCO) analysis were comparable to the cluster analysis. Finally, the investigation of the genetic variation of pran with RAPD indicated that this marker is suitable tool for assessing polymorphism and estimating the genetic similarity.



UPGMA dendrogram showing clustering pattern of pran genotypes. The bootstrap values are given on the nodes

II. CROP PRODUCTION AND PROPAGATION

Large scale multiplication of quality planting material and seeds of temperate horticultural crops

Quality rootstock/seedling material production

During the year 18745 clonal apple root stock MM-106, EMLA-106, MM111, M-9, M-27, ANLARP and M-26, free from insect, pest and diseases were multiplied and supplied/ nurseries/ govt. agencies/ used experiments.

Establishment of root stock and bud wood bank and their large scale production

For the establishment and production of rootstocks and quality bud wood a seprate bud bud wood bank of 21 apple varieties, 25 walnut selections, 9 of almond and 10 of apricot were planted and established at CITH field. For production of seedling rootstcoks, 600 kg seeds which includes almond (300kg), apricot (50 kg) and walnut (250 kg) was procured and sown in the nursery block and produced 1.90 lakh seedlings that includes apple, walnut, almond , pear , plum, peach, apricot, cherry & quince and used for grafting and budding.

Apple root stock bank at CITH, Srinagar

Almond seedling production ready for budding

From budwood bank about 4.0 lakh bud wood of elite varieties was produced in which 1.0 lakh was used for grafting purpose in CITH, 1.5 lakh bud wood was given to farmers and development departments for popularization of the varieties and 1.0 lakh bud wood was sold.

Standardization of efficient propagation techniques for production of quality planting material of walnut

Effect of rootstock and scion girth on grafting success of walnut under controlled conditions

To standardize the most suitable root stock and scion girth, an experiment was carried out with 3 different root stock girths i.e. 25-30 mm, 20-25 mm and 15-20 mm and three different scion girths i.e. 15-20 mm, 10-15 mm, 5-10 mm. Among the root stock and scion girths, A_1B_1 recorded the highest graft success (93.3%) followed by A_1B_2 (83.3%). However, the minimum graft success was recorded in A_3B_2 (44.4%). The results indicated that (25 – 30 mm) and (15 – 20 mm) use of healthy strong stocks and fully developed plumpy scions are found best and are key to higher grafting success (Table 23).

Table 23. sprouting percentage as influenced by rootstcoks and scion girth under controlled poly house condition

Treatment combinations	Sprouting (%)	Grafting success (%)
(T1) A_1B_1	96.7	93. 3
(T2) A_1B_2	90.0	83. 3
(T3) A_1B_3	83.3	76. 7
(T4) A_2B_1	83. 3	83. 3
(T5) A_2B_2	93. 3	73. 3
(T6) A_2B_3	93. 3	70. 0
(T7) A_3B_1	66. 7	55. 2
(T8) A_3B_2	50. 0	44. 4
(T9) A_3B_3	66.7	50.0
CD (5%)	*1.52*	*1.63*
SEM (±)	*4.40*	*4.76*

I) Rootstock girth
A_1 = 25 – 30 mm
A_2 = 20 – 25 mm
A_3 = 15 – 20 mm

II) Scion girth
B_1 = 15 – 20 mm
B_2 = 10 – 15 mm
B_3 = 05 – 10 mm

Comparison of sprouting percentage and grafting success in various grafting methods with different dates on different varieties under controlled conditions

To standardize the efficient propagation techniques in walnut, different grafting techniques with different dates on different varieties were evaluated to get the maximum success. Two grafting techniques i.e. wedge and tongue grafting were evaluated with three different dates i.e. 15th Feb, 1st March and 15th March on five different varieties (CITH-Walnut-1, CITH-Walnut-2, CITH-Walnut-

3, Sulaiman and Opexcultury). Wedge grafting on 15th March on CITH-Walnut-1 recorded highest sprouting (96.67%), with grafting success of (86.67%). The results indicated the success in graft take is genotype dependent. The better the maturity and quality of the scion, which contain higher soluble sugars, starch and C:N ratio, the higher the grafting survival percentage (Table 24).

Table 24. Grafting percentage with different grafting methods at different dates on different varieties under controlled conditions

Treatment	V_1	V_2	V_3	V_4	V_5	Mean
A_1B_1	46.67	56.70	50.00	40.00	23.33	43.34
A_1B_2	56.67	63.33	60.00	36.70	60.00	55.34
A_1B_3	86.67	83.33	76.70	53.33	73.33	74.67
A_2B_1	53.33	70.00	46.70	46.70	30.00	49.35
A_2B_2	56.67	63.33	56.70	43.33	50.00	54.01
A_2B_3	63.33	66.70	66.70	53.33	30.00	56.01
Mean	60.56	67.23	59.47	45.57	44.44	

CD(5%)

CD for Factor A X B = 0.522
CD for Factor A X V = 0.673
CD for Factor B X V = 0.825
CD for Factor A X B X V = 1.167

A= Grafting methods
A_1= Wedge grafting
A_2= Tongue grafting
B= Different dates
B_1= 15th February
B_2= 1st March
B_3=15th March

C= Varieties
V_1=CITH-W-1
V_2=CITH-W-2
V_3=CITH-W-3
V_4=Sulaiman
V_5=Opex Cultury

Chip budding time and height as determining factors for bud take and successive plant growth

Chip budding in apple cv. Starkrimson on crab apple seedling gave higher percentage of success in the month of February-March, July-August and September-October (88.3 -95.3%) when budded at a height of 8-10 cm, whereas, wedge grafting and tongue grafting gave 87.5 and 85.4% during February-March and T-budding gave 84.5% during June-July at 8-10 cm grafting/budding height (Table 25). Chip budding on apple clonal rootstock M 9 gave 95.9%, 90.2% and 93.8% success in February-March, June-July and September-October, respectively at budding height of 8-10 cm. Wedge grafting also gave higher graft/bud success(88.4%), followed by tongue grafting (84.5%) and T-budding (80.3%). Apple plant height ranged from 120.3-143.0 cm on seedling rootstock and 87.3-90.3 cm on M9 (dwarf) rootstock. Chip budding resulted in higher success with respective values of 92.3%, 91.4% and 90.5% in pear 94.5%, 92.4% and 89.6% in peach

Grafted walnut plants in poly house

Successful grafted walnut plants in poly house

Walnut root stock production in poly house

during February-March, June-July and September-October at 8-10 cm height. Plant height of pear and peach was in the range of 120.6-137.4 cm and 116.3-135.5 cm respectively (Table 26). Chip budding in almond gave 90.4%, 88.6% and 87.3% at 8-10 cm budding height during February-March, June-July and September-October. Whereas, in walnut chip budding during February-March gave higher success rate of 80.8% and 79.6% at 8-10 cm and 12-15 cm budding height. Tongue and wedge grafting during February-March and T-budding during June-July also gave good percentage of graft/bud success in pear, peach and almond. In walnut, wedge grafting gave 76.2% and 73.8% and tongue grafting gave 70.5% and 68.4% success at 8-10 cm and 13-15 cm grafting height, respectively. Grafted/budded almond plants attained plant height of 112.3-124.5 cm, whereas, walnut attained plant height in the range of 88.5-105.8 cm (Table 27 & 28).

Table 25. Comparative performance of chip budding and other grafting/budding on apple seedling and clonal root stock (M9) at different heights under polyhouse conditions

Budding/grafting time and height	Seedling rootstock	Root stock:M9	Budding/grafting time and height	Seedling rootstock	Root stock: M9
	Budding/ grafting success (%)	Budding/grafting success (%)		Budding/grafting success (%)	Budding/grafting success (%)
Chip budding					
Dec-Jan			Feb-Mar		
8-10cm	61.0	64.6	8-10cm	82.3	84.5
13-15cm	60.6	65.1	13-15cm	78.6	70.5
18-20cm	42.5	44.4	18-20cm	70.8	60.6
Feb-Mar			Wedge graft		
8-10cm	95.3	95.9	Dec-Jan		
13-15cm	93.5	90.5	8-10cm	85.7	88.4
18-20cm	85.6	63.1	13-15cm	37.3	36.3
Jul-Aug			18-20cm	35.5	31.5
8-10cm	88.3	90.2	Feb-Mar		
13-15cm	85.5	87.4	8-10cm	85.7	88.4
18-20cm	78.3	70.7	13-15cm	79.6	72.5
Sep-Oct			18-20cm	75.8	63.3
8-10cm	92.6	93.8	T-budding		
13-15cm	87.5	89.4	Jul-Aug		
18-20cm	80.0	72.2	8-10cm	78.6	80.3
Tongue Grafting			13-15cm	75.2	72.5
Dec-Jan			18-20cm	70.3	62.7
8-10cm	39.5	42.9	Sep-Oct		
13-15cm	35.3	35.3	8-10cm	68.6	67.4
18-20cm	34.5	30.5	13-15cm	64.3	64.7
			18-20cm	60.4	51.3

Table 26. Comparative performance of chip budding and other grafting/budding methods in pear and peach under polyhouse conditions

Pear				Peach			
Budding/grafting time and height	Budding/ grafting success (%)	Budding/ grafting time and height	Budding/ grafting success (%)	Budding/ grafting time and height	Budding/ grafting success (%)	Budding/ grafting time and height	Budding/ grafting success (%)
Chip Budding				Chip Budding			
Dec-Jan		Feb-Mar		Dec-Jan		Feb-Mar	
8-10cm	44.5	8-10cm	85.5	8-10cm	40.6	8-10cm	80.2
13-15cm	40.2	13-15cm	83.6	13-15cm	35.6	13-15cm	78.4
18-20cm	37.9	18-20cm	73.5	18-20cm	25.4	18-20cm	72.3

Pear				Peach			
Budding/grafting time and height	Budding/ grafting success (%)	Budding/ grafting time and height	Budding/ grafting success (%)	Budding/ grafting time and height	Budding/ grafting success (%)	Budding/ grafting time and height	Budding/ grafting success (%)
Chip Budding				Chip Budding			
Feb-Mar		Wedge graft		Feb-Mar		Wedge graft	
8-10cm	92.3	Dec-Jan		8-10cm	94.5	Dec-Jan	
13-15cm	90.5	8-10cm	57.2	13-15cm	92.6	8-10cm	47.4
18-20cm	82.5	13-15cm	54.6	18-20cm	85.4	13-15cm	44.6
Jul-Aug		18-20cm	45.5	Jul-Aug		18-20cm	40.5
8-10cm	91.4	Feb-Mar		8-10cm	92.4	Feb-Mar	
13-15cm	89.6	8-10cm	87.4	13-15cm	88.6	8-10cm	84.2
18-20cm	81.3	13-15cm	85.6	18-20cm	78.6	13-15cm	80.5
Sep-Oct		18-20cm	76.5	Sep-Oct		18-20cm	74.3
8-10cm	90.5	T-budding		8-10cm	89.6	T-budding	
13-15cm	88.6	Jul-Aug		13-15cm	87.7	Jul-Aug	
18-20cm	80.4	8-10cm	84.5	18-20cm	76.5	8-10cm	89.5
Tongue Grafting		13-15cm	82.5	Tongue Grafting		13-15cm	85.4
Dec-Jan		18-20cm	75.4	Dec-Jan		18-20cm	78.3
8-10cm	54.3	Sep-Oct		8-10cm	43.4	Sep-Oct	
13-15cm	50.6	8-10cm	70.4	13-15cm	41.2	8-10cm	75.4
18-20cm	42.1	13-15cm	65.4	18-20cm	37.5	13-15cm	69.4
		18-20cm	51.2			18-20cm	61.0

Table 27. Comparative performance of chip budding and other grafting/budding methods of apricot and almond under polyhouse conditions

Apricot				Almond			
Budding/grafting time and height	Budding/ grafting success (%)	Budding/ grafting time and height	Budding/ grafting success (%)	Budding/ grafting time and height	Budding/ grafting success (%)	Budding/ grafting time and height	Budding/ grafting success (%)
Chip Budding				Chip Budding			
Dec-Jan		Feb-Mar		Dec-Jan		Feb-Mar	
8-10cm	36.5	8-10cm	84.3	8-10cm	32.3	8-10cm	85.4
13-15cm	35.0	13-15cm	81.6	13-15cm	30.6	13-15cm	80.6
18-20cm	23.2	18-20cm	75.3	18-20cm	22.6	18-20cm	69.5
Feb-Mar		Wedge graft		Feb-Mar		Wedge graft	
8-10cm	90.4	Dec-Jan		8-10cm	89.9	Dec-Jan	
13-15cm	88.5	8-10cm	45.6	13-15cm	87.6	8-10cm	38.6
18-20cm	83.2	13-15cm	41.5	18-20cm	78.9	13-15cm	37.3
Jul-Aug		18-20cm	38.3	Jul-Aug		18-20cm	25.5
8-10cm	88.6	Feb-Mar		8-10cm	85.6	Feb-Mar	
13-15cm	86.4	8-10cm	89.3	13-15cm	80.3	8-10cm	89.4
18-20cm	74.3	13-15cm	84.6	18-20cm	70.3	13-15cm	86.6
Sep-Oct		18-20cm	77.5	Sep-Oct		18-20cm	71.5
8-10cm	87.3	T-budding		8-10cm	82.5	T-budding	
13-15cm	79.5	Jul-Aug		13-15cm	75.4	Jul-Aug	
18-20cm	72.4	8-10cm	88.7	18-20cm	65.7	8-10cm	88.5
Tongue Grafting		13-15cm	81.6	Tongue Grafting		13-15cm	85.7
Dec-Jan		18-20cm	76.4	Dec-Jan		18-20cm	75.6
8-10cm	40.3	Sep-Oct		8-10cm	35.6	Sep-Oct	
13-15cm	38.5	8-10cm	72.3	13-15cm	30.3	8-10cm	70.5
18-20cm	34.5	13-15cm	65.6	18-20cm	22.5	13-15cm	62.6
		18-20cm	54.5			18-20cm	55.4

Table 28. Comparative performance of chip budding and other grafting/budding methods of walnut under polyhouse conditions

Budding/grafting time and height	Budding/grafting success (%)	Budding/grafting time and height	Budding/grafting success (%)
Chip Budding			
Dec-Jan		Tongue Grafting	
8-10cm	10.5	Dec-Jan	
13-15cm	08.4	8-10cm	40.5
18-20cm	03.0	13-15cm	30.6
Feb-Mar		18-20cm	25.4
8-10cm	80.8	Feb-Mar	
13-15cm	79.6	8-10cm	70.5
18-20cm	60.4	13-15cm	68.4
Jul-Aug		18-20cm	62.6
8-10cm	25.4	Wedge grafting	
13-15cm	15.0	Dec-Jan	
18-20cm	10.4	8-10cm	55.6
Sep-Oct		13-15cm	46.3
8-10cm	10.3	18-20cm	35.6
13-15cm	09.3	Feb-Mar	
18-20cm	04.0	8-10cm	76.5
13-15cm	73.8	18-20cm	59.6

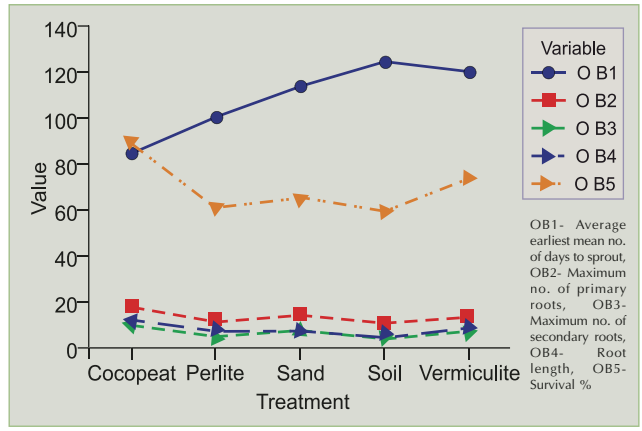
Effect of semi-hardwood cuttings and rooting hormones on propagation of grape

In grape, effect of different portion of semihardwood cuttings (terminal, middle and lower) and rooting hormones (4000 ppm IAA, 6000 ppm, IAA, 4000 ppm IBA and 6000 ppm IBA) have been recorded. The earliest mean number of days to sprouting (80 days) , maximum number of sprouts per cutting (8) and sprouting percentage (95%), length of sprout (6.8 cm) and leaves per cutting (11), maximum primary roots (18), and secondary roots (9) and root length (13 cm) and highest (91) percent survival were recorded with the treatment semi-hardwood cutting taken from middle portion of stem + IBA 6000 ppm.

Chip budding in apple, peach and walnut

Rooting capability of olive cuttings, with and without presence of leaves and buds

In olive, effect of presence of leaves and buds on vegetative and rooting characters have been recorded. The earliest mean number of days to sprouting (85 days) , maximum number of sprouts per cutting (5) and sprouting percentage (81%),

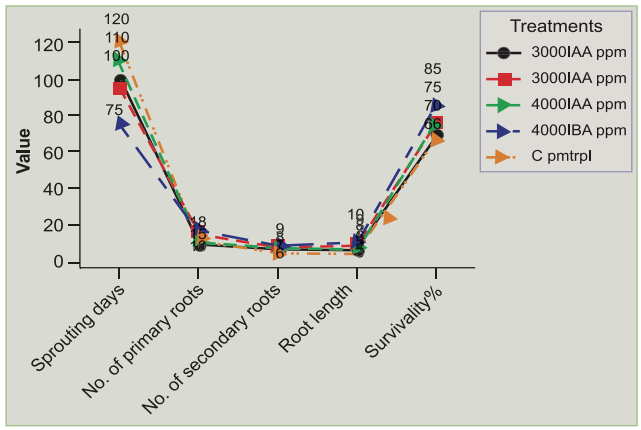


Effect of cutting with 2-3 pairs of leaves and lateral buds and rooting media on day to sprout and rooting ability of olive cv. Messenese

length of sprout (5.2 cm) and leaves per cutting (10), maximum primary roots (18), and secondary roots (10) and root length (11 cm), maximum rooting mass and highest percent survival (89) were recorded in cocopeat rooting media with 2-3 pairs of leaves and lateral bud types of semi hardwood cutting.

Effect of rooting hormone and type of cuttings on rooting of olive cv. Coratina

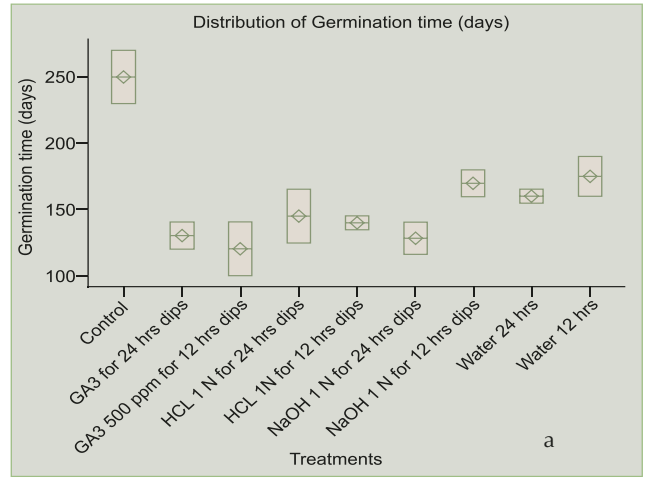
Effect of rooting hormone (3000 ppm IAA, 4000 ppm, IAA, 3000 ppm IBA and 4000 ppm IBA) and types of cutting (semi hard wood cutting with 2 node, 3 node and 4 node) was investigated. The earliest mean number of days to sprouting (75 days), maximum number of sprouts per cutting (6) and sprouting percentage (89%), length of sprout (7.12 cm) and leaves per cutting (12), maximum primary roots (18), secondary roots (9), root length (10 cm) and highest percent survival (85%) was recorded with the treatment semi-hardwood cutting with 4 nodes and IBA 4000 ppm.

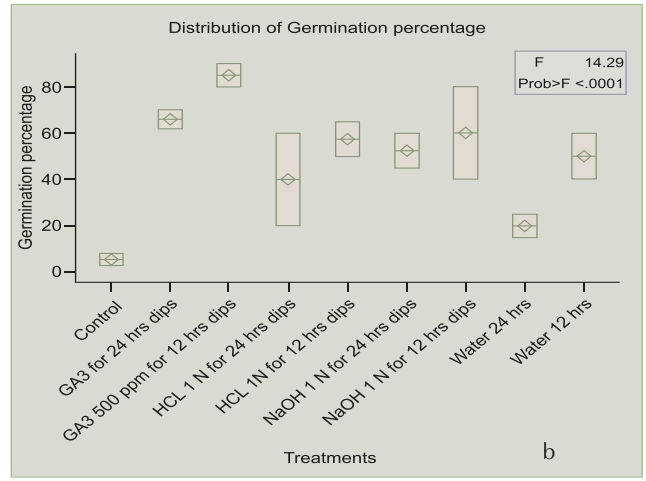


Effect of rooting harmone and semi hard wood cutting with 4 nodes

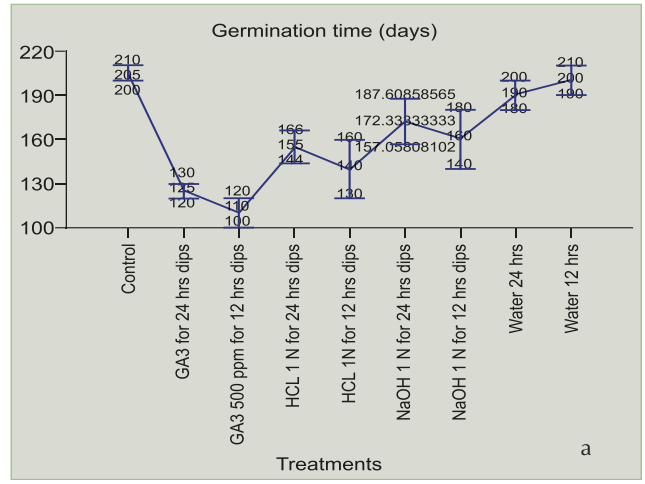
Effect of different chemical treatments on seed germination in olive

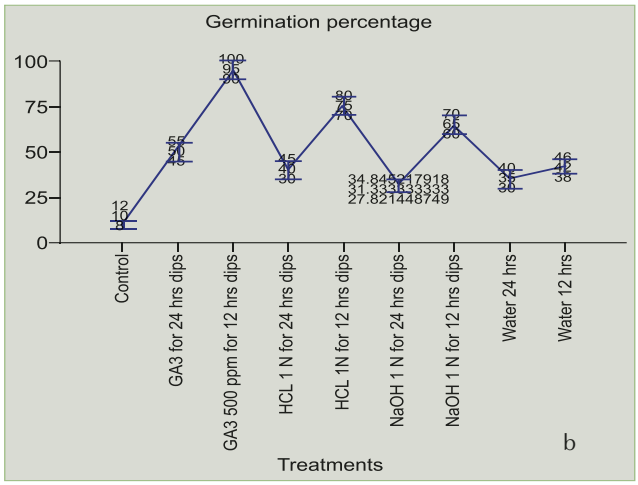
Among the treatments (GA_3 500 ppm for 12 hrs dip, GA_3 500 ppm for 24 hrs dip, HCL 1N for 12 hrs dip, HCL 1 N for 24 hrs dip, NaOH 1N for 12 hrs dip, NaOH 1 N for 24 hrs dip , Water 12 hrs, Water 24 hrs, Control) tested to improve seed germination of Coratina and Pendolino cultivar, minimum germination days and maximum germination rate was recorded in GA_3 500 ppm for 12 hrs dip as compared to control in both the cultivars.





Effect of different chemical treatments on days to seed germination and percentage in cv. Pendolino (a-b)



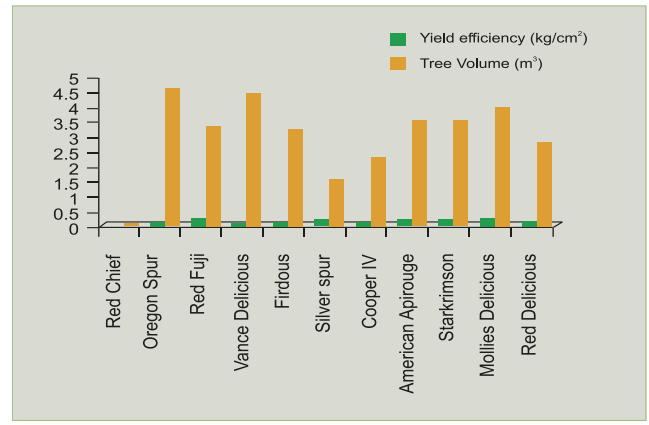


Effect of different chemical treatments on days to seed germination and germination percentage cv. Coratina (a-b)

Standardization of medium, medium high and high density orcharding in temperate fruits

Standardization of medium high and high density orcharding in apple

A study of different cultivars under different planting densities given in Table 29-33 indicated that highest yield and yield efficiency was recorded in apple cvs. Starkrimson 17.49 t/ha and yield efficiency 0.17 kg/cm² respectively followed by Oregon Spur (11.92 t/ha) with similar yield efficiency at 2.5 x 2.5m spacing. In 2.5 x 3.5 m spacing cultivar Ambri resulted in highest yield 63.91 t/ha with yield efficiency of 0.82 kg/cm² followed by Mollies Delicious (58.75 t/ha) and yield efficiency 0.55 kg/cm². Similarly cultivar Mollies Delicious in 3.0 x 3.5 m spacing recorded highest yield (40.74 t/ha) with yield efficiency 0.68 kg/cm² followed by Red Chief (10.97 t/ha) but yield efficiency was less than Cooper IV.In 3.5 x 3.5 m spacing cultivar Mollies Delicious resulted in highest yield (51.93 t/ha) with yield efficiency of 0.85 kg/cm² followed by Starkrimson. In 4.0 x 4.0 m spacing Red Gold resulted in highest yield (28.61 t/ha) followed by Oregon Spur (22.74 t/ha) and Starking Delicious (20.21 t/ha).



