# वार्षिक प्रतिवेदन

# ANNUAL REPORT

## 2010–11

भाकृअनुप
ICAR

केन्द्रीय शीतोष्ण बागवानी संस्थान
श्रीनगर, जम्मू एवं कश्मीर

Central Institute of Temperate Horticulture
Srinagar, Jammu and Kashmir

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(भारतीय कृषि अनुसंधान परिषद)

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जम्मू एवं कश्मीर, भारत

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# Contents

# कार्यकारी सारांश

शीतोष्ण बागवानी में शीतोष्ण बागवानी वाले क्षेत्रों में फसलों का उत्पादन एवं उत्पादकता बढ़ाने के लिये अनुवाशिंक सुधार, उत्पादन, संरक्षण एवं पच्छ तुड़ाव प्रबंधन का अनुसंधान कार्य मुख्य परिसर, श्रीनगर एवं क्षेत्रीय अनुसंधान केन्द्र, मुक्तेश्वर में किया गया है।

## फसल सुधार एवं जैव प्रौद्योगिकी

नई विकसित अखरोट एवं खुबानी की किस्मों का पौध उत्पादन करके देश के विभिन्न शीतोष्ण क्षेत्रों में प्रसार के द्वारा वितरण कर उनका अनुकूलनशीलता एवं व्यावसायीकरण किया जा रहा है। सब्जियों में प्रजनन व मूल्यांकन करके एक जननद्रव्य प्याज का, दो प्रजनन लाइन मिर्च का, दो क्लोन लहसुन तथा केल के दो चयन विकसित किया गया है, जिसका मुल्यांकन देश के विभिन्न क्षेत्रों में अखिल भारतीय समन्विक अनुसंधान परियोजना शाकभाजी के द्वारा किया जा रहा है।

प्रक्षेत्र जीन बैंक में शीतोष्ण बागवानी फसलों के 1976 जनन द्रव्य वंशक्रमों का संकलन कर अनुरक्षण किया गया है। सेब में 225 देशी एवं विदेशी किस्मों का संकलन स्थापित करके विभिन्न गुणात्मक मुल्यांकन किया जा रहा है। स्थानीय किस्में अम्ब्री, केसेरी, चमूरा, सहारनपूरी और रजकवारी को इकट्ठा करके उसका सवंर्धन देशी एवं क्लोनल मूलवृन्त पर किया जा रहा है। प्रूनस टोमेन्टोसा का मूलवृन्त खरीदकर उसका संवर्धन किया जा रहा है। अगेती किस्में मोलिस डेलिसियस, वेस्टा बेला और अन्ना के साथ स्काई लाइन, सुप्रीम, समर रेड और रेड स्पर अच्छा पाया गया है।

अखरोट में कुल 402 देशी एवं विदेशी निर्यात गुणवत्तायुक्त किस्मों को संकलित कर अनुरक्षण किया गया है। इसमें से 90 जननद्रव्य में फूल एवं फल आया जिसका नट एवं गिरी का वजन 7.67 से 27.93 गाम और 4.22 से 14.60 ग्राम पाया गया। कुछ उत्तम जनन द्रव्यों का संवर्धन कर मूल्यांकन एवं वितरण किया जा रहा है।

बादाम में 30 देशी एवं विदेशी जननद्रव्यों को प्रक्षेत्र जीन बैंक में स्थापित किया गया है। उसमें से ज्यादा नट का उत्पादन 2.9 टन प्रति हैक्टेयर प्रनयाज किस्म में पाया गया है तथा गिरी का अनुपात 50–60 प्रतिशत तक है।

खुबानी के 49 देशी एवं विदेशी जननद्रव्य का संकलन किये गये हैं। जिसमें से अधिकतर संकलन अधिक उपज तथा कुल ठोस घुलनशील (टी.एस.एस.) के साथ आशाजनक पाये गये हैं। चयनित किस्म सी.आई.टी.एच. खुबानी–24 प्रजाति उच्चतम टी.एस.एस. के साथ सबसे मीठी पायी गयी है।

चेरी में 34 देशी एवं विदेशी चयन को प्रक्षेत्र जीन बैंक में स्थापित किये गये हैं। जिसमें सी.आई.टी.एच.–चेरी–05, सी.आई.टी.एच.–चेरी–01, और बीगारीऊ नेपोलियन आशाजनक पाये गये हैं तथा इसका क्लोनल एवं बीजू मूल वृन्तों पर संवर्धन किया जा रहा है।

प्रक्षेत्र जीन बैंक में आडू की 28 प्रजातियां तथा नेक्टरिन की दो प्रजातियां स्थापित की गयी हैं तथा इसक पुष्पन, उपज, गुणवत्ता एवं अन्य गुणों के लिये मुल्यांकन किया जा रहा है। प्रजातियों के भौतिकीय व रसायनिक तथा गुणवत्ता मुल्यांकन के आधार पर फैनटेसिया नेक्टरिन तथा क्रेस्ट हेवेन, रेड ग्लोब, एलबर्टा, जुलाई एलबर्टा, फ्लेमिस ब्यूटी, सी.आई.टी.एच. आडू–1 एवं निमला आशाजनक पाये गये हैं।

प्रक्षेत्र जीन बैंक में आलूबुखारा के 25, नाशपाती के 37, अनार के 16 तथा अन्य गौण फलों के देशी तथा विदेशी प्रारूप स्थापित किये गये हैं। इसमें से आलूबुखारा की दो प्रजतियां तथा अनार की तीन प्रजातियां बहुत आशाजनक पायी गयी हैं और इसका संवर्धन किया जा रहा है।

कीवी फल में 5 विदेशी प्रजातियां संकलित कर मुल्यांकन हेतु लगायी गयी हैं। कीवी फल को कश्मीर क्षेत्र में लोकप्रिय बनाने के लिये कृषक भागीदारी अनुसंधान कार्यक्रम के अंतर्गत विभिन्न प्रदर्शन क्षेत्र स्थापित किये गये हैं।

अंगूर में 8 देशी एवं विदेशी किस्मों एवं मूलवृतों का प्रक्षेत्र जीन बैंक में स्थापित करने के लिए राष्ट्रीय अंगूर अनुसंधान केंद्र, पुणे से लाकर लगाया गया है तथा विभिन्न वृद्धि मानकों पर आंकड़े एकत्र किये जा रहे हैं। जैतून में कुल 19 विदेशी प्रजातियां संकलित एवं संरक्षित की गयी हैं तथा इसकी वृद्धि, उपज एवं गुणवत्ता विशेषताओं के लिए मूल्यांकन किया जा रहा है। इन प्रजातियों में पेन्डोलीनो, कोरेटीना, लेसिनो, फ्रोन्टोइओ, सीप्रेसीनो एवं मीसेनीज अच्छे पाये गये हैं। कोरेटीना किस्म का प्रारम्भिक उपज 910 ग्राम प्रति पौधा पाया गया है।

मिर्च में 256 लाइंस 7 किस्में तथा 18 संकर का परीक्षण किया गया है। जिसमें 10 लाइंस, 4 किस्में तथा 6 संकर का उपज एवं रंग के आधार पर चिन्हित कर संवर्धन किया जा रहा है। सगिया मिर्च के 26 जननद्रव्यों में से 7 लाइन, वैगन में 21 लाइन से 8 जननद्रव्य, टमाटर के 35 जननद्रव्यों में से 14 किस्में एवं संकर का उपज तथा गुणवत्ता मानको के आधार पर चिन्हित की गयी है।