Yield efficiency and tree volume of apple varieties in 2.5 x 2.5 m spacing on MM-106

Table 29. Yield and quality attributed of apple cultivars on MM-106 root stock at 2.5 x 2.5 m spacing

Cultivars	Fruit weight(g)	Yield/ plant (kg)	Yield (t/ha.)	Per cent of fruits having 90% color surface	A grade fruit %	TCA (cm²)	Yield efficiency (kg/cm²)	Tree Volume (m³)
Red Chief	184.00	3.16	5.05	82.66	82.66	76.53	0.05	4.51
Oregon Spur	164.66	7.45	11.92	90.33	57.33	71.61	0.17	3.29
Red Fuji	152.66	1.10	1.77	24.33	43.00	97.63	0.02	4.38
Vance Delicious	190.33	2.30	3.68	66.33	72.33	58.25	0.03	3.17
Firdous	140.66	3.92	6.27	89.00	88.00	45.71	0.13	1.51
Silver spur	158.66	2.61	4.18	91.00	70.00	58.26	0.05	2.21
Cooper IV	195.66	5.46	8.73	79.66	76.00	58.02	0.15	3.47
American Apirouge	85.00	2.50	4.00	9.66	90.33	66.90	0.03	2.35
Starkrimson (Bisbee)	208.00	10.93	17.49	85.66	89.00	62.39	0.17	3.90
Mollies Delicious	266.00	7.20	11.53	48.00	89.00	66.44	0.10	2.72
Red Delicious	206.33	3.41	5.47	68.00	84.33	76.44	0.04	4.37
CD (5%)	*17.46*	*N.S.*	*8.82*	*6.55*	*6.13*	*4.08*	*0.01*	*0.55*

Table 30.Yield and quality attributes of apple cultivars on MM-106 at 2.5 x 3.5m spacing

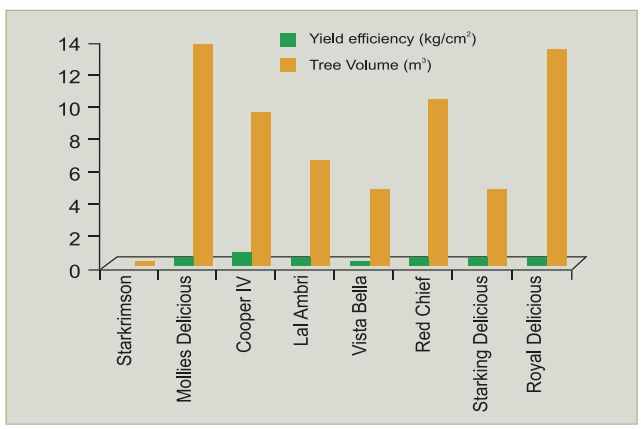
Cultivars	Fruit weight(g)	Yield/ plant (kg)	Yield (t/ha.)	Per cent of fruits having 90% color surface	A grade fruit %	TCA (cm^2)	Tree Volume (m^3)	Yield efficiency (kg/cm^2)
Starkrimson	206.00	23.07	26.34	90.00	85.33	8.66	0.26	13.53
Mollies Delicious	273.00	50.86	58.75	54.66	82.66	91.62	0.55	9.30
Cooper IV	195.66	11.42	13.04	78.00	77.00	46.11	0.25	6.36
Lal Ambri	244.00	1.60	1.82	14.33	92.33	45.38	0.03	4.51
Vista Bella	185.00	10.86	12.40	86.66	79.00	75.63	0.15	10.08
Red Chief	182.66	7.82	8.93	70.00	82.00	75.22	0.22	4.50
Starking Delicious	184.33	22.70	25.94	58.00	85.66	82.02	0.27	13.25
Ambri	138.66	55.96	63.91	19.33	66.00	65.45	0.82	4.32
CD (5%)	*20.95*	*31.16*	*35.68*	*10.55*	*5.58*	*1.63*	*0.02*	*1.85*

Table 31. Yield and yield related characters of apple cultivars after 9-10 years on MM-106 at 3.0x3.5m spacing

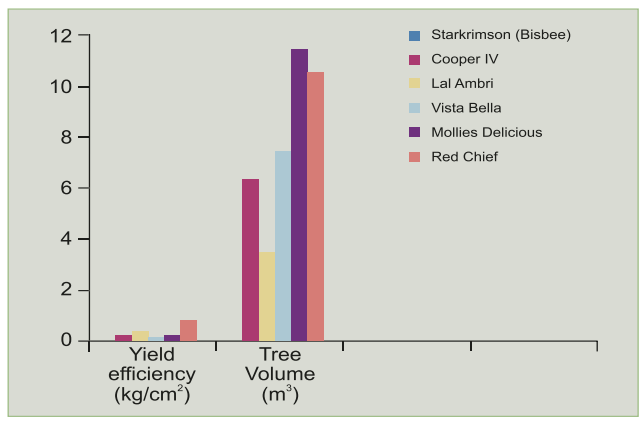
Cultivars	Fruit weight(g)	Yield/ plant (kg)	Yield (t/ha.)	Per cent of fruits having 90% color surface	A grade fruit %	TCA (cm^2)	Yield efficiency (kg/cm^2)	Tree Volume (m^3)
Starkrimson (Bisbee)	208.00	7.36	7.00	88.66	91.00	76.39	0.09	6.21
Cooper IV	195.67	8.80	9.52	82.00	82.33	33.68	0.26	3.35
Lal Ambri	244.00	1.74	1.68	23.00	94.66	66.71	0.02	7.32
Vista Bella	184.67	10.76	10.24	91.66	79.67	92.52	0.10	11.33
Mollies Delicious	273.00	42.80	40.74	57.33	89.67	62.55	0.68	10.38
Red Chief	182.67	11.52	10.97	71.33	86.67	58.45	0.19	5.38
CD (5%)	*21.37*	*N.S.*	*N.S.*	*5.62*	*5.13*	*4.25*	*0.03*	*0.90*

Table 32. Yield and yield related characters of apple cultivars on MM-106 at 3.5x3.5m spacing (9-10 years old)

Cultivars	Fruit weight(g)	Yield/ plant (kg)	Yield (t/ha.)	Per cent of fruits having 90% color surface	A grade fruit %	TCA (cm^2)	Yield efficiency (kg/cm^2)	Tree Volume (m^3)
Starkrimson (Bisbee)	208.00	14.94	12.0	91.66	93.33	20.72	0.57	2.13
Mollies Delicious	273.00	63.64	51.93	57.33	93.00	71.50	0.85	12.92
Lal Ambri	244.00	1.56	1.28	23.33	94.66	45.67	0.03	3.22
Vista Bella	189.00	8.35	6.79	91.33	86.66	85.28	0.09	11.01
Red Chief	182.66	2.09	1.72	78.33	89.33	25.32	0.08	1.65
CD (5%)	*24.78*	*N.S.*	*N.S.*	*7.65*	*4.60*	*3.78*	*0.04*	*1.58*



Yield efficiency and tree volume of apple varieties in 2.5 x 3.5 m spacing on MM-106



Yield efficiency and tree volume of apple varieties in 3.0 x 3.5m spacing

Table 33. Yield and yield related characters of apple cultivars on seedling rootstock in 4.0 x4.0m spacing (8 year old)

Cultivars	Fruit weight(g)	Yield/ plant (kg)	Yield (t/ha.)	Per cent of fruits having 90% color surface	A grade fruit %	TCA (cm^2)	Yield efficiency (kg/cm^2)	Tree volume (m^3)
Benoni	119.33	5.18	3.24	68.00	37.66	121.03	0.05	15.61
Red Gold	132.67	45.78	28.61	59.00	57.00	91.03	0.48	12.58
Golden Delicious	212.00	15.70	9.81	35.00	75.33	85.33	0.18	7.52
Starking Delicious	206.33	32.38	20.21	86.33	90.33	91.43	0.34	8.88
Red Delicious	212.66	19.33	12.08	74.66	91.66	102.38	0.17	6.85
Vance Delicious	194.33	4.89	3.05	64.33	87.00	81.99	0.05	8.11
Red Chief	186.66	5.80	3.62	83.00	81.33	168.24	0.03	4.86
Top Red	153.66	2.87	1.82	61.66	78.66	92.17	0.03	12.51
Red Fuji	162.33	7.62	4.76	25.33	47.33	85.32	0.08	10.30
Tydeman's Early Worcester	160.33	15.95	3.30	89.33	90.67	92.04	0.16	10.58
Oregon Spur	158.33	36.39	22.74	95.66	65.66	62.61	0.56	7.34
Akbar	185.33	1.76	1.10	21.66	88.67	101.79	0.02	2.44
Shireen	166.33	4.71	2.94	85.66	93.33	45.42	0.11	4.64
Gold Spur	170.66	3.42	2.14	90.33	90.00	139.64	0.02	5.53
CD (5%)	*27.08*	*12.10*	*6.98*	*9.43*	*6.16*	*5.55*	*0.04*	*1.40*

Standardization of medium high and high density orcharding in cherry

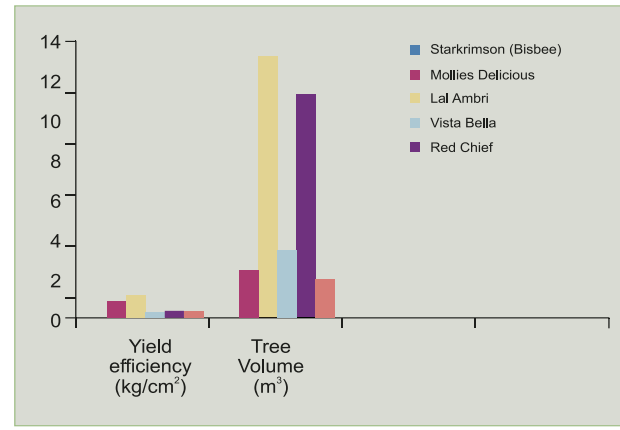
To attain maximum yield from per unit land different planting densities in cherry were compared in which cultivar Van planted at 3.0 x 3.0 m spacing gave highest yield (6.37 t/ha) followed by Stella (Table 34). Similarly yield efficiency was noted highest in cultivar Van. In 2.5 x 2.5 m spacing Bigarreau Napoleon (Double Gilas) resulted in highest yield and yield efficiency (Table 35).

Table 34. Performance of cherry cvs. on high density planting 3.0 x 3.0 m at 7-8 year age

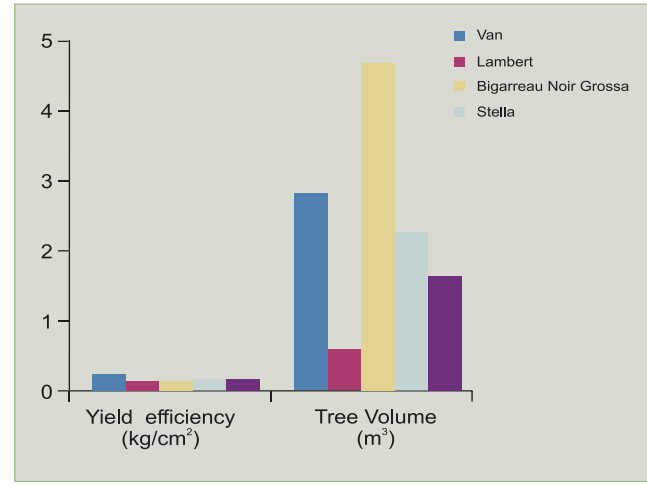
Cultivars	Yield kg/tree	Yield t /ha	TCA (cm^2)	Yield efficiency (kg/cm^2)	Tree volume (m^3)
Van	5.50	6.37	45.86	0.13	2.70
Lambert	0.76	0.84	22.91	0.04	0.48
Bigarreau Noir Grossa	4.57	5.35	91.69	0.04	4.57
Stella	4.47	5.55	66.60	0.06	2.16
CD (5%)	*1.02*	*1.02*	*4.89*	*0.05*	*1.52*

Table 35. Performance of cherry cvs. on high density planting at 2.5 x 2.5 m spacing at 7-8 years of age

Cultivars	Yield kg/tree	Yield t /ha	TCA (cm^2)	Yield efficiency (kg/cm^2)	Tree volume (m^3)
Bigarreau Noir Grossa	15.30	8.51	76.25	0.20	5.22
Bigarreau Napoleon	15.31	24.75	49.53	0.30	2.47



Yield efficiency and tree volume of apple varieties in 3.5 x 3.5 m



Yield efficiency and tree volume in cherry varieties

Standardization of medium high and high density orcharding in almonds on seedling root stock

Three almond varieties namely Makhdoom, Shalimar and Waris have been planted at a spacing viz., 2.5 m x 2.5 m (1600 pl/ha), 3 m x 3m (1111 pl/ha) and 3.5 m x 3.5m (816 pl/ha). The results of experiment indicated that trunk cross-sectional area of tree increased with decreasing the planting density from 1600 to 816 tree/ha. Maximum trunk cross sectional area of tree (115.04 cm^2), nut number (910) and nut yield (2.41 kg/tree) were recorded at 3.5 m x 3.5m spacing in Waris. Whereas, highest yield per hectare (2.68 t/ha) was recorded in Waris variety of almond at 2.5 m x 2.5 m spacing (Table 36).

Table 36. Effect of planting density and varieties on growth and yield of almond

Varieties	Density	TCSA (cm^2)	Nut Number	Nut yield (kg/tree)	Nut yield (t/ha)
Makhdoom	2.5x2.5m (1600 pl)	83.33	710	1.24	1.98
	3x3m (1111 pl)	103.35	750	1.63	1.81
	3.5x3.5m (816 pl)	114.03	812	2.02	1.64
Shalimar	2.5x2.5m (1600 pl)	73.23	215	0.43	0.69
	3x3m (1111 pl)	91.77	280	0.61	0.67
	3.5x3.5m (816 pl)	98.09	310	0.69	0.56
Waris	2.5x2.5m (1600 pl)	96.97	820	1.68	2.68
	3x3m (1111 pl)	102.77	870	1.95	2.16
	3.5x3.5m (816 pl)	115.04	910	2.41	1.96
CD (5%)	-	*16.67*	*314*	*0.62*	*0.31*

Standardization of medium density orcharding for growth, yield and quality in almond

Different varieties of almond were planted at 4 m x 4 m spacing. Results revealed that maximum trunk cross-sectional area of almond tree (181.85 cm^2) and nut number (940) were recorded in Waris. Whereas, nut yield (2.62 kg/tree and 1.64 t/ha) was recorded in Pranyaj variety of almond (Table 37).

Table 37. Evaluation of different varieties of almond under 4x4m medium density

Varieties	TCSA (cm^2)	No. of nuts/tree	Nut yield (kg/tree)	Yield (t/ha)
Makhdoom	107.82	845	2.03	1.27
Shalimar	139.31	350	0.78	0.49
Waris	181.85	940	2.36	1.48
Pranyaj	163.38	816	2.62	1.64
Primorskij	116.07	620	1.35	0.84
Merced	123.59	730	2.32	1.45
IXL	110.76	680	2.44	1.53
Non Pareil	175.12	860	1.50	0.94
California Paper Shell	163.25	540	1.91	1.19
CD (5%)	*32.30*	*264*	*0.63*	*0.45*

Medium density almond at 4x4 m spacing in flowering

Evaluatuion of apricot varieties under medium density planting for fruit yield and quality

Two planting densities (816 plant /ha and 400 plant/ha) and four varieties (CITH-Apricot-01,

Table 38. Effect of planting density and variety on growth, yield and quality of apricot

S.No.	Treatment	TCSA (cm^2)	Fruit yield	
			Kg/tree	t/ha
1.	CITH Apricot-01 (816 plant/ha)	58.30	83.83	68.40
2.	CITH Apricot-02 (816 plant/ha)	54.67	80.12	65.37
3.	Harcot (816 plant/ha)	40.41	39.44	32.18
4.	Erani (816 plant/ha)	43.52	44.93	36.66
5.	CITH Apricot-01 (400 plant/ha)	123.59	161.34	64.54
6.	CITH Apricot-02 (400 plant/ha)	119.56	155.35	62.14
7.	Harcot (400 plant/ha)	97.19	70.44	28.18
8.	Erani(400 plant/ha)	108.25	76.70	30.68
	CD (5%)	*26.12*	*30.32*	*5.24*

CITH-Apricot-02, Harcot and Erani) were evaluated for growth, fruit yield and quality. Results of the experiment indicated that highest trunk cross sectional area of tree (123.59 cm^2) and fruit yield (161.34 kg/tree) were recorded in CITH-Apricot-01 at the planting density of 400 plant/ha whereas, highest yield per hectare (68.40 t/ha) was recorded at plant density of 816 plant/ha (Table 38).

Standardization of medium high density and high density orcharding for yield and quality in peach/nectarine

In peach, two densities namely 1600 plants/ha (2.5 x 2.5) and 1111 plants /ha (3x3m) were tried. Under (2.5 x 2.5) planting density, maximum size in terms of diameter and fruit weight was recorded in cv. Gloheaven (99.97g) followed by Red Globe (86.32g), Crest Heaven (83.92g) and Fantasia (74.32g). The per tree yield was recorded maximum in cv. Gloheaven (34.56 kg) followed by Red Globe (28.05kg), Crest Heaven (24.13kg) and Fantasia (22.66g). However, under medium high density plantation on seedling rootstcoks at the spacing of 3 x 3 m accommodating 1111 trees per hectare, the maximum yield per tree was recorded in cv. Red Globe (38.38 kg) followed by Gloheaven (34.24) , Crest Heaven (30.43 kg) in 3 year old trees of peach/ nectarine. On the basis of performance and fruit quality of peach/nectarine genotypes it was observed that cultivars, Gloheaven and Red Globe are promising under high and medium high density respectively in the initial years (Table 39 & 40).

Medium high density (3m x 3 m) plantation of nectarine

High density (2.5m x 2.5m) plantation of nectarine

Table 39. Evaluation of peach/nectarine genotypes for higher fruit yield and better quality under high density (2.5 x 2.5m spacing)

No. of Genotype/ density 2.5x2.5m	No. of flowers/ plant	No. of fruit/plant	Fruit wt.(g)	Fruit length (mm)	Fruit diameter (mm)	TSS (°B)	Acidity (%)	Ascorbic acid (mg/100 g)	Fruit yield (t/ha)
Fantasia	492.66	305.00	74.32	51.12	52.15	13.83	0.311	6.26	36.25
Crest Heaven	481.00	289.66	83.92	53.08	54.16	15.30	0.321	5.78	38.60
Red Globe	505.00	325.00	86.32	44.70	53.06	14.40	0.284	6.53	44.88
Gloheaven	561.66	345.66	99.97	61.46	63.10	15.60	0.254	5.90	55.29
CD (5%)	*12.31*	*15.04*	*3.14*	*1.47*	*1.44*	*0.21*	*0.011*	*0.18*	*3.59*

Table 40. Evaluation of peach/nectarine genotypes for higher fruit yield and better quality under medium high density (3 x 3 m spacing)

No. of Genotype/ density 3x3m	No. of flowers/ plant	No. of fruit/plant	Fruit wt.(g)	Fruit length (mm)	Fruit diameter (mm)	TSS (°B)	Acidity (%)	Ascorbic acid (mg/100 g)	Fruit yield (t/ha)
Fantasia	535	350	85.1	60.35	59.23	14.2	0.316	6.9	32.75
Crest Heaven	450	310	98.18	54.16	542.95	15.2	0.322	7.4	33.47
Red Globe	680	440	87.24	52.36	51.47	16.5	0.239	6.4	42.21
Gloheaven	460	378	90.59	53.31	51.24	15.5	0.246	5.22	37.66
CD (5%)	*10.31*	*13.45*	*6.47*	*2.45*	*3.45*	*0.32*	*0.004*	*0.45*	*2.36*

Energy harvest through plant architectural engineering for increasing source and sink relationship in apple

To harness sloar light energy and efficient utilization of other resources, different training systems were tried at different spacing on the M-9 rootstcoks during the year in which Golden Delicious registered highest number of flower and fruit per plant followed by Vista Bella. The cultivar Starkrimson recorded maximum proportion of fruits having more than 90% colored surface , percentage of A grade fruits , and maximum number of intense color fruits from surface , middle and inner canopy region. Vista Bella in modified central leader registered highest number of flower and fruits per plant. Starkrimson on head and spread and spindle bush training systems with 95% fruits having more than 90% fruit skin color was observed besides, maximum color intensity in surface, middle and inner canopy. Fruit weight was registered highest 251. 25g/fruit in Mollies Delicious on modified central leader training followed by Starkrimson on spindle bush. In espalier traning system Coe -Red Fuji registered highest flowers and fruits per tree while in Spartan cultivar 92.5 % of total fruits harvested had more than 90% colored surface. Spartan had highest percent of A grade fruits and maximum color intensity in middle and inner canopy region. Cultivar Spartan on espalier training system resulted in highest fruit and percentage of fruits having more than 90% colored fruits. Highest fruit weight was recorded in Granny Smith in single axis training system (Table 41 & 42).

Table 41. Yield and quality attributes of apple varieties in different plant architectural systems on M-9 rootstock

Treatment	Total flowers / plant	Total fruits / plant	Percentage of fruits having more than 90% color	Percentage of A grade fruits	Color Intensity %			Fruit weight (g)
					SC	MC	IC	
Effect of variety and training systems								
Starkrimson X Spindle Bush (V1T1)	13.5	9	89	83.75	85	74.25	64.75	217
Starkrimson X Head and Spread (V1T2)	17.75	14	95.5	92.25	91.25	92.5	88.25	215.25
Starkrimson X Modified Central leader (V1T3)	13.5	9.75	83	77.25	79.75	86.5	82.75	211
GoldenDelicious X Spindle Bush (V2T1)	34	21.5	66.25	70.25	83	85.75	73.75	181
Golden Delicious X Head and Spread (V2T2)	40.75	31.25	71.25	82	86.75	90.5	84	182
Golden Delicious X Modified Central leader (V2T3)	24.75	21.25	51.75	54.5	44.5	55.25	38.5	182
Mollies Delicious X Spindle Bush (V3T1)	21.5	16.5	51.75	54.5	44.5	54.75	41	182.25
Mollies Delicious X Head and Spread (V3T2)	30.5	24	65.5	94.75	53	48.25	41.25	244
Mollies Delicious X Modified Central leader (V3T3)	30.75	24.25	71.25	93	54.5	59.75	65.25	251.25
Fuji X Spindle Bush (V4T1)	22	14.75	48.25	65	54.75	63	48.5	183.25
Fuji X Head and Spread (V4T2)	29.25	20	58.5	82	58	68.25	54.75	192.25
Fuji X Modified Central leader (V4T3)	25	16.75	43.5	59.25	53.25	54.75	40	177
Vista Bella X Spindle Bush (V5T1)	29.75	22	57	84.75	67.5	62.25	70	187
Vista Bella X Head and Spread (V5T2)	51.75	40.25	64.25	75	64	71.5	69.25	152.5
Vista Bella X Modified Central leader (V5T3)	59.5	54.75	77.75	75.5	66.75	57.5	52.5	168
CD (5%)	*16.23*	*13.05*	*10.05*	*12.04*	*9.29*	*7.92*	*10.34*	*23.05*

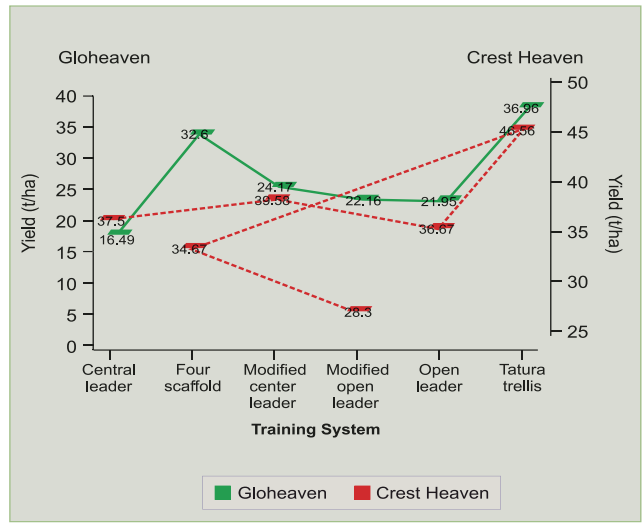
Table 42. Energy harvest through different training systems on M-9 rootstock at 1.5 x 3.0 m and 1.5 x 0.75 m spacings

Treatment	Total flowers / plant	Total fruits / plant	Percentage of fruits having more than 90% color	Percentage of A grade fruits	Color Intensity %			Fruit weight (g)
					SC	MC	IC	
Effect of variety and training systems								
Coe Red Fuji x Espalier (V1T1)	49.5	31.0	93	81.0	91.0	88.25	80.25	173.25
Coe Red Fuji x Single Vertical Axis (V1T2)	42.5	26.5	88	81.25	94.25	89.25	86.0	159.25
Sparton x Espalier (V2T1)	50.25	31.75	94.25	83.75	90.25	90.75	87.75	175.75
Sparton x Single Vertical Axis (V2T2)	20.75	14.75	90.75	85.25	91.75	88.75	90.75	175.75
Granny Smith x Espalier (V3T1)	24.25	17.0	65.5	89.0	82.75	75.25	77.0	173.75
Granny Smith x Single Vertical Axis (V3T2)	16	8.5	73.5	89.0	75.0	68.5	60.5	177.0
CD (5%)	*31.62*	*12.63*	*4.82*	*7.77*	*7.01*	*6.40*	*3.49*	*3.12*

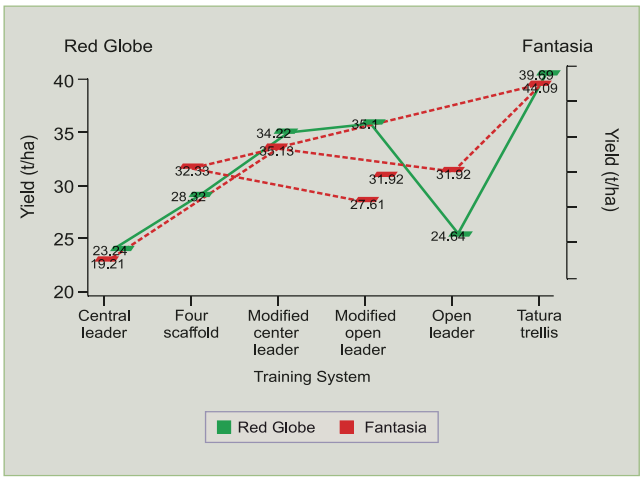
Single vertical axis training system in apple

Espalier training system in apple

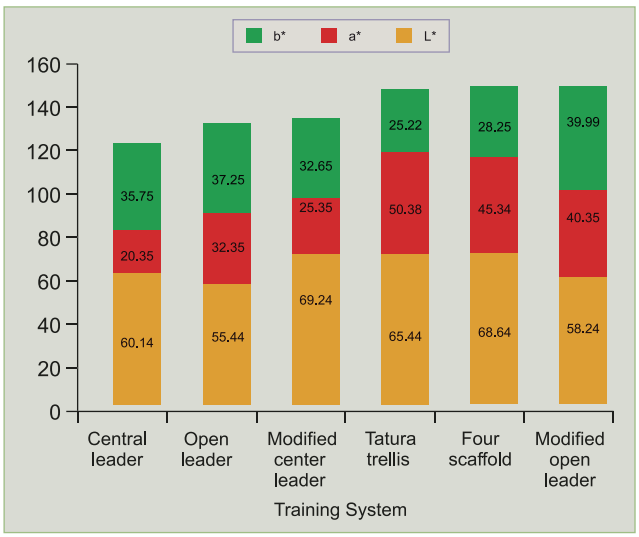
In peach among all the varieties tested maximum fruit set, fruit yield per tree, fruit yield/ha and fruit quality recorded in tatura trellis system of training at 2.5x2.5 m planting density however under 3x3m planting density in all the varieties maximum fruit set, fruit yield per tree, fruit yield/ha and fruit quality recorded in four scaffold (Fantasia, Gloheaven and Red Globe) while open leader system in Crest Heaven recorded maximum light penetration in the canopy at different heights followed by tatura trellies training system and four scaffold system. Fruit color recorded in terms of L*, a*, b* value and maximum a* value (for red/pink color) in tatura trellies followed by four scaffold system.



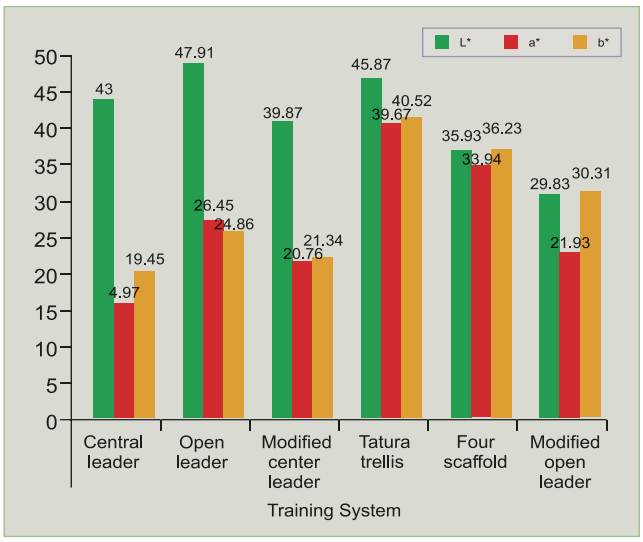
Yield of Gloheaven and Crest Heaven under different training systems



Yield of Red Globe and Fantasia under different training systems



Red Globe Fruit color in different training systems



Fantasia fruit color in different training systems

Fruiting in Red Globe under tatura trellis system

Flowering in Fantasia nectarine in tatura trellis system

Management of frost, drought and other abiotic stresses in almond and apple under changing climate scenario

Rain water harvesting and mulching for almond production under rain fed conditions of Karewa land

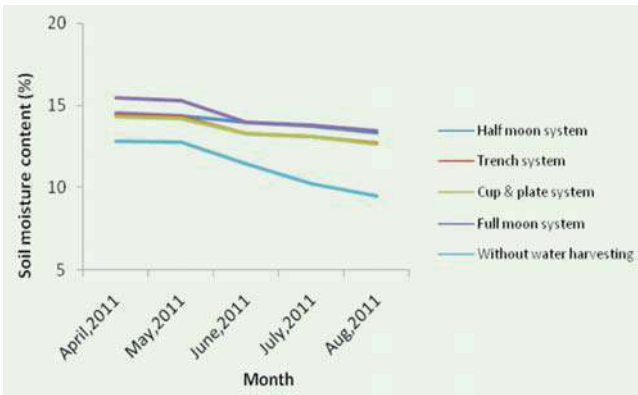
To conserve and utilize rain water, water harvesting techniques like full moon, half moon, cup and plate and trench system were created during December, 2008 and different type of mulch materials were also used for efficient moisture conservation under rainfed conditions. A control plot was also kept for comparison in the field. The experiment has been laid out in factorial randomized block design with four replications. The almond variety Non Pareil has been planted at a spacing of 4 m x 4 m. Results of the experiment indicated that maximum trunk cross sectional area of tree (244.6 cm^2) and nut yield (2.37 kg/tree and 1.49 t/ha) were recorded in full moon water harvesting system and which is significantly higher than control(Table 43). Whereas, highest nut number (1467) was recorded in half moon water harvesting system. As far as mulching is concerned, maximum TCSA

(237.3 cm^2), nut number (1260) and nut yield (2.11 kg/tree and 1.32 t/ha) were recorded in plastic mulch. Plastic mulch conserved more moisture (14.98 %) over no mulch plots. Among mulches, plastic mulch retained more moisture followed by organic mulch and minimum in control (no mulch).

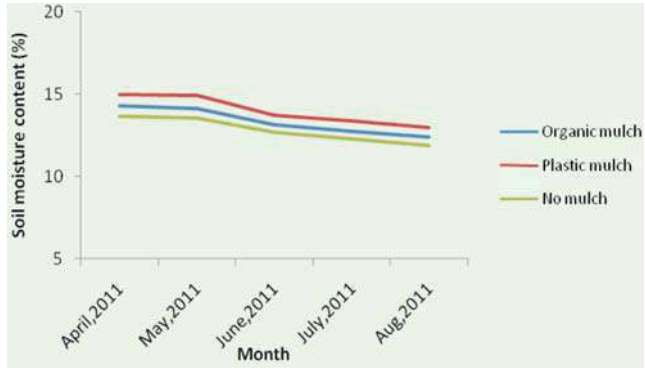
Table 43. Effect of water harvesting and mulching techniques on growth and yield of almond

Treatment	TCSA (cm^2)	Nut number	Nut yield	
			Kg/tree	t/ha
Water harvesting				
Half moon system	242.4	1467	2.23	1.39
Trench system	191.3	1028	1.99	1.25
Cup & plate system	187.1	1072	1.92	1.20
Full moon system	244.6	1445	2.37	1.49
Without water harvesting	158.2	713	1.67	1.05
CD (5%)	*40.1*	*310*	*0.28*	*0.19*
Mulching				
Organic mulch	207.1	1164	2.04	1.27
Plastic mulch	237.3	1260	2.11	1.32
No mulch	170.2	1011	1.97	1.24
CD (5%)	*31.2*	*121*	*0.61*	*0.04*

The soil moisture status was recorded from nut set to maturity at 0-30 cm depth. The maximum soil moisture content (15.47%) was recorded in full moon water harvesting system followed by half moon system (14.55%) and minimum in without water harvesting system (12.82%) during April,11 and similar trends were also observed in subsequent months during growth and development of nut. Mulch materials also played an important role in conservation of moisture for better almond production.