प्याज में 36 जननद्रव्य, लहसुन में 23 जननद्रव्य, लीक में 2, लेट्यूस में 23 जनन द्रव्य, स्पारागस में 2, केल में 85, मटर में 36, टमाटर में 64, गाजर में 43, बैगन में 38, स्वीस कार्ड में 2, चाइनीज पत्ता गोभी में 3, ब्रोकोली एवं मूली में 6 प्रत्येक, शलजम में 26, खीरा में 5, प्रान में 8, ब्रुसेल्स स्प्राउट में 1, पार्सले में 2 एवं सेलरी में 2 का मूल्यांकन एवं संवर्धन किया जा रहा है।

केसर में 32 प्रविष्टियों को स्थापित किया गया है। जिनकी पिस्टिल की लंबाई एवं वजन में विविधता पायी गयी तथा उत्तम क्लोन्स की उपज तीसरे वर्ष में 3.0 से 4.2 कि.ग्रा./है. प्राप्त की गयी है।

जरबेरा जननद्रव्यों में ड्यून, रोजेलीन तथा दाना इलेन कश्मीर क्षेत्रों के लिए तथा जननद्रव्य जी–7, 15, 16, 17, 18 और 20 मुक्तेश्वर के लिए आशाजनक पाये गये हैं।

सजावटी, औषधीय एवं सुगंधित पौधों में कुल 98 जननद्रव्यों का संग्रह कर मूल्यांकन एवं संरक्षण किया गया है। जिसका प्रजनन एवं तकनीक विकास संरक्षित तथा खुले क्षेत्र में किया गया है।

अखरोट में पुष्पन अध्यन द्वारा यह इंगित हुआ है कि 33 जननद्रव्यों में से 17 प्रोटोगाइनस तथा शेष प्रोटेन्ड्रस पाया गया है। अधिकतर जननद्रव्य में नर कैटकिन और मादा फूलों का खिलना संयोग करता है।

सेब व चेरी में पराग संगतता का अध्यन अन्तः किस्मों में संकरण करा कर किया गया है। सेब में आर्गन स्पर × गोल्डेन डेलिसियस, सिल्वर स्पर × गोल्डेन डेलिसियस तथा चेरी में वेन × डबल में 75% से अधिक फलन दर्ज किया गया है। पालीनाइजर सेब में परागण अध्ययन से पराग वायविलिटी, जमाव तथा पराग ट्यूब वृद्धि गोल्डेन डेलेसियस में सबसे अच्छा पाया गया है।

फसल विविधीकरण में उच्च मुनाफे वाली सब्जियों तथा माइनर फल, इलाइट किस्में जैसे लेट्यूस, केल, पारसले, सेलरी, चाइनीज पत्ता गोभी, प्रान, आर्टीचोक, स्पारागस, स्वीसकार्ड, ब्राकोली, सोनचल और केप गुज बेरी को चिन्हित कर लोकप्रिय किया जा रहा है।

बड़े पैमाने पर लिलियम, स्ट्रावेरी व चेरी गुणवत्ता की रोपण सामग्री के उत्पादन हेतु उत्तक संवर्धन, सुक्ष्म प्रवर्धन प्रोटोकाल का मानकीकरण तथा स्टिगमा के तरह संरचना और सूक्ष्मकन्द केसर का प्रोटोकाल इन विट्रो में किया जा रहा है। डी.एन.ए. फिंगर प्रिंटिंग का काम खुबानी के 24 व लहसुन के 40 जननद्रव्यों में आर.ए.पी.डी मार्कर के प्रयोग से किया गया है।

## फसल उत्पादन एवं प्रवर्धन

कुल 1.02 लाख क्लोनल/बीजू मूल वृंत तथा 65000 कलमी पौधा सेब, चेरी, आलूबुखारा, अखरोट, आड़ू, नाश्पाती, खुबानी तथा बादाम का तैयार किया गया जो राज्य के विकास विभाग, प्रगतिशील किसानों को जम्मू एवं कश्मीर, हिमाचल प्रदेश, उत्तराखंड, अरुणाचल प्रदेश और तमिलनाडु में वितरित किया गया है। इसके अलावा 2.06 कि.ग्रा. संकर बीज खीरा, बैगन, शिमला मिर्च, मिर्च तथा टमाटर और 488 कि.ग्रा. ब्रीडर बीज टमाटर, बैंगन, शिमला मिर्च, मिर्च, खीरा, बींस, पालक, गाजर, पत्ता गोभी, मूली तथा प्याज का तथा साथ में 2.5 लाख बडवुड और 1.5 लाख केसर का कंद उत्पादित कर वितरित किया गया है।