Effect of water harvesting techniques on soil moisture content in almond



Effect of different mulching on soil moisture content in almond

Rain water harvesting techniques in apple under rainfed condition

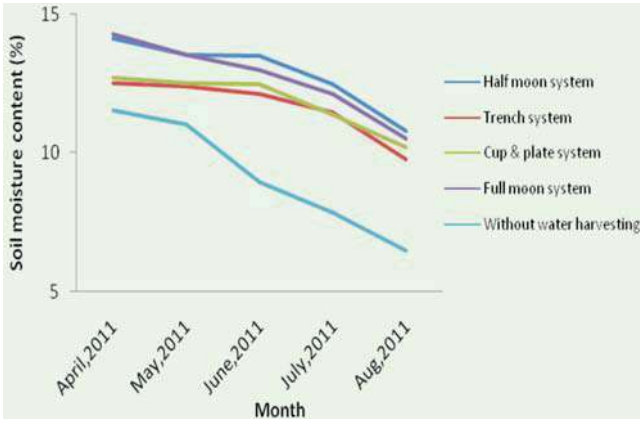
In apple, water harvesting techniques like full moon, half moon, cup and plate and trench system were created during December,2009 with different type of mulch materials used for efficient conservation of moisture under rainfed conditions. A control plot was also kept for comparison in the field. The experiment has been laid out in factorial randomized block design with four replications on apple variety Red Chief planted at a spacing of 4m x 4m . The results of the experiments revealed maximum trunk cross sectional area (104.65 cm^2) , canopy spread (1.78 m), fruit yield (22.32 kg/tree and 13.33 t/ha) were recorded in full moon water harvesting system (Table 44). Among mulches,

Table 44. Effect of water harvesting and mulching techniques on growth and yield of apple

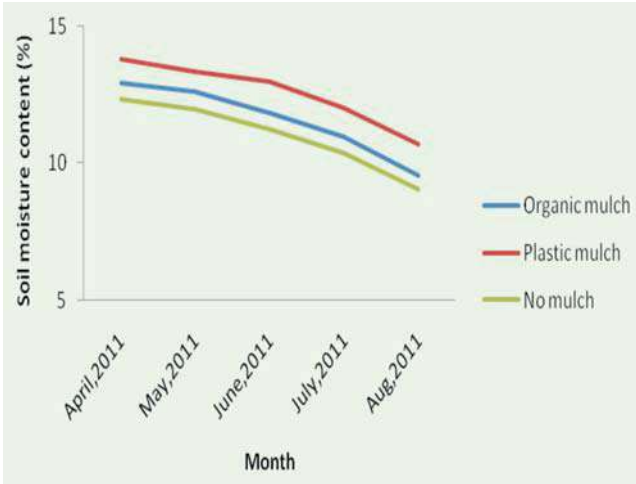
Treatment	TCSA (cm^2)	Canopy spread (m)	Fruit yield	
			Kg/tree	t/ha
Water harvesting				
Half moon system	102.45	1.91	19.95	11.84
Trench system	98.24	1.92	18.57	10.98
Cup & plate system	86.12	1.70	18.05	10.65
Full moon system	104.65	1.98	22.32	13.33
Without water harvesting	81.23	1.51	15.91	9.94
CD (5%)	*10.12*	*0.21*	*3.12*	*1.40*
Mulching				
Organic mulch	96.35	1.82	16.95	10.96
Plastic mulch	101.64	1.86	18.27	11.42
No mulch	86.45	1.44	14.63	9.14
CD (5%)	*6.59*	*0.12*	*2.16*	*1.11*

plastic mulch gave better results in respect to TCSA, canopy spread and fruit yield of apple under rainfed conditions.

The soil moisture status was recorded from fruit set to maturity at 0-30 cm depth from August to April. The maximum soil moisture content (14.14%) was recorded in full moon water harvesting system followed by half moon system (14.02%) and minimum in control (11.22%) during April,11 and similar trends were also observed in subsequent month during growth and development of fruit. Among mulches, plastic mulch conserved more moisture and retained longer period than organic mulch and control.



Effect of water harvesting techniques on soil moisture content in apple



Effect of different mulches on soil moisture content in apple

Full moon water harvesting with plastic mulch in apple

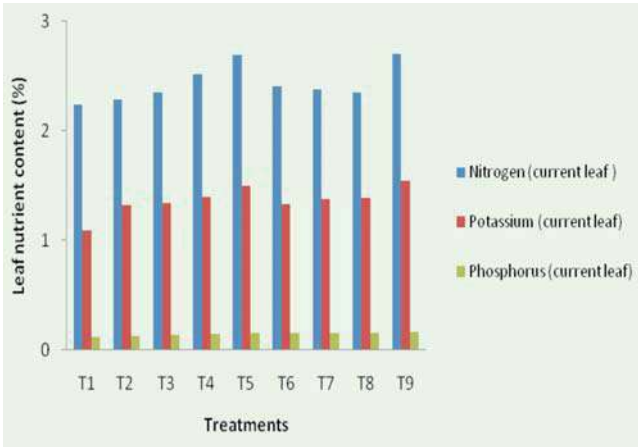
Integrated nitrogen management on yield and quality of almond and soil properties

The nitrogen was applied as per the treatments in almond which comprised of T_1-Control, T_2- 50% RDF of nitrogen, T_3- 75% RDF of nitrogen, T_4- 100% RDF, T_5- 125% of RDF, T_6-50% RDF + 20t FYM/ha, T_7-75% RDF + 15t FYM/ha, T_8- 100% RDF + 10t FYM/ha and T_9- 40t FYM/ ha, replicated thrice under RBD. Results of the experiment revealed that maximum trunk cross sectional area of tree (125.99 cm^2) was recorded in T_5 whereas, nut number (815), nut weight (2.75 g) and nut yield (2.24 kg/tree and 1.82 t/ha) were recorded in treatment of 40 t / ha farm yard manure in almond variety Waris (Table 45).

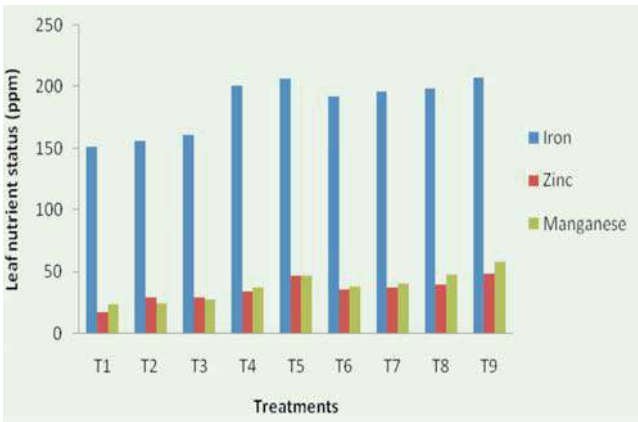
Table 45. Effect of integrated nitrogen management on growth and yield of almond

Treatment	TCSA (cm^2)	Fruit No.	Nut Wt. (g)	Nut Yield	
				kg/ tree	t/ha
T1	96.86	405	2.05	0.83	0.68
T2	106.01	550	2.10	1.16	0.95
T3	118.25	625	1.90	1.18	0.96
T4	120.23	650	1.95	1.26	1.03
T5	125.99	753	2.15	1.62	1.32
T6	120.35	750	2.22	1.67	1.36
T7	113.16	745	2.26	1.68	1.37
T8	111.18	712	2.39	1.70	1.38
T9	122.46	815	2.75	2.24	1.82
CD (5%)	*12.11*	*201*	*0.35*	*0.65*	*0.51*

The leaf nutrient analysis indicated maximum leaf NPK content (2.70 % N, 0.165 % P, 1.55 % K, 207.0 ppm Fe, 48.30 ppm Zn and 58.12 ppm Mn) in treatment of 40 t/ha farm yard manure and minimum (2.24 % N, 0.124 % P, 1.09 % K, 150.80 ppm Fe, 17.10 ppm Zn and 23.60 ppm Mn) in control treatment.



Effect of integrated nitrogen management on macro leaf nutrient contents in almond



Effect of integrated nitrogen management on micro leaf nutrient contents in almond

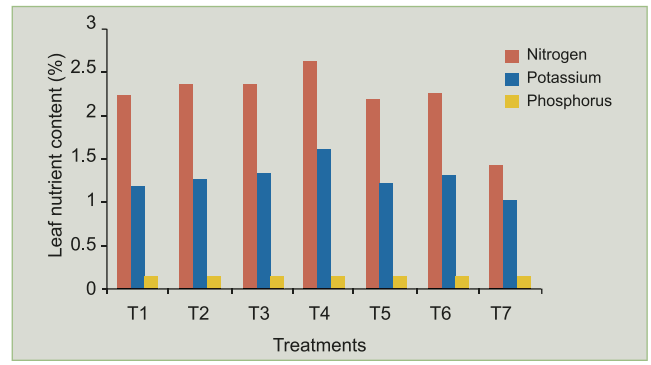
Fertigation studies in almond

The fertigation experiment was been initiated during 2011 in almond variety Waris spaced at 3 x 3 m. The treatment comprised of T_1-Recommended Dose of Fertilizers (Basal application), T_2- RDF through fertigation, T_3-75% RDF through fertigation, T_4-75% RDF through fertigation (applied N:K in the ratio of 2/3 N:1/3K at nut set to nut development and 1/3 N:2/3 K at nut development to maturation stage), T_5- 50% RDF through fertigation, T_6- 50% RDF through fertigation (applied N:K in the ratio of 2/3 N:1/3K at nut set to nut development and 1/3 N:2/3 K at nut development to maturation stage), T_7- Control were imposed as per the technical programme in April, 2011. The results of the experiment indicated that maximum trunk cross sectional area of tree (64.85 cm^2) and nut number (990 /tree) were recorded in T2. Whereas, maximum nut weight and yield (2.73 g and 2.41 kg/tree and 2.67 t/ha) were recorded in T4 and minimum in control (Table 46).

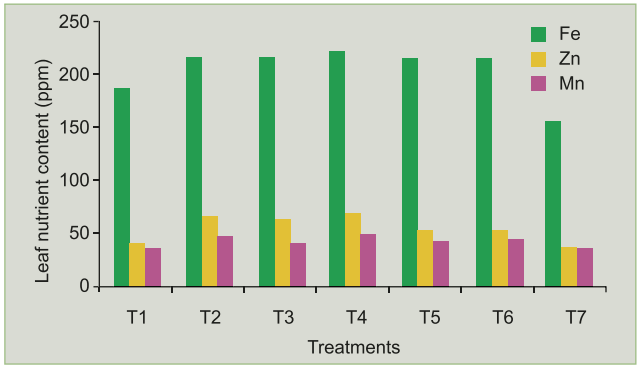
Table 46. Effect of N & K fertigation on growth and yield of almond

Treatment	TCSA (cm^2)	Nut No.	Nut Wt. (g)	Fruit Yield	
				kg/ tree	t/ha
T1	52.95	727	2.34	1.70	1.89
T2	75.67	990	2.40	2.38	2.64
T3	60.91	729	2.50	1.82	2.02
T4	64.85	882	2.73	2.41	2.67
T5	49.76	675	2.58	1.74	1.93
T6	53.98	735	2.60	1.91	2.12
T7	42.89	518	2.14	1.11	1.23
CD (5%)	*13.23*	*211*	*0.22*	*0.52*	*0.45*

The leaf nutrient analysis indicated maximum leaf NPK content (2.70 % N, 0.165 % P, 1.55 % K, 207.0 ppm Fe, 48.30 ppm Zn and 58.12 ppm Mn) with the treatment of 75% recommended dose of fertilizers through fertigation (applied N:K in the ratio of 2/3 N:1/3K at nut set to nut development and 1/3 N:2/3 K at nut development to maturation stage) and minimum (2.24 % N, 0.124 % P, 1.09 % K, 150.80 ppm Fe, 17.10 ppm Zn and 23.60 ppm Mn) in treatment control.



Leaf nutrient status of current year spur in almond

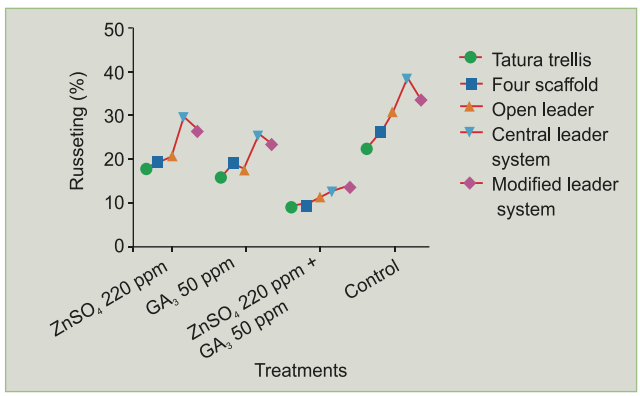


Effect of N&K fertigation on leaf nutrient status in almond

Fertigation studies in almond

Management of physiological disorders in temperate horticultural crops

To minimize the skin russeting in nectarine, effect of different chemicals ($ZnSO_4$ 200 ppm, GA_3 50 ppm, $ZnSO_4$ 200 ppm+ GA_3 and Control) and canopy architectural system (tatura trellis, four scaffold, central leader, modified central leader, open leader) on fruit skin russeting of Fantasia nectarine were investigated. Among treatments minimum fruit skin russeting was recorded with $ZnSO_4$ 200 ppm+ GA_3 50ppm, however among training systems tatura trellis was found best. Fruit quality (TSS, Ascorbic acid, acidity) was found best in tatura trellis training system with the treatment of GA_3 50 ppm as compared to control.



Effect of different chemical and canopy architectural system on skin russeting of Fantasia nectarine

Untreated fruits

Treated fruits

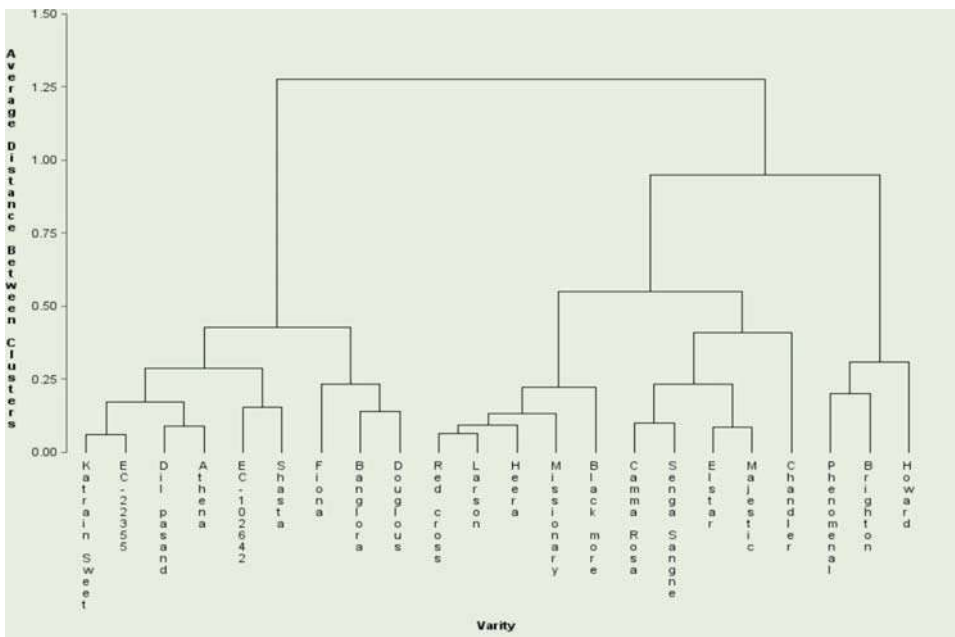
Nutraceuticals and antioxidants in minor temperate horticultural crops

To study the availability and variability of bioactive compounds and antioxidants in minor temperate horticultural crops, characterization, quantification and assessment have been done in different genotypes of strawberry, husk tomato, capegoosebrry, rose hips and kale.

In strawberry among 22 genotypes maximum ascorbic acid recorded in Missionary followed by Dil Pasand and Senga Sengana while maximum organic acid estimated in Brighton followed by Heera. Total anthocyanin was noted highest in Phenomenal, total flavonols in Katrain Sweet, total phenols and DPPH and FRAP in Howard genotypes (Table 47). In addition all the varieties were clustered for further varietal improvement and utilization in breeding programme.

Table 47. Mean performance of 22 strawberry genotypes majorly grown under temperate condition of India in relation to diversity for different health and bioactive compounds

Genotypes	Vitamin-C (mg/100 g of fresh weight)	Titrable acidity (%)	Total anthocyanin (mg cyanidin-3-glucoside equivalents 100 g_1 fw)	Total phenols (mg GA equivalents/ 100 g)	Total flavonols (mg catechin equivalents /100 g)	DPPH (mg of AAE / 100 gm of fresh weight)	FRAP (mg AAE / 100 gm of fresh weight)
Katrain Sweet	59.16	0.73	33.11	456.06	55.13	247.10	348.06
Dil Pasand	86.16	0.84	35.33	509.10	47.06	266.10	368.10
Red Cross	75.10	0.86	30.22	631.16	39.26	347.20	447.20
Larson	74.06	0.91	38.34	637.10	41.33	358.10	457.10
Camma Rosa	80.53	0.95	37.23	689.16	46.40	369.16	501.13
Elstar	82.06	0.96	36.22	720.13	42.06	378.06	567.10
Athena	74.16	1.02	31.45	489.13	51.20	259.06	365.10
EC-102642	76.16	1.02	30.46	547.10	50.13	304.06	378.13
Fiona	81.10	0.95	38.24	423.13	35.46	273.03	340.13
Banglora	82.13	0.84	39.16	401.06	39.53	235.10	333.10
Douglous	83.06	1.03	28.24	380.10	37.46	203.13	326.06
Senga Sangne	85.10	1.11	31.25	706.13	38.40	369.13	522.13
Majestic	76.13	1.26	40.94	722.06	53.13	399.10	568.06
Phenomenal	72.03	1.10	42.54	834.13	42.26	435.13	678.10
EC-22355	69.10	0.96	35.34	468.10	47.33	250.13	349.10
Shasta	64.13	0.94	38.63	527.10	46.40	279.10	405.13
Black more	59.10	1.22	37.82	598.16	38.20	325.13	425.06
Heera	52.13	1.34	30.63	634.10	31.26	356.13	450.10
Chandler	68.10	1.22	41.31	738.06	45.46	425.16	637.06
Brigton	51.03	1.44	43.32	830.13	42.33	435.16	624.10
Howard	56.10	0.85	42.72	888.10	44.53	471.10	701.13
Missionary	89.40	0.76	40.31	656.13	39.26	365.06	459.13
CD (5%)	*3.62*	*0.10*	*2.55*	*33.7*	*4.80*	*34.40*	*32.1*



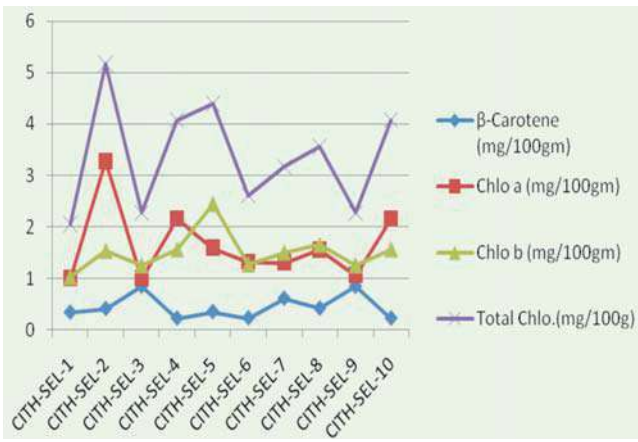
Dendrogram of 22 strawberry genotypes based on average cluster distance analysis

In cape gooseberry , chromatic value of fruits at harvest showed, that there is great difference in fruit color at the maturity. Among bioactive elements, total highest chlorophyll recorded in CITH-Sel-8, β-Carotene and ascorbic acid in CITH-Sel-15, total flavonoids in CITH-Sel-7 and total phenolics and DPPH % inhibition in CITH-Sel-10. (Table 48).

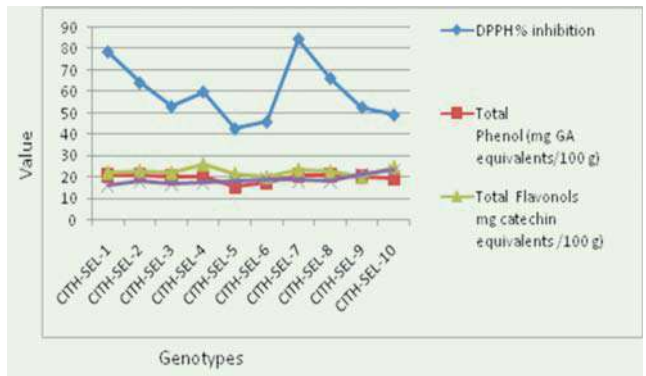
Table 48. Mean performance of cape gooseberry genotypes in relation to diversity for different health and bioactive compounds

Genotypes	Chlo a (mg/100gm)	Chlo b (mg/100gm)	Total Chlo (mg/100gm)	β-Carotene (mg/100gm)	Total Phenol (mg GA equivalents/ 100 g)	Ascorbic Acid (mg/ 100 g of fresh weight)	Total Flavonols mg catechin equivalents / 100 g)	DPPH % inhibition
CITH-SEL-1	2.160	1.773	4.107	0.233	57.220	14.12	29.213	74.507
CITH-SEL-2	1.970	2.680	4.553	0.370	70.710	15.62	26.040	89.207
CITH-SEL-3	1.453	1.347	2.907	0.240	50.333	13.23	32.960	60.507
CITH-SEL-4	1.033	1.347	2.313	0.240	50.400	17.45	31.807	61.513
CITH-SEL-5	1.440	1.747	3.227	0.633	47.120	16.95	40.233	58.313
CITH-SEL-6	1.827	1.960	3.827	0.437	43.740	15.13	33.453	54.207
CITH-SEL-7	1.007	1.033	2.047	0.363	53.807	17.23	52.627	71.013
CITH-SEL-8	3.413	1.813	5.233	0.423	54.067	18.92	30.433	72.227
CITH-SEL-9	1.033	1.267	2.410	0.863	52.133	16.64	25.633	63.233
CITH-SEL-10	2.227	1.840	4.107	0.247	77.427	15.93	31.227	94.107
CITH-SEL-11	1.907	2.647	4.547	0.370	60.453	15.54	29.953	80.713
CITH-SEL-12	1.453	1.413	2.903	0.243	63.963	14.43	36.527	82.113
CITH-SEL-13	1.460	1.747	3.227	0.623	70.710	18.94	42.127	91.747
CITH-SEL-14	1.840	1.960	3.827	0.440	61.113	19.63	33.347	82.853
CITH-SEL-15	1.000	1.467	2.407	0.863	33.107	19.84	40.127	45.553
CITH-SEL-16	2.227	1.840	4.117	0.237	52.630	18.53	50.127	70.160
CITH-SEL-17	1.453	1.413	2.907	0.253	64.917	17.43	28.547	84.113
CITH-SEL-18	1.067	1.407	2.400	0.257	47.167	16.21	31.953	56.860
CITH-SEL-19	1.440	1.747	3.240	0.623	43.753	14.34	40.333	55.753
CITH-SEL-20	1.827	1.960	3.820	0.437	49.467	13.65	27.067	50.147
CD (5%)	*0.083*	*0.135*	*0.068*	*0.021*	*5.26*	*0.583*	*0.221*	*5.68*

In husk tomato, among 10 accessions CITH-Sel-9 was found richest in β-Carotene content, CITH-Sel- 2 for total chlorophyll , CITH-Sel-6 for total anthocyanins, however CITH-Sel-10 was richer in ascorbic acid and CITH-Sel-7 in total phenols and total antioxidant activity potential.

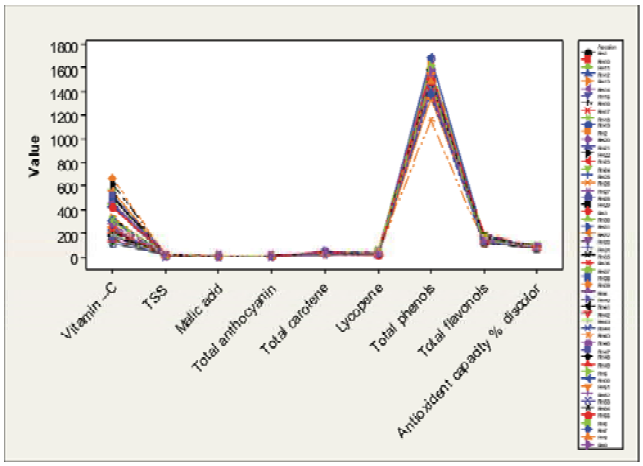


Variability in bioactive compounds in husk tomato

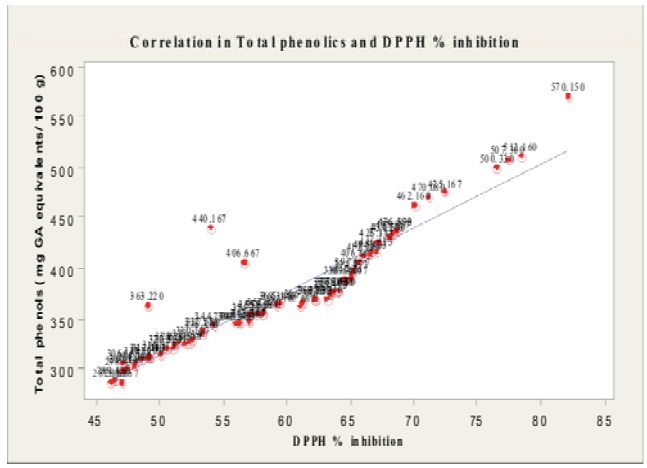


Variability in bioactive compounds in husk tomato

In rose hips, fifty five accessions were collected from different parts of the region and evaluated for phytonutrient composition and antioxidant variability. Among them maximum ascorbic acid was recorded in accession RH-47, total solouble solids and malic acid in RH-1, total anthocyanin in RH-51, total carotene in RH-40, lycopene in RH-6, total flavonoides in RH-17, total phenols and antioxidant capacity percent discoloration in RH-50.



Antioxident and phytonutrient variability in 55 accession of rose hips



Association of total phenols and DPPH (% inhibition) in 85 kale genotypes

Chromatic variability in rose hips

Field view of kale genotypes

In kale 86 genotypes were screened for antioxidant and phytonutrient properties. Total chlorophyll content was recorded highest in CITH-SAG-36, total carotene in 2011/KLVar/2, ascorbic acid in CITH-SAG-22, total flavonols in NW-SAG-23, total phenolics and DPPH % inhibition in CITH-SAG-10. Chromatic values also differ significantly in all the kale genotypes and will be very usefull for visual identification and making breeding strategy. In addition to that total phenolics and antioxidant activity clearly showed positive relationships which justify that phenols and antioxidant contents are closely associated.

Effect of various training and pruning systems in persian walnut

To study the effect of various training and pruning systems in Persian walnut, trial was laid out on three training systems. For standardization of pruning in walnut, plants were pruned at various levels viz. 10, 20, 30 per cent thinning, 10, 20, 30 per cent heading back and combination of thinning and heading back at the tune of 10+10, 20+20 and 30+30 per cent. The effect of these treatments on various horticultural traits in walnut is under progress.

Different levels of thinning out in walnut

Different levels of heading back in walnut

Different levels of thinning out + heading back in walnut

Walnut trees trained under different training systems

Integrated nutrient management in high density apple plantation at Mukteshwar

In the 5th year, FYM 50 kg/plant + vermi-compost 10 kg/plant +50g N + 75 g P_2O_5 + 250 g K_2O was found better combination, followed by FYM 25 kg/plant + vermi-compost 15 kg/plant +100g N + 125 g P_2O_5 + 300 g K_2O, irrespective of black polythene or leaf mould mulching. In the 6th year, FYM 60 kg/plant + vermi-compost 13 kg/plant +30g N + 80 g P_2O_5 + 225 g K_2O was found better combination, followed by FYM 30 kg/plant + vermi-compost 18 kg/plant +120g N + 150 g P_2O_5 + 300 g K_2O, irrespective of black polythene or leaf mould mulching. In the 7th year, FYM 70 kg/plant + vermi-compost 16 kg/plant +10g N+ 85 g P_2O_5 + 250 g K_2O was found better combination, followed by FYM 35 kg/plant + vermi-compost 21 kg/plant +140g N + 175 g P_2O_5 + 350 g K_2O, irrespective of black polythene or leaf mould mulching. In the 8th year, FYM 70 kg/plant + vermi-compost 19 kg/plant +165g N+ 178 g P_2O_5 + 548 g K_2O was found better combination, followed by FYM 70 kg/plant + vermi-compost 24 kg/plant +295g N + 268 g P_2O_5 + 648 g K_2O, irrespective of black polythene or leaf mould mulching. In the 9th year, same fertilizer combinations as in the 8th year were found to be very effective in stabilizing the vegetative and reproductive growth as recorded in the 8th year in apple cv. Starkrimson. Mulching with leaf mould or black polythene was found to be very crucial during the late winter, spring and summer season. Vermicompost and FYM combination has significantly reduced the load of inorganic fertilizers without any reduction in the total requirement of elemental form of N, P and K (Table 49).

Table 49. Blooming behaviour, fruit set, fruit quality and plant growth parameters of bearing apple trees of cv. Starkrimson under different integrated nutrient and mulching treatments.

Treat-ment	First flower open	Full bloom	End of flower-ing	Bloom density	Fruit set(%)	Fruit weight (g)	Fruit length (cm)	Fruit dia. (cm)	TSS (°B)	Acidity (%)	Plant Height (m)	Trunk dia. (cm)	New shoot growth(cm)	Yield (Kg/ tree)
T_1	24.03	31.03-5.04	15.04	15.4	36.2	194.8	7.3	7.5	12.5	0.34	3.2	7.0	70.8	22.5
T_2	26.03	30.03-5.04	16.04	16.3	37.5	196.2	7.4	7.7	12.7	0.33	2.9	6.8	71.4	25.6
T_3	1.04	6.04-9.04	15.04	12.5	30.2	178.6	6.6	7.1	11.8	0.41	2.8	6.5	68.6	13.3
T_4	27.03	2.04-9.04	18.04	17.6	38.4	196.1	7.6	8.0	13.0	0.34	3.2	7.1	80.3	25.4
T_5	26.03	31.03-6.04	18.04	18.3	39.0	199.4	7.8	8.1	13.2	0.32	3.1	7.1	86.7	27.8

Treat-ment	First flower open	Full bloom	End of flower-ing	Bloom density	Fruit set(%)	Fruit weight (g)	Fruit length (cm)	Fruit dia. (cm)	TSS (%)	Acidity (%)	Plant Height (m)	Trunk dia. (cm)	New shoot growth(cm)	Yield (Kg/ tree)
T_6	30.03	7.04-10.4	14.04	12.9	31.7	179.6	6.5	7.0	12.0	0.39	2.9	6.7	78.2	18.3
T_7	27.03	3.04-9.04	18.04	18.4	37.9	199.7	7.6	8.2	13.4	0.33	3.2	7.2	82.5	31.0
T_8	26.03	2.04-8.04	16.04	20.2	38.9	205.0	7.5	8.2	13.5	0.30	3.0	7.4	85.7	33.3
T_9	31.03	5.04-9.04	14.04	13.3	32.5	187.0	6.6	7.1	12.2	0.38	2.7	6.7	67.2	18.2
T_{10}	25.03	1.04-6.04	16.04	17.8	37.5	198.4	7.5	8.0	13.8	0.33	3.0	7.5	80.1	28.4
T_{11}	24.03	1.04-6.04	15.04	19.3	38.6	202.4	7.6	8.0	13.7	0.31	2.8	7.4	82.7	26.8
T_{12}	30.03	5.04-9.04	15.04	12.8	31.5	180.6	6.6	7.0	12.3	0.37	2.6	6.9	68.1	17.4

Standardization of organic agro-techniques for peach under high density planting system

Among the various treatment combinations, the treatment comprising vermi-compost+ mycorrhiza, Nadep + mycorrhiza and FYM + mycorrhiza performed better over other treatments (Table 50) . The physico-chemical attributes and antioxidant activities of fruits were also analyzed. The organically produced fruits were by and large superior in quality attributes than control (inorganically produced). The aphid infestations score was minimum with biopesticide chini cum followed by neem oil (Table 51).