**सेबः** अधिक उत्पादन के लिए मध्यम एवं उच्च सघनता पौध रोपण क्लोनल मूल वृंत पर परीक्षण किया गया। जिसमें अधिकतम फल उपज मालीस डेलिसियस (1.5 × 3.0 मी. दूरी पर) तथा वेस्टा बेला (2.0 × 3.0 मी. दूरी पर) M-9 मूलवृंत पर अच्छा पाया गया। इसी तरह स्टारक्रिमसन का उत्पादन (3 × 3 मी.) तथा रॉयल डेलिसियस (3.5 × 3.0 मी.) MM-106 मूलवृंत पर अच्छा पाया गया। मालीस डेलिसियस तथा स्टारक्रिमसन का उपज 3.5 × 3.0 मी. तथा रेड डेलिसियस का 4 × 4 मी. की दूरी पर MM-106 मूलवृंत पर अच्छा पाया गया। एकीकृत पोषण प्रबंधन उच्च सघनता सेब रोपण में सड़ी गोबर की खाद 50 कि.ग्रा., केंचुआ खाद 10 कि.ग्रा., 50 ग्राम नत्रजन, 75 ग्राम फॉस्फोरस तथा 250 ग्रा. पोटॉश प्रति पौधा अच्छा पाया गया है। विभिन्न सधाई प्रकारों जैसे कि स्पेलियर, कार्डन, स्पींडल वुश, मॉडीफाइड सेंट्रल लीडर, हेड व स्प्रेड तथा वर्टिकल एक्सीस का विकास किया गया है। जिसमें प्रकाश वाधा, फूलों, फलों व प्ररोही वृद्धि के अच्छे परिणाम प्राप्त हुए हैं। जल संचय तकनिकियों में पूर्ण मून पद्धति+प्लास्टिक मल्च रेड चीफ सेब में वर्षा आधारित दशा में अच्छा पाया गया है। विभिन्न फसल पद्धति में सेब+मेथी तथा सेब+लहसुन पद्धति अच्छा पाया गया है।

**बादामः** सर्वाधिक फल संख्या तथा उपज 3.5 × 3.5 मी. रोपण अंतराल से वारीस किस्म मे उच्च सधन रोपण तथा मध्यम

सघन रोपण में प्रनयाज किस्म का प्रदर्शन अच्छा है। विभिन्न जल संचय तकनिकियों में अधिक फल संख्या एवं उपज (2148:4. 29 कि.ग्रा. प्रति पेड़ तथा 2.68 टन प्रति हेक्टेयर) पूर्ण मून पद्धति+प्लास्टिक मल्च में पाया गया। एकीकृत नत्रजन प्रबन्धन में अधिक नट उपज (4.28 कि.ग्रा./पेड़) T-9 ट्रीटमेंट में तथा सबसे कम कंट्रोल में पाया गया है। पुराने बादाम के बागों का जीर्णोद्धार के लिए, पुराने वृक्षों की छंटाई तथा टाप वर्किंग वारिस किस्म से किया गया तथा साथ में 50 कि. ग्रा. सड़ी गोबर की खाद, नत्रजन 500 ग्रा., फॉस्फोरस 250 ग्रा., पोटॉश 700 ग्रा. प्रति पेड़ और पूर्ण मून जल संचय पद्धति + प्लास्टिक मल्च का परिणाम आशाजनक पाया गया है।