Protected cultivation of vegetables

Tomato: In tomato, six hybrids were evaluated under poly house conditions with two spacings and three pruning levels. Among hybrids, Heemsona (957.36q/ha) followed by CITH-TH-1(842.77q/ha) and SH-TH-1 (772.88q/ha) were found best. While among three levels of pruning, double stem recorded highest yield (878.39q/ha) than single stem or natural. However average fruit weight was highest in single stem (41.97g) and fruit number in double stem (85.96). Among two spacings, the spacing 75x50cm recorded highest yield of (843.38q/ha) than wider spacing 90x45cm.

Table 50. Performance of peach under various organic nutrient management systems

Treatment	Date of complete leaf fall	Pruned weight (kg)/ plant	Trunk girth increment (cm)	Av. Yield/Plant (kg)	Date of 50% flower opening	Date of last flower opening	Fruit set (%)	Yield (kg)
FYM	07.11.10	9.72	2.15	2.73	10.03.11	16.03.11	58.45	21.94
NADEP	06.11.10	11.67	2.25	2.89	16.03.11	22.03.11	59.70	16.66
VERMI-COMPOST	10.11.10	11.59	2.13	1.32	10.03.11	22.03.11	64.83	16.25
MYCORRHIZA	09.11.10	9.95	2.75	2.79	09.03.11	16.03.11	69.10	35.50
FYM+NADEP	11.11.10	11.75	2.82	2.58	12.03.11	16.03.11	68.50	28.95
FYM+ VERMI	10.11.10	10.98	2.72	3.81	16.03.11	22.03.11	64.30	41.23
FYM+ MYCO	17.11.10	12.85	2.87	2.47	15.03.11	23.03.11	59.07	25.89
NADEP+ VERMI	10.11.10	10.15	3.10	2.32	16.03.11	24.03.11	58.92	14.24
NADEP+ MYCO	19.11.10	13.78	3.21	3.75	17.03.11	25.03.11	69.42	27.52
VERMI+ MYCO	18.11.10	14.87	3.46	2.13	18.03.11	26.03.11	73.45	32.47
CONVENTIONAL	10.11.10	10.58	3.37	2.34	19.03.11	22.03.11	76.60	53.41

Table 51. Comparison of mean aphid infestation scores per peach leaf and percent Abbot's efficacy during 2010 and 2011

Treatment	2010			2011		
	Score		Abbot's efficiency	Score		Abbot's efficiency
	Day before spray	7 days post-application		Day before spray	7 days post-application	
Chini kum	3.27	1.06	87.13	0.17	0.06	95.31
Bauveria bassiana	3.40	2.19	64.60	0.12	0.91	88.15
Neem oil	3.35	1.87	72.27	0.10	0.72	91.10
Herbal extract	3.24	2.78	32.78	0.14	1.18	47.75
Control	3.30	3.38	—	0.18	1.52	—-

Considering all the three factors genotypes, pruning systems and planting densities, the highest yield was recorded in CITH-TH-1 (1094.23 q/ha.) pruned to double stem at the spacing of 75x50 cm.

Protected cultivation of tomato

Cucumber : Four varieties and two hybrids of cucumber were evaluated under poly house conditions with two spacing's and three pruning levels .Among varieties, Japanese Green Long (602.27q/ha) followed by Green Express (544.324q/ha) were found best. While in hybrids, SH-CH-1(819.38q/ha) was the best having high yield and quality .Among pruning levels double stem recorded highest yield(759.94q/ha) than single stem or natural. However average fruit weight was highest in single stem (329.703g) and fruit number in double stem (17.77). Among spacing's the spacing 120x60cm recorded highest yield (712.01q/ha) than wider spacing100x75. Considering all the three factors genotypes, pruning systems and planting densities, the highest yield was recorded in JGL (981.42q/ha.) pruned to double stem at the spacing of 120x60 cm.

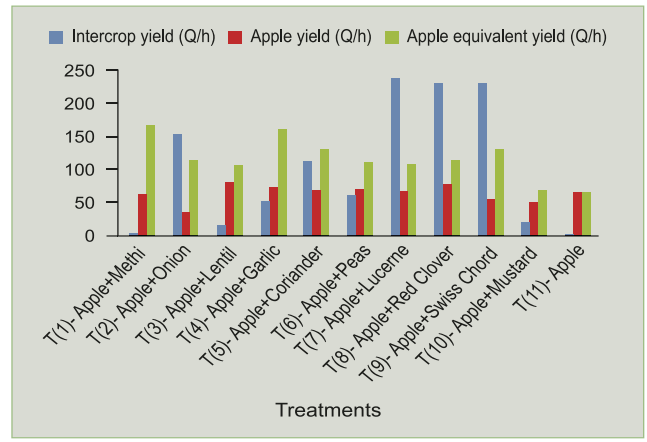
Protected cultivation of cucumber

Capsicum: Two varieties and six hybrids of capsicum were evaluated under net house conditions with two spacing's and three pruning levels. Among varieties SH-SP-706 with 701.90q/ha fruit yield performed better. However, among hybrids NS-281(946.54q/ha), Bombay (896.90q/ha), Shalimar Capsicum Hybrid-1(Y) (793.94q/ha) and Shalimar Capsicum Hybrid-2 (R) (764.97q/ha) were found best. While among pruning levels double stem recorded highest yield (846.53q/ha) than single or natural unpruned plants and the number of fruits were highest in double stem (10.84). Among spacing's the spacing of 20x50cm recorded highest yield of (880.98 q/ha) than wider spacing of 30x50cm, however average fruit weight was highest in single stem (99.10g). Considering all the three factors genotypes, pruning systems and planting densities, the highest yield was recorded in SH-SPH-2 (1154.29 q/ha.) pruned to double stem at the spacing of 20 x 50 cm.

Protected cultivation of capsicum

Development of apple based cropping system with spices and condiments, vegetables, legumes, forage and oil crops

Among the cropping sequences, treatment consisting of apple +methi recorded highest apple equivalent yield (165.90 q/ha) followed by apple + garlic(160.83q/ha) and apple + swisschard (130.31q/ha). Highest apple yield was observed with apple + lentil cropping system (81. 54 q/ha) followed by apple +red clover. Whereas, maximum soil nitrogen gain was observed in apple+lentil cropping system (9.80kg/ha) followed by apple +methi (9.71kg/ha) and apple + lucerne (9.29kg/ha). The treatment apple + methi recorded maximum soil potassium gain followed by apple + lentil and apple+red clover (Table 52). Highest cost of production was observed with cropping sequence apple + garlic followed by apple + onion due to high cost of seed and much involvement of labour (Table 53), whereas maximum cost benefit ratio was observed with apple +methi (3.71 rupees/rupee) followed by apple + swiss chard (2.99 rupees /rupee).



Yield of apple, intercrops and apple equivalent yield in different intercropping system

Table 52. Effect of intercropping on fertility status of the soil in apple orchard

Treatments	pH	EC (m.maho's)	O. C.%	Available N (kg/ha.)	Available K (kg/ha)
T(1) Apple + methi	6.77 (-.33)	0.15	0.54	429.86(+9.71)	403.64(+5.44)
T(2) Apple + onion	6.90 (0.0)	0.16	0.52	417.95 (-2.2)	396.18(-2.06)
T(3) Apple + lentil	6.80 (-0.1)	0.13	0.55	429.95(+9.80)	399.68(+1.48)
T(4) Apple + garlic	6.70 (-0.2)	0.13	0.46	418.04(-2.11)	396.96(-1.24)
T(5) Apple + coriander	6.75(0.15)	0.14	0.46	418.68(-1.47)	385.76(-12.44)
T(6) Apple + peas	6.91(+0.01)	0.15	0.49	428.68(+8.53)	398.24(-.04)
T(7) Apple + lucerne	6.90(0.0)	0.16	0.51	429.44(+9.29)	398.16(-.04)
T(8) Apple + red clover	6.70(0.2)	0.14	0.52	426.36(+6.21)	399.48(+1.24)
T(9) Apple + swiss chard	6.90(0.0)	0.15	0.51	420.63(+0.48)	396.56(-1.64)
T(10) Apple +mustard	6.90(0.0)	0.13	0.48	417.49(-2.66)	394.48(-3.73)
T(11)- Apple	6.90(00)	0.14	0.49	420.15(00)	397.21(-0.99)
Initial soil nutrient status	6.90	0.16	0.46	420.15	398.20

Table 53. Economics (Rs /ha.) of different inter crops grown with apple

Treatments	Cost of production (Rs/ha)			Total Return (Rs/ha)	Net Return (Rs/ha)	Benefit: cost ratio (Rupees/Rupee)
	Main crop	Intercrop	Total			
T(1) Apple + methi	71000	34500	105500	497700	392200	3.71
T(2) Apple + onion	71000	49000	120000	339720	219720	1.83
T(3) Apple + lentil	71000	26500	97500	328110	230610	2.36
T(4) Apple + garlic	71000	87500	158500	482490	323990	2.04
T(5) Apple + coriander	71000	25000	96000	390150	294150	3.06
T(6) Apple + peas	71000	42000	113000	333930	220930	1.96
T(7) Apple + lucerne	71000	23000	94000	321570	227570	2.42
T(8) Apple + red clover	71000	22500	93500	343170	249670	2.67
T(9) Apple + swiss chord	71000	27000	98000	391830	293830	2.99
T(10) Apple +mustard	71000	19000	90000	203070	113070	1.56
T(11)- Apple	73000	-	73000	197370	124370	1.70

Apple + mustard

Apple +garlic

Apple + fodder

Apple + methi

Evaluation of strawberry varieties under Kashmir conditions in different production systems

Strawberry is one of the most remunerative fruit crop known for its refreshing nature, taste and nutritive values which matures in first week of May in the Kashmir valley. Being a succulent fruit its availability period is very short. Thus, there was a need to evaluate the strawberry varieties under different growing conditions to extend the availability span with superior fruit quality and higher yield *vis a vis* higher benefits to the farmers. Twenty two varieties were evaluated under 4 growing conditions i.e. poly tunnel, black polythene mulch, organic mulch and normal cultivation with three replications. The significant variations in days to first harvest has been observed which ranged from 173days to 225

days from date of transplanting i.e 15th October. The earliest harvesting was obtained under poly tunnel (203.95days) from date of transplanting where as maximum number of days (233.31 days) taken to first harvest in control irrespective of varieties (Table 54). Thus period of availability was enhanced up to 4 weeks (30 days) by using different growing conditions. Earliest maturing varieties under poly tunnel were Katrian Sweet (172) followed by Dilpasand and Elastha (173days) whereas Katrian Sweet took 230 days under open conditions. Thus, availability of fruits of these varieties can be extended up to 53 days under different growing conditions. The highest yield was obtained in respective of varieties under straw mulch (33.40q/ha) which was closely followed by black polyethylene mulch (29.79/ha). The lowest yield was harvested in poly tunnel (27.39q/ha). However, variety Brighten recorded highest yield among the all tested varieties. Considering varieties and growing conditions it was observed that variety Banglora with the straw mulch gave the highest yield (62.00q/ha) followed by Douglas, Howard and Senga Sengana under straw mulch (Table 55).

Table 54. Effect of different growing conditions and varieties of strawberry on days to fruit maturity

Treatments	Poly tunnel	Black poly mulch	Straw mulch	Control	Mean
Katarin sweet	172.33	219.33	228.33	230.33	212.58
Dilpasand	173.00	219.33	229.00	230.00	212.83
Red cross	180.00	221.00	228.33	230.33	214.92
Larson	180.33	220.33	227.00	229.67	214.33
Camma Rosa	175.00	215.00	224.67	226.67	210.33
Elastha	173.33	210.00	229.67	229.67	210.67
Anthea	215.00	222.00	231.00	235.00	225.75
EC-102642	210.00	220.00	230.00	234.33	223.58
Fiana	210.00	220.33	231.33	232.67	223.58
Banglora	211.66	222.00	230.33	231.67	223.92
Douglus	215.00	226.00	231.33	232.33	226.17
Senga Sengana	218.00	226.00	230.00	233.00	226.75
Majestic	220.33	231.00	232.33	233.67	229.33
Phenomenal	215.00	214.00	231.33	235.67	224.00
EC-22355	222.33	233.67	230.33	234.33	230.17
Shastha	220.00	230.00	229.67	234.33	228.50
Black More	209.00	220.00	225.67	232.67	221.83
Heera	214.00	228.00	225.33	233. 66	225.25
Chandler	208.67	220.00	230.00	233.00	222.92
Brighten	211.00	220.67	231.33	238.33	225.33
Howard	212.00	224.33	233.00	241.67	227.75
Missionary	221.00	230.00	234.33	243.67	232.25
Mean	*203.95*	*222.41*	*229.74*	*233.31*	

Table 55. Effect of different growing conditions and varieties of strawberry on fruit yield (q/ha)

Treatments	Poly tunnel	Black poly mulch	Straw mulch	Control	Mean
Katrian sweet	12.50	30.83	49.83	43.75	34.23
Dilpasand	16.25	20.580	27.16	29.66	23.41
Red cross	15.33	18.83	20.66	24.66	19.87
Larson	16.33	18.83	18.83	19.91	18.47
Camma Rosa	28.33	32.83	25.33	19.66	26.53
Elasta	26.66	28.66	24.83	29.08	27.31
Athena	40.00	30.66	42.83	41.58	38.76
EC-102642	34.00	24.83	17.83	20.66	24.33
Fiona	34.50	34.33	34.50	28.66	32.99
Banglora	26.16	34.83	62.00	34.83	39.45

Treatments	Poly tunnel	Black poly mulch	Straw mulch	Control	Mean
Douglus	46.50	33.66	57.83	45.33	45.83
Senga Sengana	38.33	23.08	16.33	19.58	24.33
Majestic	35.00	72.50	53.66	45.33	51.62
Phenomenal	17.50	51.66	36.66	23.66	32.37
EC-22355	19.17	21.16	18.33	20.41	19.76
Shastha	19.16	14.66	17.58	13.08	16.12
Black More	40.83	26.83	21.50	19.75	27.22
Heera	29.26	16.66	19.91	17.58	20.85
Chandler	20.08	34.50	36.580	39.00	32.54
Brighten	30.33	38.66	43.66	38.33	37.74
Howard	22.50	23.33	52.41	24.00	30.56
Missionary	33.84	23.66	36.54	27.50	30.38
Mean	*27.39*	*29.79*	*33.40*	*28.45*	

Strawberry varieties growing under different growing conditions

Integrated nutrient management module for long day onion

To increase the productivity of onion ten integrated nutrient management module viz. Local recommendations without bio fertilizer, local recommendations with bio fertilizer,150:50:80:50 Kg NPKS+20 tonnes FYM /ha (DOGR recommendation) ,110:40:60:40 NPKS +15 tonnes of FYM/ha , 110:40:60:40 NPKS +7.5 tonnes of poultry manure /ha , 110:40:60:40 NPKS +7.5 tonnes of vermicompost /ha, 110:40:60:40 NPKS +7.5 tonnes of FYM + 2.5 tonnes poultry manure/ ha, 110:40:60:40 NPKS +7.5 tonnes of FYM + 2.5 tonnes vermicompost/ha , 110:40:60:40 NPKS +3.5tonnes of poultry manure + 3.5 tonnes vermicompost/ha , 110:40:60:40 NPKS +7.5tonnes of FYM+ 2.5 tonnes poultry manure /ha , 110:40:60:40 NPKS +7.5tonnes of FYM+ 2.5 tonnes vermicompost/ha was tested on Yellow Globe variety at spacing of 15x10cm (Table 56) .Among the different tested modules local recommendations with bio fertilizer recorded highest average bulb weight (248.11g)and total yield (97.54 t/ha).

Table 56. Effect of integrated nutrient management on growth and yield of onion

Treatment	Plant height (cm)	No. of leaves/plant	Equitorial dia (cm)	Polar dia (cm)	Av. bulb wt. (g)	% Double bulbs	Total bulb yield (t/ha)	Marketable yield (t/ha)
T_1	80.55	9.33	6.97	8.69	185.77	0.16	74.31	96.12
T_2	78.33	8.99	6.40	8.04	248.11	0.17	99.24	97.54
T_3	76.44	8.68	6.47	8.04	178.16	0.16	71.26	68.26
T_4	78.44	9.52	6.11	7.45	181.47	0.25	72.58	70.86
T_5	72.78	8.66	6.75	8.12	186.33	0.33	74.53	73.49
T_6	72.55	8.46	6.53	7.85	178.61	0.08	71.44	71.16
T_7	63.45	9.24	6.13	7.94	176.52	0.42	70.60	66.51
T_8	68.55	8.33	6.14	7.83	175.05	0.66	70.02	64.96
T_9	75.11	7.89	6.36	7.92	198.55	0. 50	79.42	73.00
T_{10}	76.00	10.63	6.83	7.84	173.75	0.33	69.49	65.93
CD (5%)	*8.28*	*1.01*	*0.38*	*0.29*	*15.06*	*0.31*	*48.78*	*45.94*
CV (%)	*6.45*	*6.50*	*3.47*	*2.11*	*4.63*	*58.17*	*12.75*	*12.86*

Weed management studies in onion

Eight treatment combinations of weedicides i.e. T_1 Oxyflurofen 23.5 % EC (Goal) application before planting and second application after 30 days of transplanting T_2 Oxyflurofen 23.5 EC (Goal) application before planting +Quizalofop Ethyl 5 EC(Turga Super). At 30 days after transplanting T_3 Combine application of Oxyflurofen 23.5 EC (Goal) +Quizalofop Ethyl 5 EC(Turga Super). application before planting and 30 days after transplanting T_4 Pendimethilin 30 EC before planting and second application after 30 days of transplanting T_5 Pendimethilin 30 EC application before planting and Quizalofop Ethyl T_5 EC after 30 days of transplanting T_6 Combine application of Pendimethilin 30 EC +Quizalofop Ethyl 5 EC (Turga Super). application before planting and 30 days after transplanting T_7 DOGR recommendations (Oxyflurofen application before planting +one hand weeding after 40-60 days) T_8 Weedy check were evaluated to find out effective weed control in onion. Among the different treatment combinations treatment T_2 recorded highest yield (117.50 t/ha) however, maximum weed control efficiency was observed with T_1 (Table 57).

Evaluation and standardization of agro-techniques for quality cut flower production under polyhouse and field conditions

Evaluation of gerbera genotypes under polyhouse and field conditions

During 2011, a total of twenty six different germplasm lines were evaluated under both poly house and field conditions for growth, flowering and yield characteristics. In polyhouse condition, among all the germplasm lines Dune, Rosalin and Dana Ellen yielded maximum flowers per plant i.e. 56.4, 51.76 and 48.16 respectively. Whereas, the plant height was found maximum in germplasm lines Dune (41.76 cm) followed by Winter Queen (39.16 cm) and Salvadore (38.66 cm). Stalk length was found to be maximum (63.23 cm) in cv.Dune and it was also good in respect of vase life in preservative solution (Table 58).

Table 57. Effect of weed management practices on quality and yield of onion

Treatment	Total bulb yield (t/ha)	No. of monocots/m^2	No. of dicots/m^2	Monocot fresh wt. (g/m^2)	Monocot dry wt. (g/m^2)	Dicot fresh wt. (g/m^2)	Dicot dry wt. (g/ m^2)	% Weed control efficiency
T_1	96.04	2.00	12.00	0.83	0.56	32.91	8.87	94.36
T_2	117.50	27.00	1.33	15.85	6.17	1.38	0.62	88.55
T_3	93.06	89.22	1.33	49.37	18.80	26.99	14.15	63.27
T_4	80.74	16.00	9.33	10.74	3.76	48.45	13.47	90.46
T_5	79.03	29.66	1.66	16.54	7.03	11.26	4.68	61.34
T_6	83.22	56.00	5.00	32.53	13.21	8.53	2.94	75.39
T_7	85.72	41.00	5.33	37.36	16.26	18.71	6.24	81.30
T_8	66.50	214.33	33.66	128.57	71.72	523.54	254.0	0.00
CD (5%)	*21.12*	*3.72*	*2.48*	*2.55*	*1.43*	*3.59*	*2.41*	*28.53*
CV (%)	*13.33*	*3.54*	*16.14*	*3.96*	*4.71*	*2.41*	*3.58*	*23.27*

Table 58. Performance of gerbera under polyhouse conditions

Germplasm	Plant height (cm)	Plant spread (cm)	Flower stalk length av.(cm)	Flower stem dia. (mm)	No. of leaves/plant	Flower size dia. (cm)	Av. length of leaves(cm)	No. of flower/plant
Cacharell	25.36	53.46	55	5.8	27.73	12.36	33.56	37.6
Salvadore	38.66	52.8	51.63	7.7	26.13	10.5	34.86	34.13
Scope	31.53	57.53	46.3	7.36	27.2	11.6	40.66	29.76
Dana Ellen	28.4	60.2	55.56	7.23	26.1	12.73	47.16	48.16
Sunway	33.5	52.23	54.76	8.13	24.4	14	50.93	42.63
Kayak	26.13	54.06	47.96	8.03	28.96	10.46	34.66	32.06
Carambola	34.5	52.7	57.63	7.36	18.56	12.1	40.9	26.63
Dune	41.76	53.2	63.23	7.6	27.36	12.86	39.6	56.4
Rosalin	32.43	57.13	57.76	7.46	29.73	11.3	44.56	51.76

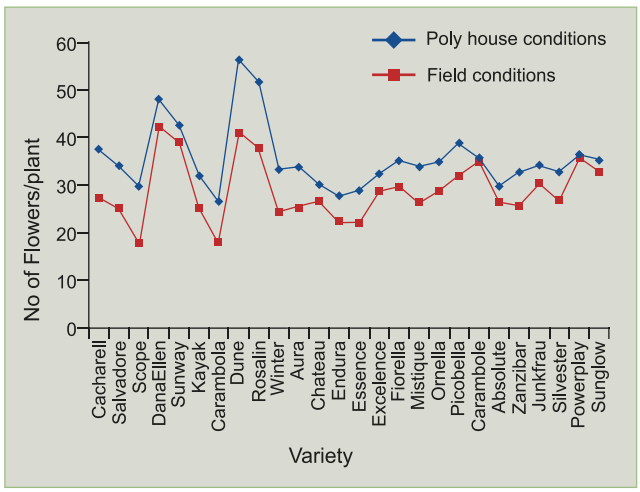
Germplasm	Plant height (cm)	Plant spread (cm)	Flower stalk length av.(cm)	Flower stem dia. (mm)	No. of leaves/plant	Flower size dia. (cm)	Av. length of leaves(cm)	No. of flower/plant
Winter Queen	39.16	60.33	48.36	7.8	31.66	12.26	45.33	33.26
Aura	27.6	45.03	31.33	5.26	24.53	9.13	31.13	33.93
Chateau	30.1	49.23	42.3	5.33	27.73	8.43	31.03	30.23
Endura	33.76	43.43	44.93	5.36	23.43	8.5	33.76	27.9
Essence	26.3	44.3	45.26	5.43	20.1	8.96	32.63	29
Excellence	28.46	50.86	49.6	6.33	16.26	10.63	32.93	32.43
Fiorella	27.93	42.9	45.9	5.56	19.13	11.73	38.2	35.26
Mistique	30.43	40.86	44.96	5.43	19.7	10.96	34.36	33.9
Ornella	30.46	46.93	44.76	6.36	19	9.06	37	34.93
Picobella	24.16	47.43	43.16	5.66	22.96	11.3	39.26	38.9
Carambole	25.16	49.63	44.26	6.46	25.2	8.83	30.5	35.6
Absolute	27.03	44	50.46	5.53	27.96	7.8	29	29.8
Zanzibar	23.7	45.46	51.13	6.33	25.63	9.36	33.83	32.8
Junkfrau	27.23	51.83	46.9	6.33	20.23	10.96	30.7	34.2
Silvester	34.16	51.8	52.03	6.23	18.83	10.16	35.13	32.83
Powerplay	31.46	55.6	48.9	7.4	18.53	11.33	34.36	36.32
Sunglow	30.83	54.3	45.13	5.4	19.3	12.6	36.7	35.4
CD (5%)	*2.12*	*2.62*	*5.32*	*0.85*	*3.66*	*0.94*	*2.60*	*4.07*

Table 59. Performance of gerbera under field conditions

Germplasm	Plant height (cm)	Plant spread (cm)	Flower stalk length av.(cm)	Flower stem dia. (mm)	No. of leaves/plant	Flower size dia. (cm)	Av. length of leaves(cm)	No. of flower/plant
Cacharell	21.3	50.12	51.23	6.21	25.74	10.3	28.36	27.3
Salvadore	25.36	51.89	47.89	6.77	21.55	8.32	29.16	25.11
Scope	30.12	54.36	42.15	7.2	24.65	9.6	37.36	17.86
Dana Ellen	25.57	57.79	49.32	7.01	23.81	11.19	42.01	42.34
Sunway	30.11	50.12	50.68	8.02	23.02	10.32	46.12	39.09
Kayak	20.12	52.01	43.22	8.21	26.45	9.56	30.68	25.36
Carambola	31.11	53.22	53.11	7.18	15.12	10.36	36.31	17.82
Dune	37.16	48.34	60.12	7.63	22.37	11.58	32.73	41.02
Rosalin	28.1	55.65	52.98	7.23	26.8	9.1	40.43	37.82
Winter Queen	37.15	58.74	44.57	7.67	27.17	10.67	41.19	24.36
Aura	21.26	42.90	27.28	5.61	22.60	7.39	25.59	25.35
Chateau	24.03	46.25	40.45	6.21	24.46	8.19	26.79	26.68
Endura	29.66	41.38	43.03	6.36	20.60	7.68	29.23	22.42
Essence	22.45	46.97	43.97	5.76	15.83	8.36	30.25	22.12
Excellence	24.38	50.48	48.16	6.17	13	9.93	31.85	28.76
Fiorella	23.66	40.97	45.93	6.17	15.87	10.58	34.99	29.70
Mistique	24.35	41.65	40.41	5.72	16.38	10.1	32.36	26.42
Ornella	25.69	46.60	46.95	7.25	17.96	8.07	34.48	28.84
Picobella	20.71	44.69	43.45	6.36	20.57	9.46	35.46	32.02
Carambole	21.33	45.92	46.25	6.49	21.27	7.33	25.53	34.98
Absolute	21.18	42.63	47.25	5.75	22.39	7.28	26.43	26.47
Zanzibar	19.46	43.90	50.45	6.37	22.84	8.30	28.67	25.59
Junkfrau	22.3	51.33	44.08	6.41	15.75	9.13	26.09	30.53
Silvester	29.7	49.35	51.25	6.61	15.26	8.61	29.66	26.81
Powerplay	25.62	54.77	45.1	7.19	13.52	9.16	30.49	35.79
Sunglow	26.27	52.70	43.04	5.49	15.72	10.21	32.63	32.78
CD (5%)	*2.77*	*4.17*	*3.19*	*0.79*	*2.93*	*1.08*	*2.19*	*3.42*

In field condition, among all the lines Dana Ellen, Dune, Sunway and Rosalin yielded maximum flowers per plant i.e. 42.34, 41.02, 39.09 and 37.82, respectively while the germplasm lines, Dune and Winter Queen were however had maximum plant height i.e. 37.16 and 37.15 cm respectively. Stalk length was found to be maximum (60.12 cm) in cv.Dune followed by cv. Carambola (53.11 cm) and Rosalin (52.98 cm).The quality of flower with respect to flower size, stalk length and vase life was found superior under polyhouse condition (Table 59).

Evaluation of gerbera germplasm under field and polyhouse conditions



Performance of gerbera germplasm under field and polyhouse conditions

Among all the cultivars Dune and Dana Ellen expressed longest vase life (15.94 and 14.81 days respectively) followed by Carambola, Sunway and Kayak. The vase life of flower also increased with increase in stem length. The vase life varied from 9.32 to 15.94 days in 60 cm stem length among the cultivars due to varietal characteristic.

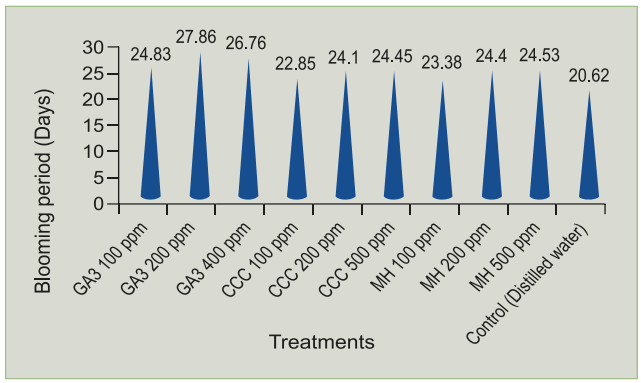
Enhancing blooming period of tulip involving PGRs and different storage periods of bulb

Among all the PGRs (GA_3, CCC, MH) , GA_3 at 400 ppm caused early sprouting (77.52 days) and increased plant height (36.20 cm), no. of leaves (4.84) and bulb (4.44) per plant as compare to control. It also induced early flowering (140.40 days) with improved flowering duration (26.76 days), flower size (6.57 cm) and stalk diameter (6.83 cm) while GA_3 200 ppm resulted in longest flowering duration (27.86 days). CCC and MH delayed sprouting and reduced plant height, but improved no. of leaves and bulb per plant. CCC and MH induced late flowering and increased flowering duration, but reduced flower size and flower stalk diameter with their increasing concentration in comparison to control (Table 60).