**अखरोटः** कम लगत का प्लास्टिक घर में वेज़ कलम प्रवर्धन से मध्य मार्च में अच्छी सफलता मिली है।

**चेरीः** चेरी के पाँच किस्मों का परीक्षण 2.5 × 2.5 मी. फसल अंतराल पर सी.आई.टी.एच. चेरी–01 का फल उत्पादन 7.9 टन/है. तथा 3 × 3 मी. पर सी.आई.टी.एच. चेरी–05 मे उपज तथा टी.एस.एस. अच्छा पाया गया है।

**आड़ूः** उच्च सघन रोपण (2.5 × 2.5 मी.) में अधिक उपज फेन्टेसिया तथा रेड ग्लोब में जबकि 3 × 3 मी. फसल अन्तराल पर भी उपर दिये गये दोनों किस्मों का फल उत्पादन अच्छा है। ऊर्जा संचय पद्धति में अधिक उपज क्रेस्ट हेवेन, ग्लोहेवेन, रेड ग्लोव तथा फेन्टेसिया को ततुरा ट्रेलीस तथा 4 स्केफोल्ड पद्धति में अच्छा पाया गया। कुमायूं की पहाड़ियों की दशा में आड़ू की सघन रोपण प्रणाली हेतु जैविक कृषि तकनिकियों का मानकीकरण किया गया। केंचुआ खाद + माइको राइजा द्वारा उपचारित वृक्षों में नाडेप + माइकोराइजा व सड़ी गोबर की खाद + माइको राइजा की तुलना में सर्वाधिक प्ररोही वृद्धि हुई और अच्छे परिणाम प्राप्त हुए।

**स्ट्राबेरीः** ब्राइट स्ट्राबेरी किस्म में फल की उपलब्धता पांच सप्ताह पहले प्लास्टिक टनेल पद्धति से तथा उसके बाद डगलस किस्म में घास मल्च से प्राप्त की गयी।

**अनारः** बालू + मिट्टी (50:50) तथा मिट्टी + गोबर की खाद (80:20) रूटीग माध्यम और सेमी हार्ड वुड कटिंग को 4000 पी.पी.एम. व्यवसायिक रूप से अच्छा पाया गया है। फल तुड़ाई से पहले पौध पोषक तत्त्व तथा वृद्धि रेगुलेटर (कैल्सियम सल्फेट 3000 पी.पी.एम.) का छिड़काव करने से फलों का फटना अनार मे कम हो जाता है।

**प्याजः** एकीकृत पोषण प्रबंधन तथा खर–पतवार नियंत्रण के अध्ययन से पता चला कि आर.एफ.डी. + बायो फर्टिलाइजर + ऑक्सीफ्लूरोफेन 23.5% ई.सी. का प्रयोग उत्तम पाया गया है।

**केसरः** केसर के खेती में फव्वारा तथा बूंद–बूंद सिंचाई पद्धति से पहले फूल आना तथा पौध बढ़वार वर्षा सिंचित की तुलना में अच्छा पाया गया। वृद्धि रेगुलेटर 1500 पी.पी.एम. एन. ए.ए. के प्रयोग से अधिक संख्या में फूल बनने वाले कन्द (65.8%) तथा कुल कंद का उत्पादन दो साल रोपण के बाद आशाजनक पाया गया।

**कट फ्लावरः** कम लागत के प्लास्टिक घर में कारनेसन के नीवा, फरीदा, क्रीमसन टेम्पो और मास्टर प्रजातियों का पौध वृद्धि तथा फूलों की संख्या अच्छी पायी गयी। फुसियों में प्लग पौध उत्पादन की तकनीक का भी मानकीकरण किया गया। सभी पांच प्रकार के सम्मिलित माध्यम और तीन लेवल नत्रजन, फॉस्फोरस तथा पोटॉश उपचारों में सर्वाधिक प्लग पौध का ताजा वजन पीट मॉस + परलाइट (3:1) माध्यम व खाद की मात्रा एन.पी.के. 12:1:1 मे प्राप्त हुआ है। जरबेरा के वेज़ लाइफ के माध्यम से पता चला है कि ड्यून और दाना इलेन का अधिक वेज़ लाइफ (16.30 और 15.53 दिन) पाया गया। गुलदाउदी में अधिक संख्या में फ्लोरेट 20:10:10 ग्रा. एन.पी.के. प्रति पौध तथा 30 × 30 सेमी. अन्तराल पर औसत कंद का वजन ट्राइकोडर्मा विरिडी तथा जी.ए. 3100 पी.पी.एम. में अच्छा पाया गया है।