Table 60. Effect of GA3, CCC & MH on flowering attributes of tulip

Treatments	Days to bud formation	Days to flowering	Blooming period (days)	Flower dia. (cm)	Flower stalk dia.(mm)
GA_3 100 ppm	133.70	142.01	24.83	6.45	6.20
GA_3 200 ppm	130.35	141.53	27.86	6.36	6.26
GA_3 400 ppm	129.02	140.40	26.76	6.57	6.83
CCC 100 ppm	139.16	147.35	22.85	6.12	6.12
CCC 200 ppm	140.25	149.23	24.10	6.54	5.59
CCC 500 ppm	142.30	150.50	24.45	6.32	5.42
MH 100 ppm	137.43	150.40	23.38	6.56	5.86
MH 200 ppm	138.52	150.93	24.40	6.14	5.87
MH 500 ppm	140.28	151.46	24.53	6.07	5.80
Control	137.54	147.43	20.62	6.37	5.64
CD (5%)	*2.365*	*1.837*	*1.642*	*0.264*	*0.298*

Effect of PGR's and storage periods in tulips



Effect of different PGRs on blooming period of tulip

Effect of different storage periods on tulip blooming and cut flower production

Among all the treatments of cold storage, treatment T5 (12 week storage at 5°C) caused early sprouting (77.61 days) with improved plant height (37.51 cm), no. of leaves (5.08) and bulb (4.56) per plant as compared to control. It also induced early flowering (142.16 days) with improved flowering duration (26.45 days) and flower size (8.31cm). Successive increase in cold storage duration up to 12 weeks caused early sprouting and increased plant height, no. of leaves per plant and no. of bulb per plant. It also induced early flowering with increased flowering duration, flower size and flower stalk diameter (Table 61 & 62).

Among the all treatments, longest vase life (10.1 days) was recorded in treatment 8-HQS 300 ppm (Table 63) followed by treatment Alumunium sulphate 300 ppm (8.9 days) and treatment 8-HQS 200 ppm (8.8 days) as compare to control (5.4 days).

Table 61. Effect of cold storage periods of bulb on vegetative attributes of tulip

Treat-ments	Days to sprouting of bulb	Plant height (cm)	No. of leaves/ plant	Days to drying of foliage	No. of bulbs/ plant
T_1	82.52	33.19	3.12	171.40	2.46
T_2	82.18	33.36	3.80	170.30	2.51
T_3	81.60	33.07	4.10	171.23	3.27
T_4	79.59	35.45	4.31	176.80	3.65
T_5	77.61	37.51	5.08	179.80	4.56
T_6	76.45	36.50	4.90	177.37	3.20
CD (5%)	*0.526*	*0.937*	*0.399*	*1.761*	*0.128*

Table 62. Effect of cold storage periods of bulb on flowering attributes of tulip

Treat-ments	Days to bud formation	Days to flowering	Flowering duration (days)	Flower dia. (cm)	Flower stalk dia.(mm)
T_1	138.50	148.25	19.30	6.25	4.24
T_2	137.40	147.20	22.52	6.64	4.54
T_3	134.54	145.38	23.74	6.23	4.80
T_4	131.50	144.90	24.50	7.54	5.20
T_5	129.26	142.16	26.45	8.31	5.15
T_6	129.50	142.10	25.89	7.23	5.00
CD (5%)	*1.253*	*1.743*	*1.828*	*0.412*	*0.402*

Vase life and quality study in tulip cut flowers

Table 63. Vase life study in tulip

Treatments	Fresh weight of spike (gm/ spike)					Water up take	Water loss	Loss/ uptake ratio	Vase life
	2nd day	4th day	6th day	8th day	10th day				
T_1	28.15	31.74	33.87	32.75	27.24	65.2	82.54	1.26	5.4
T_2	30.60	33.20	34.90	33.52	31.10	77.9	95.1	1.22	6.5
T_3	29.40	32.54	33.30	32.53	29.10	81.7	98.8	1.20	7.4
T_4	32.75	35.23	37.40	36.60	32.40	84.9	98.7	1.19	8.0
T_5	34.30	37.70	38.20	37.50	34.00	73.6	85.22	1.16	8.2
T_6	34.40	37.20	38.30	36.42	34.20	75.2	84.80	1.15	8.6
T_7	36.20	37.55	39.70	37.40	35.80	81.5	86.70	1.06	8.9
T_8	33.40	35.20	36.70	34.60	32.40	92.8	102.5	1.14	8.4
T_9	37.20	39.60	40.30	39.50	36.60	99.4	106.4	1.07	8.8
T_{10}	38.60	39.40	41.50	39.20	37.60	104.3	109.8	1.05	10.1
CD (5%)									*0.494*

Development of saffron based intensive cropping system involving almond

Data is being recorded on vegetative, flower and corm characteristic of saffron while in almond data on vegetative growth and flowering are being recorded. During second year, there was no significant impact of almond on saffron yield and quality as almond plantation in initial stage.

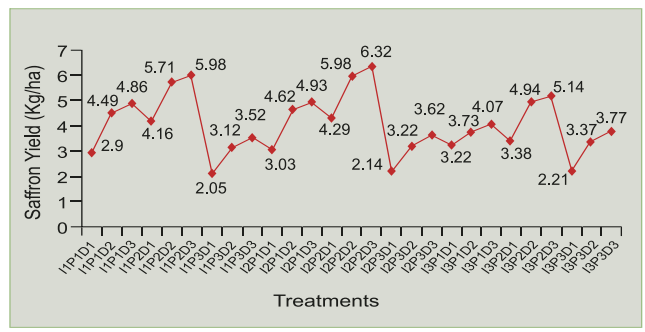
Saffron–almond intercropping system

Standardization of improved agro-techniques for maximization of saffron productivity

Among all treatments –sprinkler and drip irrigation methods caused early sprouting; early flowering with increased plant height and more no. of leaves and flowers/plant as compared to control (rainfed). Stigma fresh weight, stigma dry weight, stigma length and saffron yield per hectare were improved in sprinkler and drip irrigation methods as compared to control. Planting method- raised beds resulted in early sprouting; early flowering with increased plant height and more no. of leaves and flowers/plant as compared to ridge & furrow and flat bed systems.

During second year, planting density 15 lakh corm/ha resulted in significant improvement in saffron yield (6.32 kg/ha) as compared to planting density 10 lakh corm/ha (5.98 kg/ha.) and 5 lakh corm/ha (4.29 kg/ha.) in raised bed system with drip irrigation. While saffron yield was recorded 5.98 kg/ha. in planting density 15 lakh corm/ha as compared to planting density 10 lakh corm/ha (5.71 kg/ha.) and 5 lakh corm/ha (4.16 kg/ha.) in raised bed system with sprinkler irrigation system. Under rainfed condition saffron yield was recorded 5.14 kg/ha. in planting density 15 lakh corm/ha as compared to planting density 10 lakh corm/ha (4.94 kg/ha.) and 5 lakh corm/ha (3.38 kg/ha.) in raised bed system. Foliage height was recorded maximum 50 cm in planting density 15 lakh corm/ha followed by 49 cm in planting density 10 lakh corm/ha in raised bed with drip irrigation system while foliage height was recorded minimum 25 cm in flat bed with 15 Lakhs corm/ha under rainfed conditions (Table 64).

Among all the treatments pistil fresh weight and dry weight (100 flowers) was recorded maximum 4.28 gm and 805 mg in treatment drip irrigation with planting method raised bed and 5 lakh corm/ha, respectively followed by treatment sprinkler irrigation with planting on raised beds and 5 lakh corm/ha and treatment drip irrigation with planting on raised bed and 10 lakh corm/ha. There was significant effect of irrigation regimes and planting method and their interaction on saffron yield (dry pistil weight), however planting densities and different interaction treatments have no significant impact on saffron yield.



Effect of different irrigation regimes, planting methods and densities on saffron yield


Intensive production technologies for higher yield in saffron

Table 64. Effect of different irrigation regimes, planting methods and densities on growth, flowering and yield characteristics in saffron

Treatment	Flowering Initiation	Flowering plant %	No. of flower/ plant	Foliage height	No. of leaves/ plant	Pistil length (cm)	Pistil Fresh wt. (mg)	Pistil dry wt. (mg)	Yield (kg/ha.)
I1P1D1	16 Oct.2011	55	1.6	30	20	4.4	41.0	7.78	2.90
I1P1D2	15 Oct.,2011	60	1.5	32	25	4.4	40.6	7.75	4.49
I1P1D3	15 Oct.,2011	64	1.4	45	30	4.3	39.5	7.73	4.86
I1P2D1	13 Oct.,2011	62	2.2	45	26	4.5	42.1	8.00	4.16
I1P2D2	13 Oct.,2011	68	2.1	48	35	4.4	41.5	7.87	5.71
I1P2D3	11 Oct.,2011	72	1.8	48	32	4.4	41.0	7.80	5.98
I1P3D1	18 Oct.,2011	50	1.3	27	20	4.3	39.5	7.60	2.05
I1P3D2	17 Oct.,2011	55	1.1	26	18	4.3	39.0	7.57	3.12
I1P3D3	17 Oct.,2011	58	1.0	25	15	4.2	38.1	7.55	3.52
I2P1D1	15 Oct.,2011	62	1.8	30	22	4.4	41.3	7.93	3.03
I2P1D2	14 Oct.,2011	66	1.5	44	20	4.4	40.7	7.89	4.62
I2P1D3	14 Oct.,2011	70	1.4	46	25	4.3	39.5	7.71	4.93
I2P2D1	12 Oct.,2011	63	2.4	47	40	4.5	42.8	8.05	4.29
I2P2D2	11 Oct.,2011	70	2.2	49	38	4.5	41.9	7.95	5.98
I2P2D3	11 Oct.,2011	76	2.0	50	35	4.4	41.3	7.84	6.32
I2P3D1	17 Oct.,2011	53	1.3	28	27	4.3	39.9	7.58	2.14
I2P3D2	16 Oct.,2011	55	1.2	26	25	4.2	39.0	7.51	3.22
I2P3D3	15 Oct.,2011	58	1.2	25	22	4.2	38.3	7.44	3.62
I3P1D1	21 Oct.,2011	50	1.5	30	15	4.3	35.0	7.49	3.22
I3P1D2	20 Oct.,2011	52	1.3	29	18	4.3	34.1	7.46	3.73
I3P1D3	20 Oct.,2011	55	1.4	27	20	4.2	32.8	7.40	4.07
I3P2D1	18 Oct.,2011	55	1.6	33	26	4.4	38.5	7.69	3.38
I3P2D2	18 Oct.,2011	62	1.7	32	25	4.3	37.6	7.65	4.94
I3P2D3	16 Oct.,2011	68	1.9	30	23	4.3	35.2	7.60	5.14
I3P3D1	23 Oct.,2011	45	1.2	30	17	4.2	33.0	7.39	2.21
I3P3D2	22 Oct.,2011	47	1.1	28	18	4.2	32.1	7.34	3.37
I3P3D3	22 Oct.,2011	46	1.2	25	12	4.1	31.3	7.30	3.77
CD (5%)									*0.213*

Microirrigation and planting methods for higher saffron productivity

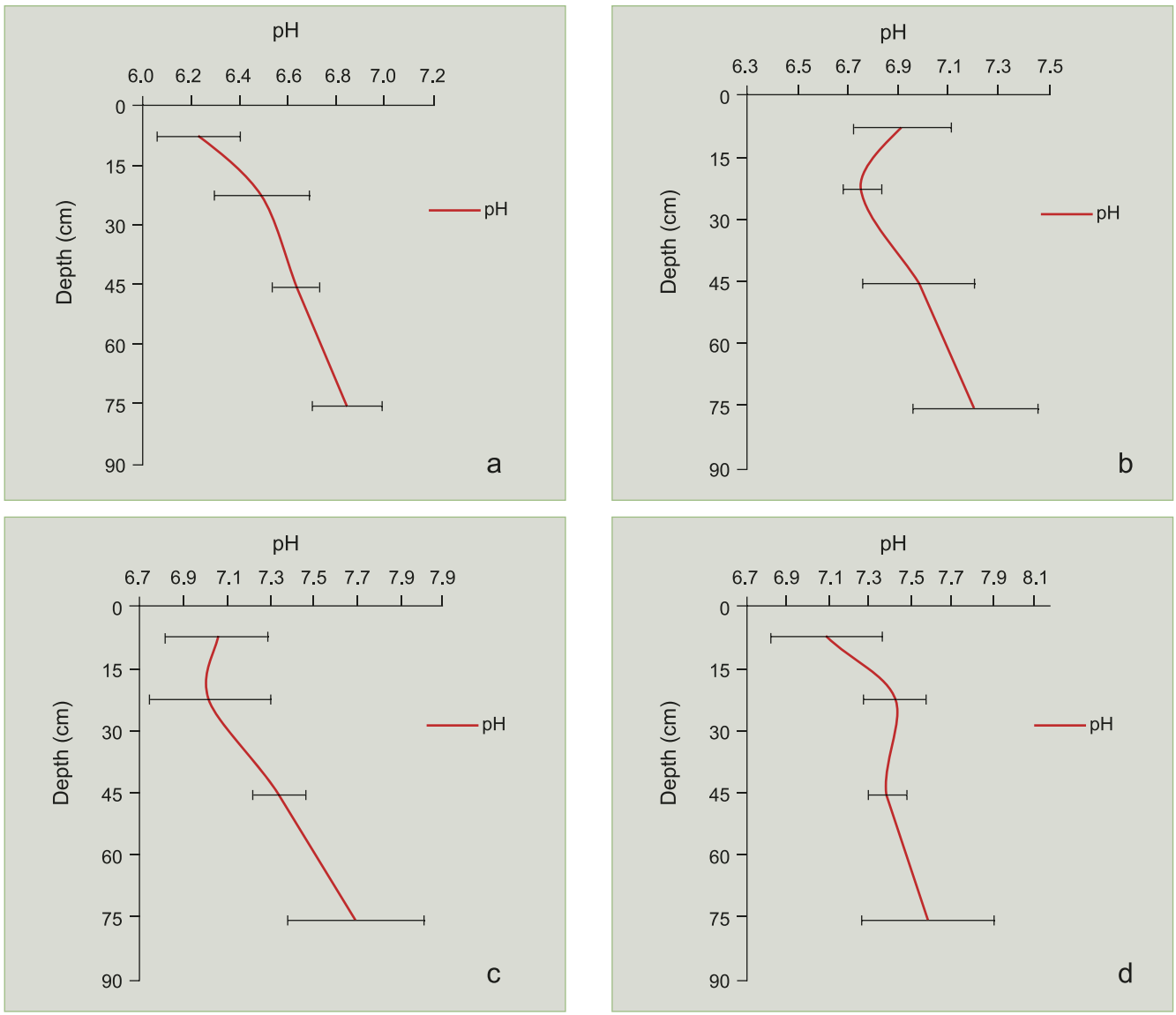
Saffron experimental plot at full bloom stage

Characterization of soil and nutritional survey of temperate fruit crop

The monitoring of nutrients and various physico-chemical properties of soil is extremely essential to know the nature of soil and its fertility status under temperate zone of the Kashmir valley, where under number of fruit crops which have different nutrient requirements, are being cultivated. Collected soil samples from different fruits and vegetable growing blocks (Sixteen) of CITH and their nutrient status was studied (major as well as important micro nutrients). As per preliminary depth wise soil analysis (with incremental depth of 0-15, 15-30, 30-60, 60-100 cm) of apple, almond, walnut and vegetable blocks of CITH, soil pH showed a varying trend in different fruit and vegetable growing blocks ranged between 6.23 to 7.69. In apple block, the pH increased with increasing depth and same ranged between 6.23 (0-15 cm depth) to 6.84 (60-100cm depth). While in Almond block pH decreased up to the 2nd depth (15-30 cm) and then again an increasing trend was noticed in third and subsequent depth. In walnut block pH increased up to the second depth and afterwards remained somewhat static till the 3rd depth (30-60 cm) and again increased pH was observed in subsequent depth. pH value was not having much variation in 1st and 2nd depth in vegetable block, afterward it increased up to the last depth (60-100 cm) .

Integrated nutrient management in soil of medium and high density orchards of apple

For improving the productivity of apple, a field experiment was initiated to develop the integrated nutrient management (INM) module, for apple crop in high and medium density plantation of CITH orchard at a spacing of 2.5 x 2.5 m and 4 x 4m respectively. For developing the INM based fertilizer



Depth wise variation in soil pH under different blocks of CITH. a. Apple orchard, b. Almond orchard, c. Walnut orchard and d. Vegetable block.

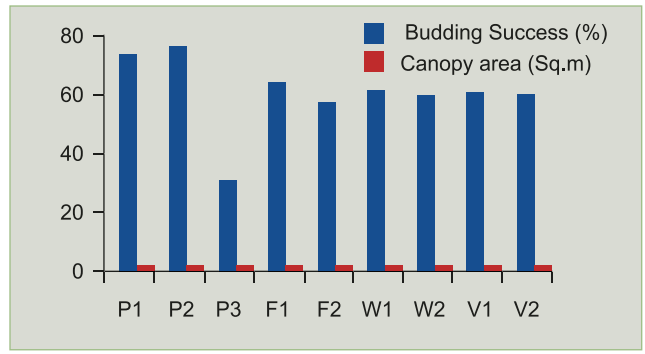
module two organic manures, namely, vermicompost and farm yard manure (FYM), biofertilizer, namely, *Azotobacter*, phospahate solublizing bacteria, *Azosprillum* and VAM, and inorganic fertilizers were used either alone or in combination. Treatments consist of sixteen nutrient levels, viz,. control, recommended dose of fertilizers (RDF of NPK), RDF+ Zn +B, 75% of RDF+ Zn +B, 75% of RDF+ Zn +B + 25% N through FYM, 75% of RDF+ Zn +B + 25% N through VC, 50% of RDF+ Zn +B + 50% N through VC, 50% of RDF+ Zn +B + 25% N through FYM + 50% N through VC, 75% of RDF+ Zn +B + Zn and B +Azotobactor, 75% of RDF+ Zn +B +Microphos, 75% of RDF+ Zn +B +Azospirllium, 75% of RDF+ Zn +B + 25% N through FYM + Azotobactor, 75% of RDF+ Zn +B + 25% N through FYM + Microphos, 75% of RDF+ Zn +B + 25% N through VC + Azotobactor, 75% of RDF+ Zn +B + 25% N through VC+ Microphos, 75% of RDF+ Zn +B + 25% additional N the experiment is under progress.

Standardization of technology for rejuvenation of old, unproductive almond orchards in Kashmir valley

Almond is most important high value and low volume nut crop of India but the productivity is much below than its potential; which understandably attributed to the prevalence of old, senile and unproductive orchards of seedling origin of unknown type. In view of above fact, rejuvenation programme was initiated. The results obtained are quite encouraging. Highest yield (1.94 Kg/tree) of in-shelled nut was recorded in first order pruning level, 50 kg FYM, 500g urea + 250g P_2O_5 + 750g K_2O, full moon water harvesting technique and Waris variety ($P_1F_1W_1V_1$). It recorded highest canopy area (2.85 m^2) which was 81.42% of control canopy (Table 65).

Table 65. Interaction effect of P.* F.*W*V on vegetative growth and nut weight of rejuvenated almond trees

Treatment	Canopy area(m^2)	% Growth over control (C=3.5sq.m)	Nut weight (g)	Yield (kg/tree)
Factor=4				
P1F1W1V1	2.55	73.00	3.46	1.94
P1F1W1V2	1.93	55.00	3.33	1.39
P1F1W2V1	1.93	55.00	2.51	1.53
P1F1W2V2	1.98	57.00	2.63	1.21
P1F2W1V1	2.03	58.00	2.70	1.66
P1F2W1V2	2.31	66.00	2.66	1.19
P1F2W2V1	2.05	58.00	2.56	1.13
P1F2W2V2	2.23	63.80	2.71	1.02
P2F1W1V1	1.98	57.00	2.43	1.23
P2F1W1V2	1.78	51.00	2.73	1.06
P2F1W2V1	2.10	60.00	2.46	1.29
P2F1W2V2	2.10	60.00	2.36	1.04
P2F2W1V1	2.31	66.00	2.46	1.47
P2F2W1V2	2.16	61.71	2.63	1.15
P2F2W2V1	2.03	58.00	2.38	1.19
P2F2W2V2	2.06	58.85	2.50	1.25
P3F1W1V1	2.85	81.42	2.16	1.25
P3F1W1V2	1.98	56.57	2.60	1.10
P3F1W2V1	2.03	58.00	2.66	1.24
P3F1W2V2	1.78	50.85	2.76	1.24
P3F2W1V1	2.16	61.71	2.36	1.25
P3F2W1V2	1.81	51.71	2.70	1.15
P3F2W2V1	2.21	63.14	2.61	1.35
P3F2W2V2	2.03	58.00	2.20	0.97
CD (5%)	*1.49*	-	*2.70*	*0.75*



Influence of pruning levels, fertilizer doses, water management techniques and varieties on nut weight and yield

Three years old rejuvenated almond laden with fruits

Three years old rejuvenated almond block

Inter institutional project

Data on plant growth attributes and flowering data of all the varieties have been recorded and found that maximum number of branches per tree was highest in Spendanader, maximum stem girth and plant height in Maha, maximum number of flowers and fruits in Bosckalinisi however maximum leaf chlorophyll content recorded in Surat Anar (Table 66).

Gulsha Red

Bedana Sedana

Table 66. Morpho-physical characteristics of pomegranate cultivars evaluated at CITH, srinagar introduced from NRCP, Solapur

Cultivars	No. of Branches	Stem girth (mm)	Plant height (cm)	No. of flower	No. of fruit/plant	Chlorophyll Content (mg/100 g)
Surat Anar	19	19.77	45.00	0	0	89.5
Spin Sakaharin	17	23.11	28.00	10	0	65.90
Boscalinisi	19	18.3	46.00	12	2	82.60
Kabuli canoor	9	13.7	30.00	10	0	80.50
Bandana Sedna	7	15.0	32.00	0	0	69.70
Spendanader	30	19.7	56.0	7	0	86.30
Dorsata MALLUS	28	20.7	38.00	0	0	79.30
Maha	25	25.0	35.00	8	0	70.20
Allah	19	19.7	40.00	5	1	87.50
Gulsha Red	10	20.20	40.00	4	1	70.00
Phule Arakta	13	15.30	30	5	0	53.70
CD (5%)	*6.69*	*3.26*	*8.67*	—	—	*18.15*

III. PLANT HEALTH MANAGEMENT

Integrated disease management of chilli wilt

The field trial on the effect of different management modules involving combination of biocontrol agents (B_o = No Biocontrol, B_1 = *T. harzianum*, B_2 = *T. viride*), chemicals (C_o = No Chemical, C_1 = Carbendazim, C_2 = Ridomil MZ) and solarization (S_o = No solarization, S_1 = solarization with black polythene, S_2 = solarization with transparent polythene) consisting of a total of 27 modules including the control check ($B_oC_oS_o$) was conducted in second year. The seed priming with respective biocontrol agents was done before their sowing. The beds were solarized with requisite polythene for about 40 days. The seedlings were root dipped in bioagents/chemical preparations before transplanting. Later on after 40 days of transplanting the seedlings were drenched with 0.1 percent chemical preparation.The plants were examined for development of wilt symptoms. The severity of wilt symptoms was recorded as 0= no wilt, 1= initiation of wilt, 2= rolling and drooping of leaves in about 30% plant, 3= rolling and drooping of leaves in about 60% plant, 4= rolling and drooping of leaves in about 80% plant and 5= whole plant including fruits wilted.

Maximum disease mitigation i.e. 63.05 percent was recorded in T_{23} i.e. $B_2C_1S_2$ i.e. with *T. viride* seed priming, carbendazim root dip and soil drenching and solarization with transparent polythene. It was followed by T_{26} i.e. $B_2C_2S_2$ with 59.41 percent disease mitigation by use of *T. viride* seed priming, ridomil MZ root dip and soil drenching and solarization with transparent polythene.

Management of corm rot of saffron with chemical seed treatment

Corm rot is a persistent problem in saffron, reduces vigour of plants with poor plant stand, flowering and yield of saffron. Infected corms are major source of primary inoculum for spread of the disease from one area to another. In order to alleviate the problem, the field trial on management of corm rot of saffron with chemical seed treatment was planted. The treatments were as follows : T_1 = Carbendazim 0.1%, T_2 = Carbendazim 0.2%, T_3 =Mancozeb 0.2%, T_4 = Mancozeb 0.3%, T_5 = Copper sulphate 0.2%, T_6 = Copper sulphate 0.3%, T_7 = Captan 0.2%, T_8 = Captan 0.3% and T_9 = Check.

The observations on healthy and wilted/dead plants stand and flowering in each treatment were recorded. The data revealed that among the nine treatments maximum plant stand i.e. 82.50 percent was recorded in T_2 (Carbendazim 0.2%) followed by 77.50 percent plant stand in T_8 (Captan 0.3%) with 83.33 percent and 72.22 percent, enhancement in healthy plants respectively over check whcih gave only 45.00 percent healthy plant stand. The flowering was also recorded to be maximum in T_2 (Carbendazim 0.2%) i.e. 24.22 percent followed by 23.00 percent flowering in T_1 (Carbendazim 0.1%) and 22.52 percent in T_8 (Captan 0.3%) as compared to 16.80 percent flowering in check (Table 67). The trial has been replanted in 2011-12 and plants being examined for wilt symptoms.

Table 67. Effect of chemical seed treatment on corm rot of saffron under field conditions during 2011

Treatment	Percent healthy plants in different treatments	Percent enhancement in healthy plants	Av. Percent flowering
$T_{1=}$ Carbendazim 0.1%	72.50(58.40)	61.11	23.00(28.63)
$T_{2=}$Carbendazim 0.2%	82.50(62.26)	83.33	24.22(29.43)
$T_{3=}$Mancozeb 0.2%	63.33(52.73)	40.73	19.62(26.26)
$T_{4=}$Mancozeb 0.3%	71.66(57.86)	59.24	22.07(28.00)
$T_{5=}$Copper sulphate 0.2%	70.83(57.33)	57.40	18.78(25.63)
$T_{6=}$ Copper sulphate 0.3%	74.16(59.46)	64.80	21.33(27.50)
$T_{7=}$ Captan 0.2%	69.16(56.30)	53.68	19.25(25.93)
$T_{8=}$ Captan 0.3%	77.50(61.66)	72.22	22.52(28.33)
$T_{9=}$CHECK	45.00(42.10)	-	16.80(24.16)
CD (5%)	*3.66*	-	*N.S*
CD (1%)	*5.05*	-	*N.S*

* Angular transformation values in parentheses

Biological control of white grub

The culture of entomopathogenic fungus *Beauveria bassiana* has been maintained on Potato Dextrose Agar medium. The entomopathogen has been multiplied on maizemeal-sand medium as well as in broth culture employing fermenter. The fermenter multiplied culture has been transferred to talc and the talc preparation of the culture is being applied in field for its evaluation in management of white grub (*Holotrichia consanguinea*) in apple and walnut at the rate of 40g/tree, 50g/tree, 60g/tree, 70g/tree and 80g/tree along with check of untreated trees. The impact assessment of biological agaent treatments id inder progress.

Studies on efficacy of kresoxim methyl against powdery mildew of apple

The chemical was evaluated on apple rootstock MM-106 plants for its efficacy to control powdery mildew as powdery mildew of apple is problem on rootstocks and pollinizer varieties. The plants of apple rootstock MM-106 were earlier sprayed with 1.50 percent horticultural mineral oil during second fortnight of March, 2011 for sanjose scale/mite control and subsequently sprayed with 0.06 percent Dodine in first fortnight of May, 2011 for primary scab control and protected for scab later on. Two sprays of kresoxim methyl @0.03% and 0.05% percent as well as hexacanazole @ 0.05 percent were applied in first and second fortnight of September for management of powdery mildew along with unsprayed check. In each treatment five replications of four plants each were maintained following randomized block design. In first week of October, 2011 powdery mildew infection on 25 representative leaves on terminal shoots was recorded on 0-5 scale with rating 0= no disease incidence (healthy), 1= coating of powdery mildew on leaves upto 5 percent, 2= coating of powdery mildew on leaves upto 25 percent, 3= coating of powdery mildew on leaves upto 50 percent and infection on stem, 4= coating of powdery mildew on leaves upto 75 percent and infection on stem and 5= cent percent coating of on leaves and severe infection on stems. The maximum disease mitigation i.e. 76.28 percent was recorded in T2 i.e. 0.05 percent kresoxim methyl spray with minimum percent disease index of 17.28 percent as compared to 72.88 percent disease index in check i.e. unsprayed plants and 38.40 percent disease index of powdery mildew in rootstock plants sprayed with 0.05 percent hexacanazole (Table 68).

Table 68. Efficacy of kresoxim methyl 50% SC against development of powdery mildew of apple in Srinagar conditions during the year 2011-12

Treatment	Av. Percent Disease Index*	Percent Disease Mitigation $\left(\frac{C-T}{C} \times 100\right)$
T_1= Kresoxim methyl 0.03%	24.96 (29.74)	65.75
T_2 = Kresoxim methyl 0.05%	17.28 (25.74)	76.28
T_3 = Kresoxim methyl 0.05%	38.40 (38.26)	47.31
T_4 = CHECK	72.88 (56.22)	-
C.D. (P 0.05)	*2.63*	-
C.D. (P 0.01)	*3.69*	-

**Angular transformation values in parentheses*

Studies on gummosis of stone fruits and its management

During 2011, the almond varieties planted at CITH experimental station were examined for symptoms of fruit gummosis due to shot hole fungus having fungal spots along with exudation of gum. The data revealed that all of the almond varieties planted at the experimental farm exhibited less than four gum droplets per fruit. The maximum gum exudation i.e. 5.45 percent fruits with 2-3 droplets and 14.12 percent fruits with one droplets were recorded in almond variety Merced. Maximum unblemished fruits with nil exudation during 2011 were recorded in almond variety Shalimar (Table 69).

Table 69. Fruit gummosis in almond varieties planted at CITH, Srinagar during 2011

Variety/Strain	Av. percent fruits with gum exudation			
	Nil exudation	Fruits with 1 droplet	Fruit with 2-3 droplets	Fruit with more than 3 droplets
Non Pareil	90.57	09.41	Nil	Nil
IXL	96.66	04.41	Nil	Nil
California paper Shell	87.09	10.00	2.89	Nil
Merced	80.41	14.12	5.45	Nil
Makdoom	94.77	05.22	Nil	Nil
Shalimar	98.41	01.58	Nil	Nil
Waris	94.67	05.32	Nil	Nil
Pranyaj	90.00	10.00	Nil	Nil
Primoskij	93.89	06.09	Nil	Nil
Drake	87.78	12.20	Nil	Nil

Insect population dynamics on different varieties/ genotype of apple, almond and apricot

Insect pests infestation data have been recorded in apple, almond and apricot. During 2011-12, flea beetles infestation was very severe, attacking almost all the fruit crops. The hibernating adult flea beetle starts its activity on 1st week of March and lays eggs singly or groups in soil. The grubs feeds on weeds and pupate in soil and the adults emerge gregariously infesting host plants. The infestation was very high in apricot,apple and almond, respectively. A very high population of European red mite was also recorded in almond (high density) as well as in apple. In addition, aphids, leaf hopper and white grubs infestation were also recorded.

Adult flea beetles gregariously feeding on apricot

Flea beetle grubs feeding on weed

In case of natural enemies studies were undertaken to document the coccinellid beetles of temperate fruits. A total of 14 species belonging to 12 genera of predatory coccinellids were recorded. Among these, three species namely, *Halyzia sanscrita* Mulsant, *Illeis confusa* Timberlake and *Serangium* sp. are new record to Jammu and Kashmir fauna and one species *Stethorus aptus* Kapur is new to India. The *Stethorus aptus* was recorded feeding on European red mite, *Panonychus ulmi*. This predatory beetle would be one of the potential natural enemy for the management of European red mite. Keeping in this view, study were undertaken to study the biology and its predatory potential under laboratory.

Halyzia sanscrita Mulsant

Illeis confusa Timberlake

Stethorus aptus Kapur

In addition, survey was also undertaken to identify the diapausing place for coccinellids during winter. The sampling was made from fallen leaves, soil around base of tree and cracks on trees trunk. It was found that, coccinellids prefer to diapause more on cracks of trees compare to soil or fallen leaves. Percent survival was also more in beetle diapausing on cracks of trees during winter.

Development of IDPM module in tomato, cucumber and capsicum for protected cultivation

The efficacy of different treatments against aphids was studied during 2011under polyhouse conditions. Seed sowing of cucumber variety JGL, tomato Himsona and capsicum Nishat-1 was done

during 4th week of March and transplanting was done during 3rd week of May. The crop was raised as per the recommended package of practices. The efficacy of six different treatments comprising T1= Neem oil (3%),T_2 = *Beauveria bassiana* (2.5 ml/litre), T_3 = Pogamia soap (5%), T_4 = NSKE (5%), T_5 = Dimethoate (0.06%) and T_6= untreated check (water spraying) wrere applied. The observations were recorded on 15 randomly selected leaves in each plot one day before the application of spray as pre-treatment. The post treatment counts were recorded at 1, 3, 7, 10 and 15 days after the application of each treatment and the untreated check. The results of present investigation pertaining to efficacy of different treatments against aphids on cucumber, tomato and capsicum indicated that all the treatments were significantly superior over untreated check. All the treatments showed almost similar trend in their efficacy against the pest throughout the observation period. The significantly highest mean reduction in pest population was observed in dimethoate (0.06%) with mean number of 15.40, 11.40 and 19.68 aphids over untreated check 353.73, 79.33 and 81.09 per 5 leaves on cucumber, tomato and capsicum, respectively. This was followed by NSKE (5%) and pogamia (5%) on cucumber and capsicum. However, on tomato the next best treatment was pogamia soap after dimethoate (5%).The remaining treatments also reduced the pest population significantly over the untreated check. However, neem oil (3%) and *Beaveria bassiana* proved least effective and were found more effective after 10 days of application.

The Asian hornet *Vespa* sp. management in apiary

The hornet *Vespa* sp. was severely attacking the honey bee colonies in J&K. Therefore, an experiment was conducted to identify different types of food lures, namely meat, fish, fresh apple, rotten apple, and apple juice for attracting the *Vespa* sp. Among these, fish attracted more number of wasps compared to other food lures. The trap was also designed for mass trapping of wasps, which needs further improvements for effective trapping.

Vespa sp. attacking the honey bee

Fish attracting *Vespa* sp.

Integrated disease management through participatory research

Chilli: For integrated management of chilli wilt, the plots were solarized with transparent polythene for 40 days before transplanting of seedlings; the seedlings were root dipped with *T. viride* (5g/litre) and transplanted and carbendazim drenching (0.1%) in rootzone of seedlings 4 weeks after transplanting was done. At farmers field one check plot as per farmers practice and three treatment plots were planted. The incidence of chilli wilt after 4 weeks, 6 weeks, 8 weeks and just before harvesting was recorded in randomly selected 100 plants in each plot.

Table 70. Incidence of chilli wilt in demonstration trial at farmers field during 2011

	Percent wilted plants			
Time of observation	Check (Farmers Practice)	Treatment Plot 1	Treatment Plot 2	Treatment Plot 3
4 weeks after transplanting	15.0	0.0	0.0	0.0
6 weeks after transplanting	24.0	0.0	0.0	0.0
8 weeks after transplanting	42.0	3.0	5.0	7.0
Just before harvesting	79.0	5.0	9.0	15.0

The results in Table 70 showed that in the treatment module applied plots the disease incidence ranged from 5.0 percent to 15.0 percent as compared to check plot of farmers practice with 79.0 percent chilli wilt incidence at harvesting indicating that IDM module for management of chilli wilt is highly effective and could be taken up by state extension departments for popularization.

Biotechnological interventions for improvement of apple through virus and genetic fidelity certification and production of virus tested elite planting material:

The Survey for examination of apple trees in farmer's orchards planted in different apple growing areas of valley was taken up. The apple growing areas

included Pattan, Sopore, Baramulla, Shopian and Budgam. Leaf samples showing discernible symptoms of apple mosaic virus (APMV) and apple chlorotic leaf spot virus (ACLSV) were collected and partially processed for ELISA detection of these two viruses. ELISA was conducted using Bioreba Kit containing both primary antibody and conjugate and DAS-ELISA was performed for confirmation of viral disease. The results of detection of above mentioned two viral disorders indicated that mean infection of APMV in these five apple growing areas ranged from 1.3 to 6.6 percent and mean infection of ACLSV in the same locations ranged from 2.3 to 6.9 percent.

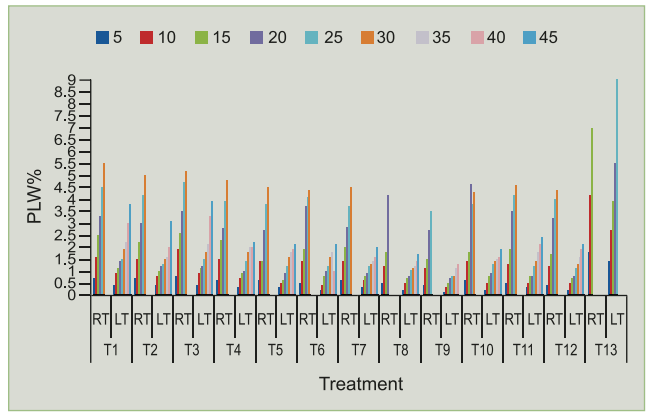
IV. POST HARVEST MANAGEMENT

Minimal processing and packaging of high value vegetables and fruits for quality maintenance and storage

Effect of sanitizing agents, antioxidants and shrink wrapping of capsicum for quality maintenance and storage

Capsicum (*Capsicum annum* L.) is an important vegetable because of its high nutritional value but is highly perishable with a short shelf life. Common post harvest problems of pepper fruit after harvest include significant metabolic and physiological activities, colour and quality degradation and shrinking as well as fast physical decay and rapid senescence. The most effective method of maintaining quality and controlling decay of peppers is by rapid cooling after harvest followed by storage at optimum temperature (7-10 °C) and high relative humidity (95-98%) . The storage life of pepper fruit is limited by pathological deterioration, rapid water loss and susceptible to chilling injury, which limits storage to temperature above 7 °C. Since pepper fruits cannot be stored at a low temperature because of chilling injury necessary to slow physiological activities (rate of respiration, ripening etc), it is through other means where treatment of fruits with sanitizing agent , anti oxidants and shrink wrapping are found great importance and have great potential benefit. This study was undertaken to determine the effectiveness of pre storage treatments of sanitizing agent (sodium hypo chlorite) and antioxidants (citric acid) and shrink wrapping of pepper fruits for maintaining quality and increasing shelf life during storage. For the study capsicum fruits of variety Nishat-1 were harvested, at the ripening stage at 85 % coloration and uniform size (150 ± 10 g) and colour. After harvest fruits were washed and subjected to treatments of sanitizing agent (sodium hypochlorite 100ppm for 1 minute), dipping in 1 % citric acid for 30 seconds (as anti oxidants) and packaging in semi permeable film (15, 19, and 21 ¼), whereas, control fruits were simply washed and were neither treated with sanitizing agents or antioxidants nor were shrink wrapped. The experimental material was stored at room temperature (25±2° C) and at low temperature (5±1°C). Second year experimental results reveals that pre packing treatments of capsicum with sodium hypochlorite followed by dip in 1% solution of citric acid and finally packing in semi permeable film, the shelf life of capsicum fruits at both the storage conditions/temperatures improved. However, significant results were obtained when capsicum fruits were treated with sodium hypochlorite (100 ppm), citric acid (1%) and shrink wrapping of fruits in 19 ¼ semi permeable film and stored at low

Control and treated fruits of capsicum



T1 = SPF 15μ
T2= SPF 19μ
T3= SPF21μ
T4= SPF15μ+C.A
T5= SPF15μ+S.H.C
T6= PF15μ+S.H.C+C.A
T7= SPF19μ+C.A
T8= SPF19 μ+S.H.C
T9= SPF19 μ+S.H.C+C.A
T10= SPF21 μ+C.A
T11= SPF21 μ+S.H.C
T12= SPF21 μ+C.A+S.H.C
T13= Control

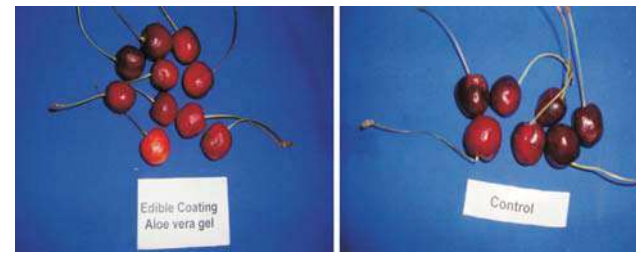
Effect of sanitizing agent, antioxidant and shrink wrapping on PLW % of capsicum variety Nishat-1 during storage

temperature. This treatment can be effective to store the capsicum fruit as for 30 ± 2 days at room temperature and 45-48 days at low temperature showing significantly minimum loss in weight and retaining maximum inherent colour, firmness and desirable quality.

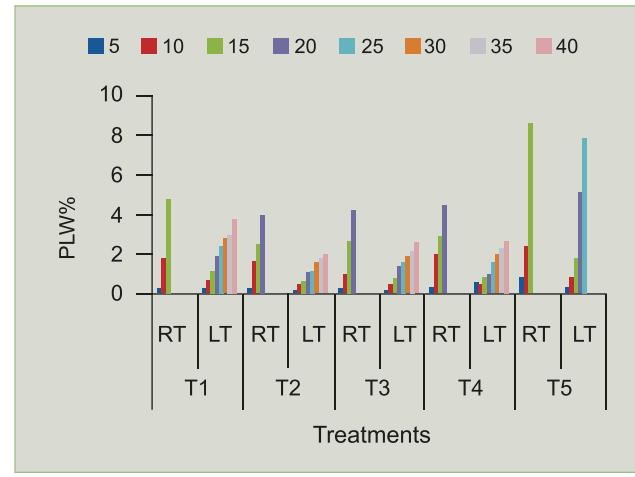
Effect of *Aloe vera* gel coatings on the shelf life and quality maintenance of cherry

Cherry is one of the most appreciated fruit by consumers due to its exquisite taste. The main quality indices are skin colour, which is related to fruit ripening, firmness and largely affected by anthocynin concentration , TSS, TSS/ acid ratio and colour. Both these parameters determines consumers acceptance. Cherry fruits deteriorate rapidly and in some cases do not reach consumers at optimal quality. The main causes of its deterioration are weight loss, colour change, softening, surface pitting and loss of TSS/acidity ratio. Several post harvest technologies have been used to control decay, but the use of chemicals as fungicide is restricted and consumers demand agri based commodities without pesticide residue. Edible coatings are used to improve appearance of fruit, maintenance of its quality and act as barriers during processing, handling and storage. They do not solely retard fruit/vegetable deterioration or enhance its quality, but also safe due to natural biocide activity or to the incorporation of anti microbial compounds. Different compounds have been used as edible coatings to prevent physiological weight loss. Derivatives of fatty acids and poly saccharides as coatings have been reported to reduce fruit respiration rate and weight loss. The present investigation was undertaken to study the effect treatment of cherry variety Mishri (Bigarreau Napolean) to sanitizing agents and surface coating with Aloe vera gelfor quality retention, colour retention and shelf life.

Cherry fruits of variety Mishri harvested at optimum maturity were washed and sorted before application of tretments. The washed and dried fruits were treated with sanitizing agent (Sodium hypochlorite), citric acid (as anti oxidant) and surface coated with *Aloe vera* gel 25 (T1) , 50 (T2), 75 (T3) and 100 % (T4), whereas control fruits treated in cold water only. The experimental material was then stored at room temperature and low temperature conditions to see the quality retention and enhancement in shelf life. Aloe vera gel of 50% concentration and stored at low temperature (5±1°C) extended the shelf life upto 40 days with least PLW (2%) compared with control (7.8%, maximum firmness of fruit (28) compared to 20.0 in control, maximum TSS (17°B) compared to 13.5 Brix in control, maximum ascorbic acid12.2 mg/ 100g at 40 days of storage compared to 7.8 mg/ 100g at 20 days of storage.



Treated and untreated cherry fruits



Effect of aloe vera gel coating on PLW% of cherry cv. Mishri.

Effect of shrink wrapping on quality maintenance and storage life of nectarine variety Fantasia

Fruits of nectarine var. Fantasia at optimum maturity stage and free from scars and defects after washing in 100 ppm sodium hypochlorite and treating with 1% citric acid were shrink wrapped in different gauge semi permeable film and stored at low temperature (5 ±2°C, RH 90 %)) and room temperature to study the quality retention and enhancement in shelf life.

The fruits shrink wrapped in semi permeable film showed enhancement in storage life compared to control in both the storage conditions. However nectarine fruits shrink wrapped in 19 µ film and stored at low temperature (5 ± 2°C) showed least PLW (1-2%) compared to control (11.4 %), retained quality and firmness (27.8) compared to control (29.0) up to 40 days of storage compared to control where fruits started deteriorating after 24 days of storage. The treated and shrink wrapped fruits at room temperature retained their quality and firmness up to 10 days compared to that of control where it was retained up to 4 days only. The nectarine fruits if kept untreated at room temperature showed highly perishable character. Hence it was confirmed from experimental findings that nectarine fruits if shrink wrapped and kept at low temperature can be stored up to 40 days with least loss in physiological weight and quality parameters.

Effect of sanitization, antioxidants, edible coatings and shrink wrapping of apple varieties for quality maintenance and storage life

Mollies Delicious an early variety of apple have less shelf life, quality gets deteriorated with storage time after 2 weeks of harvesting. Trial was taken to increase the shelf life of apple fruits of variety M. Delicious by treating/ edible coating with different concentrations of *Aloe vera* gel and shrink wrapping with different size of semi permeable films.The fruits coated/treated with 50% conc. of *Aloe vera* gel and shrink wrapped in 25 µ film showed enhancement in storage life at both the storage conditions when compared with control. However significant results were obtained when fruits were coated with 50% *Aloe vera* gel and shrink wrapped in 25 µ film and stored at low temperature (5 ± 2°C). The fruits under this treatment stored up to 68 days showing least PLW, maximum retention of quality and appeal, firmness index (36.1) compared to control (30.9).

Shrink wrapped fruits and control

In case of variety Red Chief, Shrink wrapping of fruits with semi permeable film, 19 and 25 µ films were equally effective to reduce the physiological loss in weights, retain maximum quality parameters, firmness (20.1 and 21.7 respectively) compared to control (12.3).

Golden Delicious a late maturing variety of apple having excellent demand in the market looses its firmness and shape after 2 weeks of harvesting. To retain its shape and firmness and to increase its shelf life with maximum retention of quality parameters, a trial was taken to study the effect of shrink wrapping on the quality maintenance and shelf life of apple variety G. Delicious. The fruits after harvesting and washing were treated with 100 ppm sodium hypochlorite, dipped in citric acid 1% for 30 seconds and shrink wrapped in different thickness semi permeable PE film. Shrink wrapping with 25 µ film increased the shelf life significantly (110-120 days) with least PLW (1.78%) compared to control (8.0%) and maximum retention of quality in terms of TSS, acidity and ascorbic acid and fruit firmness (24.3).

Maturity indices for high oil recovery in olive

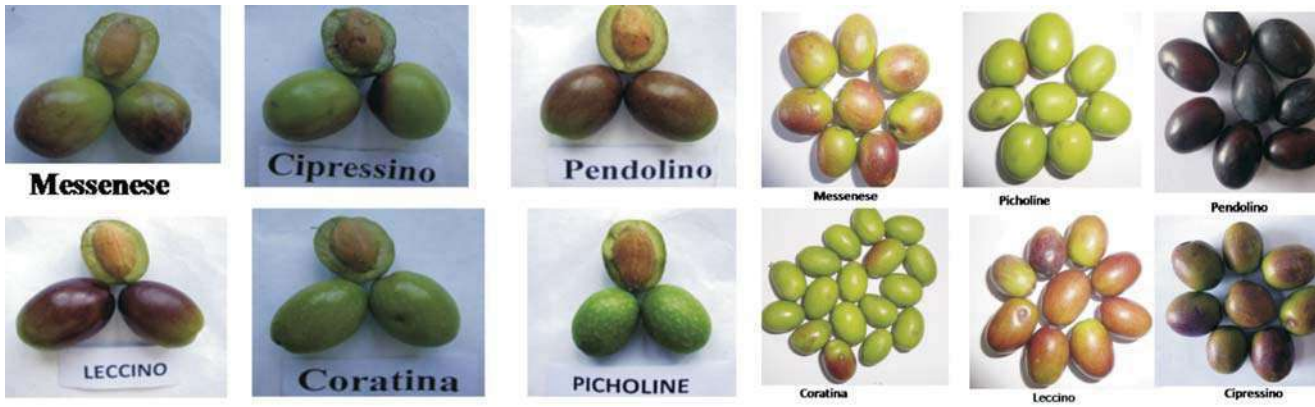
Data on determining maturity indices for getting maximum oil extraction from the fruits was recorded and preliminary results showed that from second week of Oct. to first fortnight of Nov. month, was found best to harvest fruits to get higher oil percentage in Coratina, Leccino and Pendolino however in Messenese, Cipressino and Picholine from second fortnight of Oct to end of Oct. found suitable for harvesting the fruits to get maximum oil yield (Table 71&72).

Table 71: Effect of harvesting stages on maturity indices, firmness and percent oil recovery in olive

Harvesting stage	Date of harvesting	Maturity index			Firmness index			Oil recovery %		
		Coratina	Leccino	Pendolino	Coratina	Leccino	Pendolino	Coratina	Leccino	Pendolino
Harvesting 1	10 Sept., 2011	1.15	1.22	1.73	26.25	27.98	28.69	8.23	5.36	6.55
Harvesting 2	20 Sept., 2011	1.83	1.74	1.96	23.65	25.64	26.68	12.54	9.25	9.35
Harvesting 3	30 Sept., 2011	2.56	2.27	2.49	22.68	24.35	23.20	15.84	13.69	14.87
Harvesting 4	10 Oct., 2011	2.84	2.98	3.18	20.65	21.24	20.32	21.65	17.98	18.45
Harvesting 5	20 Oct., 2011	3.47	3.59	3.37	19.54	18.68	19.65	29.36	25.57	23.68
Harvesting 6	30 Oct., 2011	3.79	3.85	3.89	17.24	17.40	17.99	20.25	18.85	21.33
Harvesting 7	10 Nov., 2011	4.68	4.86	4.52	16.68	16.20	15.19	18.87	16.45	17.21

Table 72 : Effect of harvesting stages on maturity indices, firmness and percent oil recovery in olive

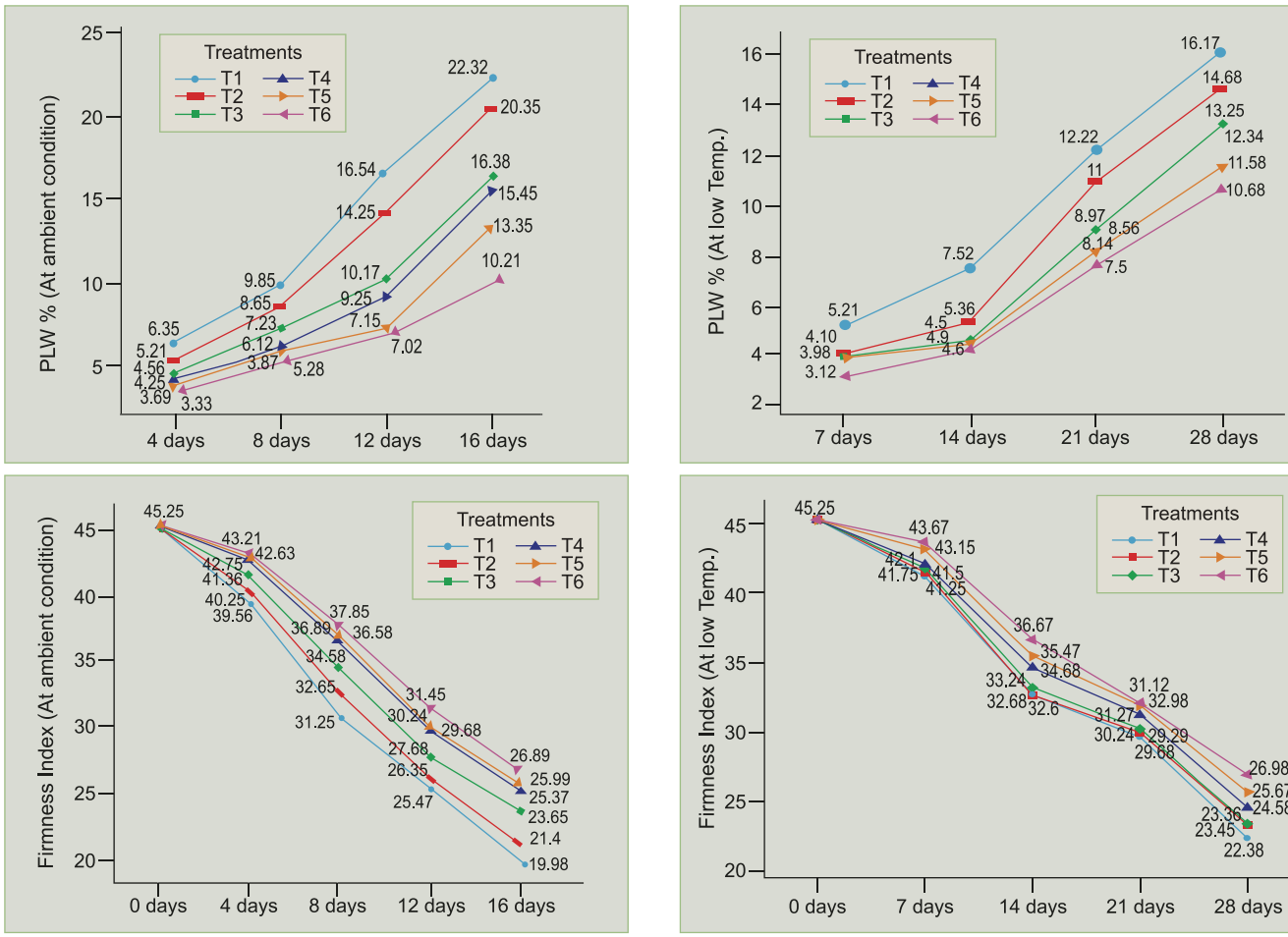
Harvesting stage	Date of harvesting	Maturity index			Firmness index			Oil recovery %		
		Messenese	Cipressino	Picholine	Messenese	Cipressino	Picholine	Messenese	Cipressino	Picholine
Harvesting 1	10 Sept., 2011	1.36	1.47	1.55	27.25	29.68	30.37	6.25	9.14	4.62
Harvesting 2	20 Sept., 2011	1.65	1.88	1.89	25.65	27.25	26.68	10.45	12.24	8.98
Harvesting 3	30 Sept., 2011	1.94	2.59	2.35	23.67	25.67	24.22	15.47	15.17	11.87
Harvesting 4	10 Oct., 2011	2.57	2.94	2.98	20.10	23.69	22.69	18.58	19.19	16.54
Harvesting 5	20 Oct., 2011	3.38	3.86	3.46	19.87	21.25	20.30	20.36	22.23	19.56
Harvesting 6	30 Oct., 2011	3.69	4.25	3.90	18.40	19.11	18.91	23.68	25.78	21.35
Harvesting 7	10 Nov., 2011	3.98	4.86	4.56	16.00	16.98	15.68	19.01	17.54	16.14



Stages of optimum maturity indices for olive harvesting

Effects of post-harvest pre-cooling processes and cyclical heat treatment on the physico-chemical properties of "Crest Heaven Peach" during cold storage

Fruits samples were harvested at optimum maturity and applied different cooling treatments with different storage (at ambient and low temp (4^0C). Pre –cooled with ice water retained higher firmness, pectin content, bio-chemical properties than normal tap water treatments under both the condition. Addition $CaCl_2$ 2% to ice water along with cyclical heat treatment during storage increased firmness up to 40% and reduced the degradation of the ascorbic acid and pectin hydrolysis and minimized PLW l% loss up to 25% . Sensory analysis also resulted that peaches with ice water containing $CaCl_2$ 2% having higher firmness more attraction and color as compared normal tap water treatment in both the storage condition. Shelf life increases with better quality fruits up-to 16 days in ambient condition and 28 days at 4^0C with treatment of ice water containing $CaCl_2$ 2% as compared to normal water treatment 9 days and 15 days (4^0C) respectively.



(T1: Hydrocooling with normal water (ambient temperature), T2: Hydricooling with ice water, T3: Hydricooling normal water + $CaCl_2$ 1%, T4: Hydricooling with ice water+$CaCl_2$ 1%, T5: Hydricooling normal water + $CaCl_2$ 2%, T6: Hydricooling ice water + $CaCl_2$ 2%)

Effects of post-harvest pre-cooling processes and cyclical heat treatment on the PLW%, pectin content and firmness of "Crest Heaven Peaches" under ambient and low temperature storage condition

Post Harvest management of temperate fruits for storage and value added products

Evaluation of cherry varieties for quality and storage potential

Fruits of four varieties of cherry i.e. Mishri (Bigarreau Noir Grossa), Double (Bigarreau Napoleon), Awal No. and Stella harvested at optimum maturity stage were studied for quality parameters and storage potential. Maximum TSS was recorded in var. Mishri (Bigarreau Noir Grossa) (19.2° B) and in Stella. (15.5° B) while maximum fruit firmness was recorded in variety Stella (16.5)

Fruits of different varieties of cherry at optimum maturity stage were washed in chlorine water, dried and packed in 250 g capacity of CFB boxes of 3 micron thickness and stored at room temperature and low temperature (5° C) and 85 % RH. Studies conducted up to 24 days of storage reveal that minimum shelf life of all the varieties was extended when stored at low temperature; however maximum shelf life of 28-30 days was recorded in case of variety Double when stored at low temperature without quality deterioration and loss of appeal 10-12 days when stored at room temperature.

Evaluation of apricot varieties developed at CITH for storage potential

Three varieties of apricot developed/released by CITH were evaluated for quality parameters for storage and processing potential. The results revealed that maximum size fruits were recorded of variety

CITH- A-1 (76.7 g) followed by CITH- A- 2 (59.6 g). Maximum TSS (15.9° B) was recorded in variety CITH- A-1 followed by CITH- A-2 (13.7° B). Maximum firmness of fruits was recorded in variety CITH- A-1 (23.3) followed by CITH- A-2 (21.9). Ascorbic content were found highest in CITH-A-3(9.80 mg/100g). After 29 days of storage at low temperature minimum PLW % was in CITH-A- 1 (5.25) and maximum in CITH -A- 3 (7.32) where as maximum fruit firmness was recorded in CITH 2 (19.0) closely followed by CITH- A-1 (17.0) and minimum in CITH-A- 3 (14.4).

Varietal evaluation of peach for storage

Two commercial varieties of peach i.e. Red Globe and Gloheaven were evaluated for quality characteristics and shelf life and storage. Fruits of these two varieties at proper maturity were harvested washed and evaluated for quality parameters. Fruits of variety Red Globe were found to contain maximum TSS 75.4 °B where as it was 8.0 °B in Glow Heaven. Maximum firmness of fruits was also recorded more in fruits of variety Red Globe (52.9) where as it was 37.6 in case of Gloheaven. Storage study revealed that fruits of variety Red Globe and Gloheaven can be stored up to 15 days at room temperature. When compared for quality parameters and their retention it was found that fruits of variety Red Globe showed least PLW. At low temperature the fruits of Red Globe can be stored up to 30-32 days and that of Gloheaven for 27-28 days with minimum PLW, maximum retention of firmness, appeal and nutrients.

Product Diversification of underutilized temperate fruit crops

Product diversification process technology was developed for making novel value added products of Cape gooseberry. During the period of investigation technology was developed, refined and standardized for making cape gooseberry jam, sauces, osmo dehydrated products having excellent taste, aroma, and appeal and over all acceptability for consumers. Processing technology was developed for making value added products like Jelly, jam and osmo dehydrated products. Processing of mulberry for making value added products was also initiated but the technology would be refined this year for giving it a novel touch for colour, taste and appeal. In addition to development technology for processing, steps were taken for safe packaging of these products for quality maintenance and long shelf life.

Value added products of mulberry

Value added products of wild cherry

Value addition, storage and sensory quality evaluation of different products from major and minor temperate fruits

Among the different treatments comprising malta juice and ginger, the squash prepared from malta (20%) and ginger (5%) was found best at the time of preparation and after three months storage . The acidity, ascorbic acid and reducing sugars were found to reduce whereas the total soluble solids and total sugars increased during storage of the products. Further, products prepared by blending major and minor temperate fruit juices viz., rhododendron, *kapha*l, *kilmora*, *galgal* and ginger in different ratios revealed the best squash prepared from rhododendron (15%) + *galgal* (5%) + ginger (5%) among various combinations (Table 73). The apricot available locally was evaluated for various physico-chemical characteristics and it was found that the local varieties are not suitable for drying as the TSS was found very low.