**सब्जियों की संरक्षित खेतीः** उच्च मुनाफे वाली फसलें जैसे टमाटर, शिमला मिर्च और खीरा को कम लागत वाला पॉली घर में विभिन्न सघाई विधियों व रोपण अन्तराल मे उगाया गया। टमाटर की किस्म हिम सोना, सी.आई.टी.एच.–टी.एच.–1 और एस.एच.–टी.एच.–1 अच्छा पाया गया। खीरा में जापानीज लांग ग्रीन और ग्रीन एक्सप्रेस किस्म तथा संकर एस.एच.–सी.एच.–1 की उपज तथा गुणवत्ता अच्छी पायी गयी। शिमला मिर्च में एस. एच.–एस.पी.–706 की ऊपज अच्छी पायी गयी। जबकि संकर एन. एस.–281, बाम्बे, शालीमार शिमला मिर्च, संकर–1 (वाई) और शालीमार शिमला मिर्च संकर–2 (आर) अच्छा पाया गया। सघाई और पौध अन्तराल दो तना तथा 90 × 45 सेमी. अन्तराल में टमाटर एकल तना और 120 × 60 सेमी. अन्तराल में खीरा तथा एकल तना और 20 × 50 सेमी. अन्तराल मे शिमला मिर्च की सर्वाधिक पैदावार व गुणवत्ता दर्ज की गयी।

## पौध स्वास्थ्य प्रबंधन

मिर्च में म्लानि रोग कश्मीर घाटी में एक प्रमुख समस्या है। अधिकतम रोग शमन (61.7%) ट्राइकोडरमा विरडी, बीज प्राइमिंग, कार्वेंडाजीम में मूल को डुबोकर तथा मृदा में मिलाकर सफेद प्लास्टिक से सोलेराइजेशन से किया जा सकता है।

सफेद कुरमुला का प्रबंधन विवेरिया वेसियाना फॉरमूलेशन–मेज

मील–सेंड मिडियम को माइल्ड संक्रमण दशा मे मृदा मे मिलाने से अच्छे परिणाम प्राप्त हुए।

सेब के पामा रोग का प्रबंधन क्रेसाविसम मीथाइल 0.05% छिड़काव करने से सेब के पामा रोग के संक्रमण का प्रभावकारी ढंग से प्रबंधन किया जा सकता है।

सेव वरूथी (पेनोनायकस अलीमी) की प्रभावकारी रोकथाम हेतु दूसरे उपचारों की तुलना में फेनपायरोक्सीमेट 0.005% की दर से छिड़काव करने से अच्छे परिणाम प्राप्त हुए हैं।