Enhancement of shelf life of different temperate fruits through post harvest chemical interventions

The different cultivars of peach like FLA-16-33, Flordaking, Canter and Flordasun were treated with salicylic acid @400 ppm, Ca-EDTA @ 500 ppm with control (water dip) and stored at ambient conditions. It was found that the fruits treated with bio-regulators had significantly better firmness throughout the storage as compared to control. Further, Red June cultivar of peach from different locations was also evaluated for various physico-chemical characters and it was found that there is significant difference in various characters because of altitude.

The storage study of three cultivars of apple *viz.*, Fanny, Golden Delicious, Vance Delicious after treating with salicylic acid (200ppm) and calcium (0.4%) along with control was also carried out. Among the treatments Ca treated fruits had better storage life as compared to others and among the varieties Fenny was found the best (Table 73). Similarly, storage study of pear at ambient conditions comprising six cultivars after treating with salicylic acid and calcium was also undertaken. The fruits treated with Ca had better shelf life as compared to other treatments. Similarly, among different cultivars under the study revealed Sand pear the best for storage followed by Gola and Kakria Table 74). The plum cultivar Santa Rosa was also treated with the bio-regulators and the storage study at ambient and low temperature showed that there is significant reduction in TSS, acidity, ascorbic acid, sugars and PLW in all the treatments. At ambient conditions the fruit can be stored for 20 days by treating either with salicylic acid or calcium whereas the shelf life was more than 40 days at low temperature.

Table 73. Physico-chemical characters of different blended squashes at ambient conditions (6 months)

Character	Treatments									
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}
TSS (°B)	46.8	44.0	46.0	47.2	48.6	47.2	46.2	46.4	46.6	46.2
Acidity (%)	0.325	0.320	0.440	0.330	0.750	0.635	0.125	0.320	1.655	1.302
Ascorbic acid (mg/100g)	4.0	6.5	6.0	6.5	4.0	6.0	4.0	4.0	11.0	8.5
Reducing sugars (%)	1.54	2.35	5.85	2.95	4.57	3.75	1.80	1.90	3.92	7.84
Total sugars (%)	41.50	40.00	40.20	42.00	43.00	41.60	40.10	41.00	41.02	40.15
Total antioxidants (mMTE/L)	9.125	8.165	9.254	7.520	6.455	5.650	4.025	3.045	1.205	1.405
TSS acid ratio	144.00	137.50	105.54	143.03	64.80	74.33	369.60	145.00	28.16	35.48

Table 74. Effect of salicylic acid and calcium on total antioxidants (mMTE/L) of different varieties of apple during storage

Treatment	Storage period (Days)						
	0	10	20	30	40	50	60
T_1	10.515	10.490	10.368	10.220	10.012	9.791	9.509
T_2	10.520	10.454	10.306	10.147	9.938	9.693	9.386
T_3	10.515	10.392	10.270	10.110	9.816	9.595	9.263
T_4	8.614	8.589	8.466	8.343	8.159	7.926	7.730
T_5	8.620	8.539	8.404	8.270	8.074	7.853	7.607
T_6	8.610	8.490	8.380	8.221	7.975	7.791	7.485
T_7	6.895	6.846	6.711	6.564	6.380	6.196	6.012
T_8	6.890	6.809	6.662	6.503	6.319	6.073	5.890
T_9	6.900	6.724	6.601	6.454	6.258	5.950	5.767
CD (5%)	*0.0065*	*0.0052*	*0.0038*	*0.0041*	*0.0038*	*0.0051*	*0.0058*

T_1= Fenny 200 ppm Salicylic acid, T_2= Fenny 0.4% Ca-EDTA, T_3= Fenny control, T_4= Golden Delicious 200 ppm Salicylic acid, T_5= Golden Delicious 0.4% Ca-EDTA, T_6= Golden Delicious control, T_7= Vance Delicious 200 ppm Salicylic acid, T_8= Vance Delicious 0.4% Ca-EDTA, T_9= Vance Delicious control

1st Annual Group Meeting of AINRP on Temperate Fruit Crops

1st Annual Group Meeting of All India Network Project on Outreach of Technologies for Temperate Fruit Crops was organized by Central Institute of Temperate Horticulture, Srinagar from 26-27th March, 2012. Prof. Tej Partap, Vice Chancellor SKUAST-K, was the chief guest of the inaugural function and Prof. A.R. Trag, Vice Chancellor, Islamic University of Science and Technology, Awantipora, presided over the function. Dr. Jag Mohan Singh Chauhan, Ex -Vice Chancellor, Dr. YSPUHF, Solan and Dr. A.A. Sofi, Ex-Director, CITH, Srinagar, were the guest of honour. Sh. Mohd. Rafi, District Development Commissioner, Budgam and Sh. Farooq Ahmad Lone, Director of Agriculture, Kashmir were present on the occasion.

Prof. Nazeer Ahmed, Director, CITH while presenting report briefed the participants about the role of the network project in the development of temperate horticulture in the country and said to promote, horticulture sector in temperate region, Indian Council of Agricultural Research approved the AINRP on outreach of technologies for temperate fruit crops as plan project of CITH during 11th plan. A total six projects were formulated and implementd up by the Institute at 8 network centers under different agro-climatic conditions besides making brief presentations on activites and achievements of different centers.

Inaugural Function of 1st AINRP Group Meeting of Temperate Fruits

IVRC meeting in progress during AINRP group meeting

IRC meeting

Institute Research Council meeting was held on 16th Aug. 2011. Project wise presentations were made by all the scientists. The salient achievements along with the activities to be taken up next year were presented. Prof. N. Ahmed, Director, CITH who is also chairman of IRC, gave critical inputs on experimentation for obtaining realistic and reproducible results. New projects were proposed, which were also approved by the house.

IRC meeting in progress

9th Research Advisory Committee Meeting

The 9th RAC meeting was held on 27th August, 2011 at main campus, Srinagar under the Chairmanship of Dr Jagmohan Singh Chauhan, Former Vice Chancellor, Dr. Y.S. Parmar University of Horticulture & Forestry, Solan (HP). The other members of RAC who attended the meeting were Dr. S. N. Pandey, Ex-ADG(Hort.), ICAR, New Delhi, Dr. D.P. Singh, Ex. ADG (VC), ICAR, New Delhi, Dr. N. Kumar, Dean (Hort.) TNAU, Coimbatore, Tamil Nadu, Dr. J. Kumar, Dean, College of Agriculture, G.B. Pant Univ. of Agril. and Tech. Pant Nagar, Uttarakhand, Dr. A.K. Dhawan, Ex. Prof. & Head, Div. of Entomology PAU, Ludhiana, Punjab, Dr. S. Rajan, Asstt. Director General (Hort.I), ICAR, Prof. Nazeer Ahmed, Director CITH and Dr. D.B. Singh, Pr. Scientist (Vegetable Science) and Member Secretary RAC, CITH. The Committee visited the experimental farm and laboratories, and had detailed discussion and interactions with the scientists and suggested several recommendations after reviewing all the ongoing projects.

RAC meeting in progress

Hon'ble memebers of RAC inetasrcting with scientists

ICAR Inter-Institutional Sports Meet

Ten participants from CITH including Chief De-Mission, Mr Ramesh Kumar, Scientist, participated in ICAR Inter-Institutional Sports Meet-North Zone held at CSWCRTI, Dehradun from 18-21st April, 2011. All the participants took part in different games and obtained 4th position in 800 M and relay race. Besides that participants also qualified for final round of 100, 200, 400 m race and carrom.

CITH sports team at Inter-Institutional Sports Meet-North Zone, Dehradun

Hindi week

At main campus as well as regional station, celebrated Hindi Week from 14-20th Sept., 2011 to promote and implement national language in the institution. On this occasion 7 competitions were organized. All the staff members of the main campus and Regional Station participated in the competitions during Hindi Week.

Vigilance week

Institute observed Vigilance week from 31st Oct. to 5th November 2011 in which staff members were sensitized on role of vigilance and taken oath for working sincerely and honestly.

CITH staff observing vigilance awareness week

Review meeting

To review the progress of various projects, a review metting on "Horticulture Technology Mission (MM 1 Research) was held on under the chairmanship of Nodal Officer and Director, CITH, Prof. N. Ahmed.

Horticulture technology mission meeting (MM 1 Research) in progress

Parthenium awareness week

Observed Parthenium awareness week during 16th-22nd Aug. , 2011 at RS, Mukteshwar for creating awareness among the farmers about health hazards and harmful effect caused by this weed.

Seminar organized

National Seminar in collaboration with NRC for Seed Spices, Ajmer on "Enhancing area, production and productivity of seed spices in temperate regions of J&K was organized from 2-3rd Dec., 2011.

Inaugural session of seminar

Stake holders meet

"Stake holders meeting and workshop on Importance of DUS Testing and Farmers Right" was

Gathering in stake holders meeting and workshop on importance of DUS testing and farmers rights

held at CITH, Srinagar on 19th Nov. 2011, in which about 50 stake holders participated who gave valueable inputs and feedback for 12th plan prepration.

Media and press meet

Media personals of North India visited the institute and interacted with scientists and discussed about the technologies developed at this institute.

Director, CITH intracting with media personals about CITH technologies

During the period more than 4000 orchardists/ farmers from different parts of J&K and Uttarakhand visited the main campus and regional station, along with officers from development departments. They were taken around the experimental farms and other units and demonstrated various technologies being developed in walnut, apple, almond, apricot, saffron, high value vegetables and cut flowers. They were also provided bud wood, planting material and seeds of elite varieties for popularization.

On farm, 122 field demonstrations as detailed in Table 75 were laid out at different farmers field to demonstrated the varieties and technologies whose performance was very good and they are being slowly accepted by farmers and demand for such demonstrations is increasing. Besides this, trainings were also provided to farmers and extension officers on various technologies not only of J&K state but also to officers from other temperate states on scientific cultivation of temperate horticultural crops for higher production and farm income (Table 76).

Table 75. List of demonstration laid at farmers field for popularization and adoption of technologies

S. No.	Name of the project	No. of demons-tration
1.	Demonstartion of newly identified and released varieties of walnut, apricot, almond and apple	8
2.	Rain water harvesting and moisture conservation	13
3.	High density plantation of almond for higher productivity	3
4.	Pollination management in apple and almond	5
5.	Refinement and demonstration of high density plantation on clonal rootstock for higher apple productivity	6
6.	Standardization of technology for rejuvenation of old and unproductive almond orchards in Kashmir valley	10
7.	Low cost poly house walnut propagation	10
8.	Production of high value vegetable	15
9.	Protected cultivation of vegetable	30
10.	Minikit trial of new onion variety	7
11.	Popularization of kiwifruit for under crop diversification	5
12.	Saffron corm rot management	5
13.	Chilli wilt management	5
	Total	122

Regional Station, Mukteshwar participated in farmer's fair organized by VPKAS, Almora 24th Sept., 2011 and March 2012 at Habalbagh where exhibits of various activities were put along with farm produce for sale.

Major Trainings

Training on intensive production technology in saffron for higher productivity

A three day programme was organized by CITH, Srinagar on "Intensive Production Technology in Saffron for Higher productivity" from 28 – 30th Oct.,

Jenab Ghulam Hassan Mir, Hon'ble Minister for Agriculture, J&K State releasing manual on intensive saffron production technology

2011. In the training 32 agri./ horticulture Officer/ progressive farmers participated from different districts of Jammu and Kashmir divisions. In the training programme various lectures were delivered by the resource persons covering different aspects of saffron growing viz., present status and scope, micro irrigation, intercropping, IPDM, INM, IWM, mechanization , tissue culture and post harvest technology and value addition along with practical in laboratory and field. Jenab G.H. Mir, Hon'ble Minister for Agriculture, J&K state was the chief guest for valedictory function.

Training on agricultural marketing, prospects and challenges

Three days training programme in collaboration of CCS National Institute of Agricultural Marketing, Jaipur, focused on "Agricultural marketing, prospects and challenges" to 25 Horticultural Officers of J&K was organized from 11-13th Oct., 2011 at CITH Srinagar. Jenab Shyam Lal Sharma , Minister for Health, Floriculture and Horticulture, J&K was the chief guest for valedictory function.

Hon'ble Minister and dignitories interacting with officers during valedictory function

Table 76. Training programme conducted during the year 2011- 12

Dated	Title	Number of participants
27-12-2011	Technique of training and pruning in temperate fruits	35
27-12-2011	Brain storming workshop on protection of plant varieties and farmers right authority	35
28-12-2012	Brain storming workshop on protection of plant varieties and farmers right in temperate zone of Arunachal Pradesh	34
29-12-2011	Training programme on pruning and training of young orchards of apple	34
30-12-2011	Grafting/ budding in walnut, layering of malling rootstocks	30
10-08-2011	Two days programme on budding techniques in temperate fruit crops	13
11-08-2011	Two days programme on budding techniques in temperate fruit crops	20
12-08-2012	Training on budding techniques of temperate fruit crops	05
2-4-2011	Diversification of high value vegetable crops for enhancing socio-economic status of farmers	20
4-4-2011	Protected cultivation of high value vegetable crops	55
8-10-4-2011	Cultivation of high value vegetables and propagation techniques of walnut under zero energy poly house	50
9-9-2011	*Insitu* moisture conservation techniques in almond and apple	48
10-9-2011	*Insitu* moisture conservation techniques in almond and apple	50
26-7-2011	Processing of temperate fruits for value added products	50
28-29-9-2011	Product diversification of temperate fruits and diversification of temperate exotic vegetables	70
28-30-10-2011	Intensive production technology in saffron for higher productivity	32
11-13-10-2011	Agricultural marketing prospects and challenges	25
7-14-2-2012	Plant architectural engineering for higher energy harvest in temperate fruits	45
5-9-2012	Propagation techniques in walnut	50
9-9-2012	Propagation techniques in walnut Kishtwar	50
10-9-2012	Propagation techniques in walnut Doda	50
5-7-2012	Onion day	15
8-9-2011	Vegetable growing for employment	50
21-12-2012	Enhancing area, products and productivity of seed/ spices in temperate region	50
22-3-2012	Orchard management in temperate fruits	24

Training on *In situ* moisture conservation techniques in almond and apple in Kishtwar and Doda Districts of Jammu region.

Training on product diversification of temperate fruits

Hon'ble Union Minister of State for Agriculture & Food Processing Industries, GOI, Sh Harish Rawat visited the CITH stall during Horti-Expo 2011 at Dehradun

Training on low cost walnut propagation

Training of farmers and officers of horticulture department of Arunachal Pradesh


Training for farmers on vegetative propagation of walnut at CITH, Srinagar


Training for farmers on growing of high value vegetables


Training for unemployed youth for round the year vegetable production and walnut propagation

Training to nursery growers on budding

Training/awareness of farmers for rejuvenation technique in almond

Special trainings and visits arranged

- Visit & trainings to progressive farmers of Kodaikanal, Tamilnadu was organized on 22nd July, 2011 and given information on cultivation of temperate fruits in the region and suggested possibility of growing temperate fruits in Kodaikanal.
- Farmers from West Bengal visited the regional Station on 6th April, 2011 who were apprised about different aspects of production technologies of temperate horticultural crops.
- Regional Station organized exposure visit of 20 Master farmers to Bio Life Foods Pvt. Ltd., Talla Ramgarh along with HPPI on 6th Aug., 2011 where vegetable freezing and storage was shown.
- Farmers (10 farmers +1 HEO) from Solan area of H.P. visited the Institute on 16th June, 2011 who were taken around field and shown various activities of temperate horticulture.
- Students of BSc. III year(Agriculture) from SKUAST-J(13 girl+12boys+2teacher) visited institute on 8th July, 2011 who were apprised and shown various R&D activities of the institute.
- Students of BSc.II year(Agriculture) From SKUAST-J (21 students+ 2 teacher) visited institute on 27th July, 2011 who were apprised and shown various R&D activities.
- Farmers from Distt. Leh (20 farmers +1 Officer) under ATMA visited CITH on 5th Nov., 2011 who were shown various technological developments and new varieties developed by the institute.
- Farmers and officers from Afghanistan (29 No.) visited CITH who were given profile of activities being carried out in temperate horticulture in the country.

Scientists interacting with farmers, students and entrepreneurs

Awards and Recognitions

Prof. Nazeer Ahmed

- Awarded, Fellow, ISHRD for significant contribution to horticultural research and development in temperate region
- Received 1st Prize for research Paper entitled" Performance of some elite walnut genotypes in Jammu and Kashmir (National Seminar, PAU Ludhiana)
- Received 1st Prize for research Paper entitled" Weed Management Studies in Onion (National Seminar, PAU Ludhiana)
- Honoured as Chief Editor, Indian Horticulture Journal, Indian Society of Advanced Horticulture, Awantipora
- Received certificate of accreditation and four Star rating to CITH nursery by NHB for quality and disease free planting material production.
- Received certificate of appreciation to CITH in recognition of outstanding performance as best DUS Project Centre-2011
- Serving as Member Programme Planning and Policy Committee, PPV & FRA, New Delhi
- Acted as Member, Board of Management, CSHPKV, Palampur H.P.
- Chaired, Technical Session II, 2nd Annual group Meeting, AINRP, Onion and Garlic, Ooty, TNAU, Coimbatore, April 2012
- Chaired, Technical Session VIII for Review of DUS Project for Tree Spices, Fruits and others, PPV & FRA New Delhi, 11-12 November, 2011
- Chaired, Technical Session 1. Theme: Mountain Agriculture in Transition–Challenges and way forward. 1st Jammu & Kashmir Agricultural Science Congress, SKUAST-K, Srinagar, 2011
- Acted as Chairman, Organizing Committee, 1st Annual Group Meeting of AINRP on "Outreach of Technologies in Temperate Fruits -2012, CITH, Srinagar

Prof. Ahmed receiving ISHRD, Fellow from Sh. Harish Rawat, Hon'ble Union Minister of State for Agriculture & Food Processing Industries, GOI

- Aced as a Member Technical Session V, Horticultural Crops, 5th Annual Review Meeting of ICAR Niche Area of Excellence, CSKHPKV, Palampur
- Served as Member National Steering Committee, National Symposium on Technological Interventions for Sustainable Agriculture, GBPUA&T Ranichauri, Uttarakhand, May 2011
- Chaired, Technical Session-V Emerging issues and challenges in conservation Horticulture. National symposium on Conservation Horticulture, GBPUAT, Dehradun, 2011
- Chaired, Technical Session II, Collection, evaluation & conservation of germplasm. All India Coordinated Research Project on Vegetable Crops-XXX Group Meeting at GBPUA&T, Pantnagar 2012
- Chaired, Technical Session VIII, Resistant Varietal Trials. All India Coordinated Research Project on Vegetable Crops-XXX Group Meeting held at GBPUA&T, Pantnagar, 2012

Dr. D.B. Singh (Pr. Scientist)

- Awarded ISAE Team Award 2011-2012 for development of pomegranate aril extractor given by Indian Society of Agricultural Engineers.

Dr. Dinesh Kumar (Pr. Scientist)

- Received appreciation certificate from PPV& FRA for outstanding DUS project centre for the year 2011.

Dr. K.K. Srivastava (Sr. Scientist)

- Awarded "Young Scientist Associate Award-2012, by Bioved Research Institute of Agriculture and Technology" in 14th Indian Agriculture Scientists and Farmers Congress on 18th February, 2012, University of Allahabad.

Dr. S.R. Singh (Sr. Scientist)

- Received two best paper presentation awards in National Seminar on New Frontier and Future Challenges in Horticultural Crops. Held at PAU Ludhiana from 15to 17 March-2012.
- Received appreciation certificate from PPV & FRA as best DUS centre award.

Dr. O.C. Sharma (Sr. Scientist)

- Received "Outstanding Professional Award 2010" by Indian Society of Hill Agriculture (ISHA) on 3rd May, 2011in National Symposiumon Technological Interventions for Sustainable Agriculture held at Ranichauri organized by GBPUAT and ISHA,Ranichauri, Uttarakhand.

Dr. D.B. Singh receiving award during function

- Awarded "Founder Fellow of ISHA (2010)" by Indian Society of Hill Agriculture (ISHA) on 3rd May,2011in National Symposium on Technological Interventions for Sustainable Agriculture held at Ranichauri organized by GBPUAT and ISHA, Ranichauri, Uttarakhand.

Dr. B. Das (Sr. Scientist)

- Received certificate of appreciation as Co-PI for the award under the DUS project 'Best Project Centre for the year 2011 for the project Validation of DUS International Guideline under Indian condition for apple and pear by PPV and FRA.
- Received letter of appreciation during 2011 from Hon'ble Deputy Director General (Horticulture) based on the Scientist Progress Monitoring System and recommendation by the Director, CITH.

List of Publications

A) Research publications (International/ National)

Ahmed, N., Mir J. I., Mir, R. R., Rather N., Rizwan R., Wani, S. H., Shafi, W., Mir, H. and Sheikh, M. A. (2012). SSR and RAPD analysis of genetic diversity in walnut (*Juglans regia* L.) genotypes from Jammu and Kashmir, India *Physiology and Molecular Biology* 2: 149-160.

Das, B., Krishna, H., Attri, B.L., Ahmed, N. and Ranjan, J.K. (2011). Harvest maturity standards and fruit quality of some apple cultivars under high altitudal conditions. *Indian J. Hort.* 68 (2): 170-179.

Das, B., Ahmad, N., Srivastava, K. K., Ranjan, P. (2011). Top working method and bloom density of pollinizers as productive determinant for spur type apple (*Malus* x *domestica* Borkh.) cultivars. *Scientia Horticulturae* 129: 642–648.

Krishna, H., Das, B., Attri, B.L., Kumar, A. and Ahmed, N. (2011). Interaction between different pre and postharvest treatments on shelf life extension of 'Oregon Spur' apple. *Fruits* 67 (1): 31-40.

Lal, S., Ahmed, N. and Mir, J.I. (2011). Physiological studies on cracking phenomena of pomegranates under temperate condition. *Indian J. Plant Physiology* 16 (3-4): 326-330.

Lal, S., Kumar, D., Singh. D.B, Ahmed, N., Kumar, R. and Dar G.A. (2011). Effect of pre harvest application of calcium chloride and gibberellic acid on shelf life and post harvest quality of apricot (*Prunus armeniaca* L.) cv. Harcot. *Journal of Hort. Sciences. 6* (1): 46- 51.

Lal, S., Singh, D.B., Ahmed, N., Kumar, R. and Pal. A. (2011). Effect of storage temperature and duration on shelf life and quality of pomegranate fruit. *International Journal of Agricultural Sciences* 7 (1): 187-192.

Mir, J.I., Ahmed, N., Itoo, H., Sheikh, M. A., Rashid R. and Wani, S. H. (2012) *In vitro* propagation of Lilium (*L. longiflorum*) - a high value commercial cut flower *Indian Journal of Agricultural Sciences* 82: 455–8.

Mir, J.I., Ahmed, N., Rashid, R., Wani, S. H., Sheikh, M. A., Mir, H, Parveen, I and Shah, S. (2012). Genetic diversity analysis in apricot (*Prunus armeniaca* L.) germplasms using RAPD markers. *Journal of Biotechnology* 11:87-190.

Singh, D.B, Attri. B.L. and Singh, C. (2012). Underutilized fruit crops of Andaman: Its Biodiversity and role in environmental conservation and nutritional security. *Indian Forester* 138 (1): 27-30.

Singh, D.B., Singh, R., Kingsly. A.R.P. (2011). Effect of *Aloe vera* coatings on fruit quality and storability of strawberry (*Fragaria x ananassa*). *Indian Journal of Agricultural Sciences* 81 (5):407-412.

Singh, D.B., Attri, B.L. and Singh, C. (2012). Under-utilized fruit crops of Andaman: Its bio-diversity and role in environmental conservation and nutritional security. *Indian Forester* 138 (1): 27-30.

Singh, D.B., Lal. S, Ahmed. N, Qureshi. S.N. and Pal. A.A. 2011. Screening of cape Goose berry (*Physalis peruviana*) collections for adaptation under temperate ecosystem. *Progressive Hort.* 43 (2): 211-214.

Singh, D. B. 2012. Evaluation and characterization of pomegranate under arid ecosystem. *Indian J. Plant Genetic Resources* 25 (2): 139-145.

Singh, S.R., Mir, J.I., Ahmed, N., Sashid, N., Wani, S., Shiekh, S.H, Mohiudin, H., Shafi, W., Jan, N. and Mir, H. (2011). RAPD profile based grouping of garlic (*Allium sativum L.*) germplasm with respect photoperiodism. *Journal of tropical Agriculture* 49: (1-2)114-117.

Srivastava, K.K., Das, B., Ahmad, N., Singh, S.R., Rather , J.A. and Bhat, S.K. (2011). Correlation and co-heritability studies of yield and yield associating characters in apple. *Indian Journal of Agricultural Sciences* 82 (3): 270-276.

Srivastava, K.K., Sharma, M.K. and Bhat. S.K (2012). Quality attributes of promising apricot (*Prunus armeniaca* L.) introductions from North-Western. Himalayan region. *Indian Journal of Agricultural Sciences* 83 (1): 78-80.

B) Scientific/teaching reviews

Das, B., Ahmed, N. and Singh, P. (2011). *Prunus* diversity- early and present development: A review. *International Journal of Biodiversity and Conservation* 3 (14): 721-734.

Krishna, H., Ahmed, N., Attri, B.L., Kumar, A. Ranjan, P. and Ranjan, J.K. (2011). Sharka in plums: Diagnostics and management. *Archives of Phytopathology and Plant Protection* 45 (2): 170-191.

C) Extension folders/ Bulletins/ Popular Articles

Ahmad, N., Srivastava, K.K., Lal. S. and Kumar R. (2011). Global Warming carved niche for quality apple production. *Indian Horticulture* 56 (1): 9-10.

Attri, B.L., Tripathi, A.N. and Bist, P.S. (2011). Soilless media for vegetable fruit sapling production under greenhouse. *Agrobios Newsletter*, X (7):39-41.

Das, B., Ahmed, N. and Attri, B.L. (2012). Management of European Red mite in apple orchards. CITH-RS, Mukteshwar, Technical Bulletin: 06.

Das, B., Ahmed, N. and Attri, B.L. (2012). Integrated nutrient management for spur type apple cultivars. CITH-RS, Mukteshwar, Technical Bulletin: 10.

Das, B., Ahmed, N. and Attri, B.L. (2012). Pollination management in apple orchard. CITH-RS, Mukteshwar, Technical Bulletin: 07.

Das, B., Attri, B.L. and Ahmed, N. (2012). Chip budding: a highly successful all time propagation method for temperate fruit crops. CITH-RS, Mukteshwar, Technical Bulletin: 09.

Das, B., Attri, B.L. and Ahmed, N. (2012). Harvest maturity standards for apple cultivars. CITH-RS, Mukteshwar, Technical Bulletin: 08.

Kumar, D., Ahmed N. and Srivastava K. K. (2012). Almond productivity enhanced under Karewa lands of Kashmir. *ICAR News* 18(1):7.

Kumar, R., Ahmed, N., Lal, S. and Bhatt, A.B. (2011). Mahakate phoolon ka garh–Jammu Kashmir. *Phal Phool*, March –April : 3-6.

Kumar, D., Ahmed N., Verma, R.K. Singh, D.B., Dar, G.A. and Ahmed, T. (2011). *Khubani:Ek Intihayi Amdan Bakhash Fasal (Urdu)*. Published by Director, CITH Srinagar.

Lal, S., Ahmed, N., Verma, R.K., Srivastava, K.K. , Mahinderan, G. and Kumar, R. (2011). *Ak anar aay hajar. Phal Phool*, July-August: 19-21.

Ranjan, P., Attri. B.L., Ranjan, J.K., Das, B., Krishna, H. and Ahmed, N. (2011). Alstroemeria in Kumaon Hills for prosperity. *Indian Hort.* 56 (1): 20-21.

Singh, D.B. and Patil, R.T. (2011). Novel value added products from wild pomegranate. *ICAR News* 17 (1):11-12.

Singh, D. B., Ahmed, N., Kumar. D. and Lal S. (2011). Apricot Fruit Bar. *ICAR News* 17 (4): 14-15.

Singh, D. B (2011). Value added pomegranate products to enrich farmers. *Indian Horticulture*, Jan.-Feb :15-18.

Singh, S. R., Ahmed, N, Lal, S., Quari, S. and Srivatava, K.K. (2012). Kale :a wonder leafy vegetable. *Science India* 15 (1) : 41-47.

Singh, S. R., Ahmed, N., Hayat, S. and Shagoo, P.A. (2011) *Akhrot ki Chasmkari and Paiband Kari*. Published by Director, CITH Srinagar.

Singh, S.R., Ahmad, N., Quqri S., Jan N. and Srivastava, K.K. (2011) Globe artichoke- a nutritious vegetable for health. *Indian Horticulture* 56 (2): 25-26.

Singh, S.R., Ahmad, N., Hayat, S., Srivastava, K.K., Kumar, D. and Lal, S. (2012). Practical manual on training and pruning of temperate fruit crops. Published by Director, CITH Srinagar.

Srivastava, K.K., Ahmed, N., Singh, D.B. and Bhat, S.K.. (2012). *Purane aur kam fasal bagoi ke liye*

rejuvenation ek nayab tarika. (Urdu). Published by Director, CITH Srinagar.

Srivastava, K.K., Ahmad, N., Kumar, D., Lal. S., Verma, R.K., Bhat, S.K., (2011). Rejuvenation A promising technique of reviving almond orchards. Published by Director, CITH Srinagar.

Srivastava, K.K., Ahmad, N., Rather, J.A. and Bhat, S.K., (2012). Protection of plant varieties and farmer's rights authority , MOA, GoI, *Darkhton Ke Tahafuz and Kisano ke Hokok* (Urdu). Published by Director, CITH Srinagar.

Srivastava, K.K., Ahmed, N., Singh, S.R., Kumar, D., Lal, S., Verma, R.K. and Bhat, S.K. (2011). *Cherry Ki Vaigyanik Kheti* (Hindi). Published by Director, CITH Srinagar.

Srivastava, K.K., Kumar, D., Ahmad, N., Bhat, S.K. (2012). *Badam ke Purane Bagon Ka Zirondhar* (Hindi). Published by Director, CITH Srinagar.

Srivastava, K.K., Sundouri, A.S., Sharma , M.K. and Singh, S.R. (2011). Opening new avenues for nectarine peach. *Indian Horticulture* 56 (1): 19-21.

Srivastava, S.K., Attri, B.L., Sahoo, L.P., Arya, M.P.S. and Behera, B.C. (2012). Empowering farmwomen in eco-friendly pest management of vegetables. DRWA, Bhubaneswar, Technical Bulletin: 19, 30 p.

Kumar, A., and Attri, B.L. (2011). Mashroom Jaley main Ramvan (2011). *Amar Ujala*, 6, Oct: 4.

Attri, B.L. and Ahmed, N. (2012). *Gramin Khetihar Mahilao Ke liye Bahuupyogi Sunya Urja Chalit Shitkaksh*. Published by Director, CITH Srinagar.

D) Book

Das, B., Ahmed, N., Attri, B.L. and Singh, P. (2012). Production of quality and elite planting material of temperate fruit crops. Published by Director, CITH Srinagar, 150 p.

E) Book Chapters

Singh, D.B. (2012). Utilization of co-products of horticultural crops and its impact on Environment. *In*: Food Processing Technology, published by CIPHET, Ludhiana. pp 277-289.

Singh, S.R. and Sharma, M.K. (2011). Orchard soil management. *In*: The Pear, Production, Post – Harvest Management and Protection. (Eds. R.M. Sharma, S.N. Panday and V. Panday) IBDC. Publishers, Lucknow, pp 225-232.

Srivastava, K.K., Sharma, A.K., Singh, S.R. and Sharma, M.K. (2011). Canopy Management. *In*: The Pear, Production, Post–Harvest Management and Protection. (Eds. R.M. Sharma, S.N. Panday and V Panday) IBDC. Publishers Lucknow pp 225-232.

F) Lead Papers in Conferences/symposia/seminars/ abstracts

Ahmed, N., Singh, D. B. and Pal, A.A. (2011). Marketing and export of temperate fruits. Lead paper presented during Swadesh Prem Jagriti Sanghoshti 2011 and National Seminar on Horti Business-Linking farmers with Market. May 28-31. Dehradun. Uttarakhand.

Ahmed, N., Singh, S.R., Lal, S. and Hayat, S. (2011) Under utilized horticultural crops of northern Himalayan states. Souvenir of National seminar on developing the potential of under utilized horticultural crops of hill region held at Imphal from 14-16 Feb-2011, pp 18-27.

Ahmed, N., Singh, S. R., Mir , H., Bakshi, Meghana and Shagoo, P. (2012). Performances of some walnut genotypes in Jammu and Kashmir. National seminar on New Frontiers and Future Challenges in Horticultural Crops (NFFCHC-2012). pp 4.

Das, B., Ahmed, N. and Attri, B.L. (2011). Budwood bank establishment and propagation methods for quality of planting material production of temperate fruits. Abstract book of National Conference on Horti-Business Linking Farmers with Market held at Dehradun w.e.f. 28-31 May, 2011. Abstract No. TS 11: P-18, pp 128-129.

Kumar, D. and Ahmed, N. (2011). Impact, adaptation and mitigation strategies for rainfed almond production in India. National Symposium on Technological Intervention for Sustainable Agriculture at GBPUAT & ISHA, Hill Campus, Ranchauri, Uttrakhand, May 3-5th, 2011.

Kumar, D. and Ahmed, N. (2012). Water stresses and their management in fruit crops. Lead lecture in National Seminar on New Frontiers and Future Challenges in Horticultural Crops at PAU, Ludhiana March, 15-17th, 2012.

Singh, D.B. and Kumar, D. (2012). Diversification of Temperate Fruits and their sustainable exploitation. Paper presented during National Seminar on "New Frontiers and future challenges in Horticultural Crops" 15-17th March 2012 held at PAU, Ludhiana.

Singh, S.R., Ahmed, N. and Amin, M. (2012). Studies on population dynamics of onion thrips (*Thrips tabaci*) under long day conditions. National seminar on New Frontiers and Future challenges in Horticultural Crops (NFFCHC-2012). pp 95.

Verma, R.K., Ahmed, N., Andrabi, M and Sharma, N.N. (2012). Bioefficacy of Kresoxim methyl against apple scab (*Venturia inaequalis*) abatement in Kashmir conditions. 3rd Global Conference on Plant Pathology for food security" January 10-13, 2012. Udaipur. p 158.

Verma, R.K., Ahmed, N., Mir, J.I., Verma, M.K., Srivastava. K.K., Mohiuddin, Hina, Rashid, R. and Andrabi, M. (2012). Apple varietal behaviour towards apple mosaic and apple chlorotic leafspot diseases evidenced by immunodiagnostic methods in Kashmir valley. National Seminar on "New Frontiers and Future challenges in Horticultural crops (NFFCHC-2012)". 15-17th March 2012. Punjab Agrl. University, Ludhiana. p 169.

Participation in Workshops/ Conference/Trainings/Meetings

Prof. Nazeer Ahmed, Director, CITH

- Attended meeting of Directors of Horticulture Division, at New Delhi on 11th April, 2011.
- Visited Kodai Kanal and Ooty to monitor and record progress of Network project trials of Outreach Programme of Temperate Fruits on 27 - 28th April, 2011.
- Attended second Annual Group Meeting of AINRP on onion and garlic at TNAU, Coimbatore on 29 - 30th April, 2011
- Attended 5th Annual Review Meeting of ICAR Nich Area of excellence at Palampur on 28th May, 2011.
- Attended Swadesh Prem Jagriti Sangosthi and National Conference on Horti Business Linking Farmers with market at Dehradun from 29 - 31st May, 2011.
- Attended Steering Review Committee Meeting of Mini- Mission-I of Horticulture Mission North East Himalayan States at Shimla on 2 - 3rd June, 2011.
- Attended meeting of "12th plan Working Sub group on Horticulture crops" IARI, New Delhi, 24th June, 2011.
- Participated in Director's Conference at New Delhi on 15 - 16th July, 2011
- Attended meeting of AICRP/Network Project at Krishi Bhawan, New Delhi on 26th July, 2011
- Attended Board of management Meeting of CSKHPV at New Delhi on 27th July, 2011
- Attended NBPGR Workshop at New Delhi from 29 - 31st July, 2011
- Attended training programme on 'Employees perspective on labour related laws' at NAARM, Hyderabad, from 3 - 8th August, 2011
- Attended one day workshop on 'Disposal of appeal under RTI' conducted by ISTM at New Delhi, deputed by ICAR on 19th August, 2011.
- Visited the orchards of Shri Vijay Stokes, a progressive apple grower at Shimla, Kotgarh, Shimla on 3rd Sept., 2011.
- Attended interactive meeting with Hon'ble Agriculture Minister, GOI and moderation work at ASRB, New Delhi on 27 - 28th September, 2011.
- Attended Workshop on Mountain Agriculture at CSWRTI, Dehradun, 2nd April, 2011 and CITH Regional Station, Mukteshwar on 3rd April 2011.
- Attended Directors Meeting of Horticulture Division, NASC, New Delhi, 11th April, 2011.
- Visited Arunachal Pradesh & Sikkim as a member of ICAR Roving Team, 12-19th Sept., 2011.
- Attended interactive meeting with DG ICAR; NASC, New Delhi, 27-28th Sept., 2011.
- Attended DUS Review Meeting at NASC, New Delhi, 11 -12th Nov., 2011.
- Attended Brain Storming Session on Hill Agriculture at VPKAS, Almora, 13-14th Nov., 2011.
- Attended Review Meeting of HTM at SKUAST(J), Jammu, 25-26th Nov., 2011.
- Attended meeting on Network Project on borers at NBAII, Bangalore, 9th Dec., 2011.
- Attended Interaction Meeting with Farmers of HTM projects at Akhnoor, Jammu, 16th Dec., 2011.
- Attended AICRP(VC) Group Meeting, GBPUAT, Pantnagar, 12 - 16th Jan., 2012
- Attended 5th Meeting of the PPV & FRA, NASC, New Delhi, 16th January, 2012.
- Attended National Dialogue on climate change at IIHR, Bangalore, 28-29th January, 2012.

- Attended DUS meeting at PPV & FRA at NASC, New Delhi, 1st Feb., 2012.
- Attended Directors Conference, NASC, New Delhi, 16-18th Feb., 2012.
- Attended meeting on Nanotechnology platform & meeting on "Outreach Programme" for XIIth Plan and meeting Director General, ICAR and Secretary, DAC, NASC, New Delhi, 11-14th March, 2012.

Dr. R. K. Verma (Principal Scientist)

- Attended Project Monitoring Committee Meeting on Apple Network Programme on 17 - 18th June, 2011 at University of Jammu.
- Attended Apple Network Project Meeting on 23rd September, 2011 at IHBT (H.P.).
- Attended "3rd Global Conference on Plant Pathology for food security" at Rajasthan College of Agriculture, M.P. University of Agriculture & Technology on January 10-13th, 2012 at Udaipur.

Dr. D.B. Singh (Principal Scientist)

- Attended training on Science Administration and Research Management for Middle and Senior level Scientists from 5-16th September, 2012 at Administrative Staff College of India, Hyderabad.
- Attended Meeting cum workshop on Towards more effective role of Head of Divisions and Regional Stations held during 14-16th June, 2011 at CIAE, Bhopal.
- Participated in National Workshop on Non Destructive Systems for Quality evaluation of Food' on 9-10th Feb., 2012 at CIPHET, Ludhiana.
- Participated in Horticultural Industry Meet and first Annual Convention on 6th March, 2012 at IIHR, Bangalore.
- Attended National Seminar on Horti Business-Linking farmers with Market organized by Amit Foundation from 28-31st May, 2011 at Dehradun, Uttarakhand.

Dr. Dinesh Kumar (Principal Scientist)

- Attended National Symposium on Technological Interventions for Sustainable Agriculture from 3-5th May, 2011 at GBPUAT, Hill Campus, Ranichauri, Uttarakhand
- Attended AICRP review meeting of Horticulture Division on 25th July, 2011 at New Delhi
- Attended review meeting of DUS project on 11-12th November, 2011 at NASC Complex, New Delhi.
- Attended Conservation Horticulture Plateform meeting on 5th Nov., 2011 at CIAH, Bikaner, Rajasthan.
- Attended sensitization cum training workshop for HYPM Nodal officer on 2nd Feb., 2012 at CIFE, Mumbai.
- Attended National seminar on New Frontiers and Future Challenges in Horticultural crops on 15th March, 2012 at PAU, Ludhiana
- Attended All India Network Group meeting of Outreach of Technologies for Temperate Fruit Crops from 26-27th March, 2012 at CITH, Srinagar

Dr. K.K. Srivastava (Senior Scientist)

- Attended training on Phenotyping and molecular breeding for improving drought adaptive traits in crops" from 13-22nd February, 2011 at Deptt. of Crop Physiology, UAS, Banagalore, Karnataka.
- Attended First meeting of Sub task force constituted for identification of special characteristics in strawberry and peach & plum was held on 1st Feb., 2012 at PPV & FRA, NASC complex, New Delhi.

Dr. S.R. Singh (Senior Scientist)

- Attended All India Networking Research Projects on Onion and Garlic group meeting from 29-31st April, 2011 at TNAU Coimbatore.
- Attended All India Coordinated Research Projects on Vegetable Crops group meeting from-12-16th Jan., 2012 at G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand.

Dr. O.C. Sharma (Senior Scientist)

- Attended Refresher Course on Agricultural Research Management for Directly Recruited Senior / Principal Scientists w.e.f 19th Jan-8th Feb., 2012 at NAARM, Hyderabad.
- Attended National Symposium on Technological Interventions for Sustainable Agriculture organized by GBPAUT and ISHA, from 3 - 5th May, 2011 at Ranichauri, Uttrakhand.

Mr. Shiv Lal (Scientist)

- Attended training programme on Data Analysis using SAS from 1-6th August, , 2011 at NDRI, Karnal.
- Attended training course on Smart Packaging Techniques for Self- Life Enhancement and Retention of Bioactive Compounds in Food from 11-24th October, 2011 at CIPHET, Ludhiana.
- Attended training course on Introduction to GIS and application form 13th Feb. - 9th March, 2012 at National Remote Sensing Center, Hyderabad.
- Attended and participated in ICAR-Industry meets on 23rd May, 2011 at NASC Complex, New Delhi.
- Attended sub-taskforce meetings on DUS on peaces/plum and strawberry on 1st Feb., 2012 organized by PPV&FRA, NASC,Complex, New Delhi.
- Attended User intraction meet -2012 from 16-17th Feb., 2012, organized by NDC, ISRO, NRSC, Hyderabad during training programme at NRSC, Hyderabad.

Mr. Ramesh Kumar

- Attended six days training on Data Analysis Using SAS NAIP consortium for strengthening statistical computing for NARS from 1- 6th Aug. 2011 organized by National Dairy Research Institute, Karnal.
- Attended two days seminar on Enhancing area, production and productivity of seed spices in temperate region of J&K held at CITH, Srinagar from 2 - 3rd December, 2011 jointly organized by CITH, Srinagar and NRCSS, Ajmer.
- Attended the review meeting of Economic Revival of J&K Saffron Sector chaired by Director, DAC, Ministry of Agri., GOI on 1st June, 2011 held at Directorate of Agriculture, Kashmir.

Dr. G. Mahendiran

- Attended National consultation- cum- Training on Diagnostic in Horticultural crops on 16th April, 2011 at CPRI, Shimla.
- Attended National meeting on Agricultural Entomology for the 21st Century: The way forward on 25-26th Aug., 2011 at NBAII, Bangalore.

Mr. Sarvendra Kumar (Scientist)

- Successfully completed four month training (April 2011- August 2011) programme "93rd Foundation Course on Agricultural Research Service (FOCARS)" at National Academy of Agricultural Research Management (NAARM), Hyderabad.
- Attended National Training on Predicting Soil Carbon Sequestration in View of Global Warming and Climate Change from 24th Feb., - 8th March 2012 at NBSSLUP, Nagpur.

Dr. B.L. Attri (Principal Scientist)

- Attended workshop on Hill Agriculture from 2-3rd April, 2011 at CSWCRT&I, Dehradun inaugurated by Hon'able Secretary DARE, Govt. of India and DG, ICAR.
- Attended National conference on Horti-business-Linking farmers with market organized by Swadesh Jagriti Sangoshthi from 28-31st May, 2011 at Dehradun.
- Attended 2 days KVK interface meeting w.e.f. 6-7th June, 2011 at DCFR, Bhimtal.
- Attended symposium on protected cultivation of vegetables and flowers – value chain approach on 12th Jan., 2012 at GBPUA&T, Pantnagar.
- Attended the inaugural session of XXX annual group meeting of AICRP on vegetables w.e.f.

13-16th Jan., 2012 on 13th Jan., 2012 at GBPUA&T, Pantnagar.

- Attended brain-storming session on "Hill Agriculture – Tryst with challenges and beyond" organized by VPKAS, Almora during 6th USSTC-2011 on 14th Nov., 2011 at Almora.
- Attended 1st group meeting of AINRP on Outreach technologies of Temperate fruit crops w.e.f. 26-27th March, 2012 at CITH, Srinagar.
- Attended workshop on Horticultural Technology Mission for North East and Himalayan States on 28th June, 2011, and 23rd Feb., 2012 at VPKAS, Almora.

Mr. Arun Kishor (Scientist)

- Successfully completed foundation training course for agricultural research service w.e.f. 27th April, 2011 to 25th August, 2011 at NAARM, Hyderabad.
- Attended national training course on allele mining for abiotic stresses in vegetable crops w.e.f. 24th February, 2012 to 8th March, 2012 organized by IIVR, Varanasi.

List of Ongoing Projects

S.No.	Title of the Project	Project Code	Duration	
			Date of initiation	Date of Completion
I. Crop improvement and Biotechnology				
1	Survey, collection, characterization and documentation of temperate horticultural crops	CITH-01	1998	On going
2	Breeding for development of superior varieties/ hybrids in Solanaceous vegetables	CITH-07	2000	On going
3	Evaluation of walnut genotypes in relation to floral biology and yield attributes	CITH-24	2008	2012
4	Development of superior cultivars/hybrids in temperate fruits through conventional and non conventional methods	CITH-40	2009	2020
5	Studies on improvement and production of saffron	CITH-06	1999	On going
6	DNA finger printing of apple, walnut and apricot	CITH-47	2009	2012
7	Standardization of micro-propagation of apple, walnut, saffron and lilium	CITH-48	2009	2012
II. Crop Production and Propagation				
1	Large scale multiplication of quality planting material and seeds of temperate horticultural crops	CITH-04	1999	On going
2	Standardization of efficient propagation techniques for production of quality planting material of temperate fruits and nuts	CITH-02	1998	Ongoing
3	Standardization of medium, medium high and high density orcharding in temperate fruits and nuts	CITH-03	1999	On going
4	Energy harvest through plant architectural engineering for increasing source and sink relationship in apple and other temperate fruit crops	CITH-31	2008	2013
5	Effect of integrated nitrogen management on yield and quality of almond and soil properties	CITH-34	2008	2012
6	Fertigation studies in almond	CITH-46	2009	2012
7	Evaluation of strawberry varieties under Kashmir conditions in different production systems	CITH-39	2009	2012
8	Enhancing blooming period of tulip using PGRs and different storage period.	CITH-42	2009	2012
9	Standardization of agro techniques for quality cut flower production both under poly house and open conditions	CITH-43	2009	2012
10	Management of physiological disorders in temperate fruits	CITH-32	2008	2012
11	Effect of various training and pruining systems in Persian walnut	CITH-54	2011	2016
12	Effect of bioregulators and physiological maturity of microshoots of apple rootstock MM-111 on rooting under *in vitro* conditions	CITH-55	2011	2012
13	Antioxidant and phytonutrient characterization of minor temperate horticultural crops	CITH-52	2011	2013
14	Integrated nutrient management in high density apple plantation under different mulching	CITH-15	2007	2012
15	Standardization of organic agro techniques for peach under high density planting system	CITH-19	2007	2012
16	Evaluation of gerbera genotypes under protected conditions and refinement of technologies for production and propagation	CITH-28	2008	2012
17	Development of intensive cropping system involving almond and saffron	CITH-41	2009	2012
18	Characterization of soil and nutritional survey of temperate fruit crop	CITH-44	2009	2012
19	Integrated nutrient management in medium and high density orchards in apple	CITH-46	2009	2012

S.No.	Title of the Project	Project Code	Duration	
			Date of initiation	Date of Completion
III. Crop Protection				
1	Management of chilli wilt	CITH-21	2008	2013
2	Studies on efficacy of kresoxim methyl against apple scab	CITH-51	2008	2012
3	Studies on gummosis of stone fruits nuts and its management	CITH-22	2008	2012
4	Insect population dynamics on different varieties/ genotypes of apple, almond and apricot	CITH- 53	2011	2013
IV. Post Harvest Management				
1	Minimal processing, packaging and storage study of high value vegetables and fruits for quality maintenance and storage	CITH-30	2008	2012
2	Standerization of pre and post harvest practices for extending shelf life of apple fruits	CITH-27	2009	2012
3	Value addition, storage and sensory quality evaluation of different products of major and minor temperate fruits	CITH-49	2009	2012
4	Post harvest management of temperate fruits and nuts for storage and value added products	CITH-37	2009	2013
5	Enhancement of shelf life of different temperate fruits through post harvest chemicals interventions	CITH-50	2009	2012
V. Development of technologies for mitigation of climate change				
1	Management of frost, drought and other abiotic stresses in almond and apple in changing climate scenario	CITH-33	2008	2012
VI. Rejuvenation of old senile orchard				
1	Sandardisation of technology for rejuvenation of old unproductive almond orchards in Kashmir valley	MM-2.45	2008-09	2011-12
VII. Development of cropping system involving horticultural and other allied crops				
1	Development of apple based cropping system with legume, spices, vegetables, medicinal and aromatic plants	CITH-38	2009	2012
VIII. AICRP/Network projects				
1	Network project on outreach of technologies for temperate fruit crops	Plan Project	2008	On going
2	Network project on onion and garlic (co-operation centre-PI)	DOOGR	2008	On going
3	Survey, collection, evaluation and conservation of temperate pomegranate genotypes/ wild species/ varieties under North Western Himalayan region	Inter Institutional Project	2010	2015
4	Intellectual property management and transfer/ commercialization of agricultural technology scheme	ICAR	2008	On going
5	Establishment and strengthening of tissue culture facilities	DAC	2010	2015
6	AICRP on vegetable (Voluntary centre)	ICAR	2008	On-going
IX. Validation of DUS Internaional guidelines under Indian conditions				
1.	DUS on apple and pear	PPV & FRA	2008-09	2012
2	DUS on walnut and almond	PPV & FRA	2008-09	2012
3	DUS on apricot and cherry	PPV & FRA	2008-09	2012
4	DUS on strawberry	PPV & FRA	2011-12	2013
5	DUS on peach and plum	PPV & FRA	2011-12	2013
X.	Biotechnological interventions for improvement of apple through virus and genetic fidelity certification and production	DBT	2011-12	Ongoing
XI.	Establishment and strengthening of tissue culture facilities	DAC	2011-12	2014-15
XII.	Horticulture Technology Mission Projects (15 Activities)	DAC	2005	On going

Research, Review and Management Committees

Research Advisory Committee (RAC) w.e.f. 07-09-2011 to 06-09-2013

S. No.	Name of Member	Capacity
1	Dr. Jagmohan Singh Chauhan Ex. Vice-Chancellor Dr. Y.S. Parmar University of Horticulture and Forestry Solan. (HP)	Chairman RAC
2	Dr. S.N. Pandey Ex. ADG (Hort.), ICAR New Delhi	Member
3	Dr. D.P. Singh Ex. ADG (VC), ICAR New Delhi.	Member
4	Dr. N. Kumar Dean (Hort.) Tamil Nadu Agricultural University Coimbatore,Tamil Nadu	Member
5	Dr. J. Kumar Prof. & Head, Div. of Plant Pathology G.B. Panth University of Agriculture and Technology, Pant Nagar, Uttaranchal	Member
6	Dr. A.K. Dhawan Prof. & Head, Div. of Entomology Punjab Agricultural University Ludhiana, Punjab	Member
7	Prof. Nazeer Ahmed Director CITH, Srinagar, J & K	Member
8	Dr. S. Rajan ADG (Hort. I), ICAR KAB-II, Pusa, New Delhi-110 012	Member
9	Syed Altaf Bukhari Managing Director FIL Industries, Kohinoor House Srinagar, J & K	Member
10	Shri Thakur Randhir Singh Former Minister 298 EP Flat, Wazarat Nagar Jammu-Tawi	Member
11	Dr. Desh Beer Singh Pr. Scientist CITH, Srinagar, J & K	Member Secretary, RAC

Institute Management Committee (IMC) w.e.f. 18.11.2008 to 17.11.2011

S. No.	Name of Officer with Designation and address	Designation
1	Prof. Nazeer Ahmed Director, CITH, Srinagar	Chairman
2	Dr. S. Rajan Asstt. Director General (Hort. I) ICAR, KAB-II, Pusa, New Delhi	Member
3	Director (Horticulture) Govt. of J&K, Rajbagh, Srinagar (J&K).	Member
4	Director (Horticulture & Food Processing) Department of Horticulture, Chabuthai Ranikhet, Almora (Uttarakhand)	Member
5	Dr. M.S. Wani Prof. cum Chief Scientist Fruit Breeding, Division of Pomology SKUAST-K, Srinagar	Member
6	Shri Thakur Randhir Singh Former Minister, 298 EP Flat Wazarat Nagar, Jammu -Tawi	Member
7	Syed Altaf Bukhari Managing Director, FIL Industries Kohinoor House, Srinagar, J&K	Member
8	Finance and Accounts Officer CPRI, Shimla (HP)	Member
9	Dr. A.K. Singh Head, Fruit and Horticulture Technology IARI, New Delhi - 110012	Member
10	Dr. A.T. Sadashiva Principal Scientist (VC) IIHR, Bangalore	Member
11	Dr. M.K. Verma Senior Scientist (H) Fruit and Horticulture Technology IARI, New Delhi - 110012	Member
12	Shri Javid Iqbal Mir Scientist (Agri. Biotech.) CITH, Srinagar	Member
13	Shri Y.S. Dhanik Asstt. Admn. Officer CITH, Srinagar	Member Secretary

Distinguished Visitors

1. Dr. V.A. Parthasarthy, Director, IISR, Calicut visited CITH main campus Srinagar on 14th June 2011.
2. Sh. Bijay Kumar, MD, National Horticulture Board, Gurgoan visited CITH main campus Srinagar on 15th June 2011.
3. Shri Ravi Prakash Arora, Special Secretary (Agri.), Govt. of Uttar Pradesh visited the CITH Regional Station, Mukteshwar on 1st June, 2011.
4. Sh. Rajiv Mehrishi, IAS, Secretary (ICAR) & Special Secretary (DARE) visited CITH main campus Srinagar on 17th June, 2011.
5. Dr. S.C. Gupta, ADG (APSB), ICAR, Krishi Bavan, New Delhi, visited CITH main campus Srinagar on 14th June, 2011.
6. Dr. S. Ayyappan, Hon'ble Director General (ICAR) & Secretary (DARE) visited CITH main campus Srinagar on 8th July, 2011.
7. Sh. R.K. Rathore, DAC, New Delhi, visited CITH main campus Srinagar on 18th August, 2011.
8. Dr. Vijay Pal Sharma, IIM, Ahemadabad, visited CITH main campus Srinagar on 25th August, 2011.
9. Sh. Shyam Lal Sharma, Hon'ble Minister for Health , Floriculture and Horticulture, J & K. visited the Insitute on 13th October, 2011.
10. Dr. K. Narayana Gowda, Vice-Chancellar, UAS, Bangalore, visited main campus Srinagar on 6th November, 2011.
11. Dr. Gurbachan Singh, Chairman ASRB visited the CITH Main campus srinagar on 3rd November, 2011.

Hon'ble Director General (ICAR) & Secretary (DARE) looking at promising peach varieties at CITH, Srinagar

Sh. Sham Lal Sharma, Hon'ble Minister for Health, Floriculture and Horticulture, J & K interacting with staff at CITH, Srinagar

Sh. Rajiv Mehrishi, IAS, Secretary (ICAR) & Special Secretary (DARE) looking at newly developed high yielding walnut varieties at CITH, Srinagar

Chairman ASRB, Dr. Gurbachan Singh interacting with scientist in Saffron research block at CITH, Srinagar

Personnel

CITH Head Quarter, Srinagar

RMP

- Prof. Nazeer Ahmed, Director

Scientific

- Dr. R.K.Verma, Principal Scientist, Plant Pathology
- Dr. D.B.Singh, Principal Scientist, Hort-Vegetable Science
- Dr. Dinesh Kumar, Principal Scientist, Hort-Fruit science
- Dr. K.K. Srivastava, Senior Scientist, Hort-Fruit Science
- Dr. S.R. Singh, Senior Scientist, Hort-Vegetable Science
- Dr. Om Chand Sharma, Senior Scientist, Hort-Floriculture
- Dr. Anil Shama, Senior Scientist, Soil Science
- Mr. J.I. Mir, Scientist, Plant Biotechnology
- Mr. Shiv Lal, Scientist, Hort-Fruit Science
- Mr. Ramesh Kumar, Scientist, Floriculture
- Dr. G. Mahendiran, Scientist, Agril. Entomology
- Mr. Sarvendra Kumar, Scientist ,Soi Science

Director Cell

- Mrs. Shahida Rafiq, P.A. to Director

Technical

- Dr. Girija Shankar, T-6
- Sh. Eshan Ahad, T-5
- Sh. Brijendra Kumar, T-5
- Sh. Muneer Ahmad Sheikh, T-3
- Sh. Diwakar Vithuji Sawaji, T-2
- Sh. Mehraj-ud-din Bhat, T-3 (Driver)
- Sh. Farman Ali, T-3 (Driver)
- Ms. Syed Mubeen Saif Shah, T-1
- Sh. Ajaz Ahmad Wani, T-1

Administrative

- Sh. Ramesh Kumar, Asstt. Admn. Officer
- Sh. Fayaz Ahmad Dar, AF &AO
- Sh. Showket Ahmad Mir, Assistant
- Sh. Mukhtar Ahmad Mir, UDC
- Sh. Riyaz Ahmed Mir, UDC
- Sh. Mehraj-ud-Din Meer, LDC
- Sh. Tariq Ahmad Mir, Jr. Stenographer

Supporting Staff

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

Regional Station, Mukteshwar

Scientific staff

- Dr. B.L. Attri, Principal Scientist, Hort-Fruit Science
- Dr. B. Das, Senior Scientist Hort-Fruit Science
- Dr. Anil Kumar, Scientist, Plant Pathology
- Mr. Arun Kishor, Scientist, Hort-Fruit Science

Technical staff

- Sh. Vinod Chandra, T-5 (Technical Officer)
- Sh. Man Mohan Singh, T-3 (Driver)
- Sh. Puran Chandra, T-2
- Sh. Ishtiyaq Ahmad, T-1

Adminstrative

- Sh. Diwan Chandra, Assistant
- Sh. Pushpendra Kumar, Junior Clerk

Supporting staff

- Sh. Narayan Singh, S.S.GR. I
- Sh. Govind Giri, S.S.GR. I

Staff of IVRI Regional Station attached at CITH

- Sh. G.A. Sofi, P.S. to Director
- Sh. Mohammad Ramzan Wani, T-2
- Sh. Mushtaq Ahmad Khan, T-2
- Sh. Ghulam Hassan Mir, SSS
- Sh. Ghulam Hassan Gojaree, SSS
- Sh. Ghulam Ahmed Rather, SSS
- Sh. Abdul Rashid Dar, SSS
- Sh. Ghulam Nabi Bhat, SSS
- Sh. Ghulam Nabi Ganai, SSS

Appointments / New Joinings

Dr. Anil Sharma, joined CITH, Srinagar as Senior Scientist (Soil Science), w.e.f. 19th March, 2012. He was earlier serving as Junior Scientist at SKUAST-Jammu.

Sh. Arun Kishor, joined CITH, RS, Mukteshwar as Scientist Hort. (Fruit Science) w.e.f. 13th September, 2011.

Sh. Sarvendra Kumar, joined CITH, Srinagar as Scientist (Soil Science), w.e.f. 19th September, 2011.

Dr. V. Girija Shankar, joined CITH, Srinagar as T-6 w.e.f. 20th June, 2011.

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

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