### पच्छ तुड़ाई प्रबंधन

न्यूनतम प्रसंस्करण व भराई से शिमला मिर्च का सोडियम हाइपोक्लोराइड से एक मिनट तक तथा 1% सीट्रिक एसिड से उपचारित करने के बाद 25µ सेमी परमीएबल फिल्म से सीलबंद करके 32 दिनों तक सामान्य तापमान पर तथा 50 दिन तक कम तापमान पर (5 ± 2°C, RH–90%) न्यूनतम वजन कमी तथा अधिकतम वीटामिन सी. व फर्मनेस पाया गया। चेरी में एलोवेरा जेल का एडिबल कोटिग का कनसेन्ट्रेसन 1:1 तथा भण्डारण कम तापमान (5 ± 2°C, RH–90%) पर सेल्फ लाइफ को 36–40 दिन तक बढ़ाया जा सकता है तथा अधिकतम एस्कार्विक एसिड, टी.एस.एस. और फर्मनेस कन्ट्रोल की तुलना में अच्छा पाया गया। स्प्रिंक रेप्ड फेन्टेसिया नेक्टरिन फल को न्यूनतम तापक्रम पर 40 दिन तक सबसे कम फल वजन में कमी तथा गुणवता का भण्डारण किया गया। सेव किस्म मालिस डेलिसियस को 50% एलोवेरा जेल से 25µ फिल्म से कोटिंग व स्प्रिंक रेप्ड करके 68 दिन तक मण्डारण तथा न्यूनतम तापमान (5 ± 2°C) पर विना किसी नुकसान के रखा जा सकता है। परन्तु पच्छ तुड़ाई जी.ए. + कैल्सियम इ.डी.टी.ए. + तुड़ाई उपरान्त सिसिलिक एसिड का उपचार करने से सेब का सेल्फ लाइफ बढ़ जाता है। खुबानी में पच्छ तुड़ाई कैल्सियम क्लोराइड (15%) 80% पुष्पन पर, फल लगने पर, तुड़ाई के 15 दिन पहले छिड़काव करने से न्यूनतम फल वजन मे कमी आती है। खुबानी की किस्में सी.आई.टी.एच. खुबानी–1, अफगानी तथा सी.आई.टी.एच. खुबानी–2 के फल को न्यूनतम तापमान पर रखने से सेल्फ लाइफ 30 दिन तक बढ़ जाती है। खुबानी में फ्रूट बार तकनीक विकसित की गयी है। इसे 9 महीने तक मण्डारण किया जा सकता है। इसका गठन, रंग, एरोमा, स्वाद तथा गुणवत्ता, चिपकने का गुण नही एवं कम से कम ब्राउनिंग होने से बचाया जा सकता है। इसी तरह रोडोडेन्ड्रान + गलगल + जिंजर स्क्वाश का तकनीक विकसित किया गया तथा मूल्यांकन मे अच्छा पाया गया। ट्यूलिप के बल्ब को कोल्ड ट्रीटमेंट देकर पुष्पन क्रिया को समय से पहले तथा फूल खिलने के समय को बढ़ाया जा सकता है। इसी तरह साइकोसील तथा एम.एच. का प्रयोग करने से देर से फूल आते हैं लेकिन पुष्पन समय देर तक रहता है।

# Executive Summary

To improve production and productivity of temperate horticultural crops in the region, the research work on genetic improvement, production, protection and post harvest management was carried out both at main campus Srinagar and Regional Station, Mukteshwar.

## Crop Improvement and Biotechnology

To popularize newly released genotypes of walnut and apricot, the varieties were multiplied on large scale and supplied to different regions of the country for their adoptability and further commercialization. In vegetables through breeding and evaluation one genotype in onion, two advance breeding lines in chilli, two selections in kale and two elite clones in garlic were developed and introduced in AICRP vegetable trials for their performance evaluation in multi locations across the country.

At field genebank, as many as 1976 germplasm lines of temperate horticultural crops have been collected, characterized and are maintained. In apple, a total of 225 exotic and indigenous apple cultivars with diverse state have been established and are being evaluated for various qualitative and metric traits. The local cultivars namely true Ambri, Kesseri, Chamura, Saharanpuri, Razakwari were also collected and have been multiplied on seedling and clonal rootstock. Besides varieties, a total of 24 clonal rootstocks of both indigenous as well as exotic ones have also been maintained for further propagation. A clonal root stock of *Prunus tomentosa* was also procured and multiplied. Among early varieties Mollies Delicious, Vista Bella and Anna have been found promising alongwith Skyline, Supreme, Summer Red and Red Spur.

In walnut, a total of 402 indigenous as well as exotic varieties having export quality have been collected and established. Among these, 90 genotypes have come to bearing whose nut and kernel weight ranged from 7.67 g to 27.93 g and 4.22 to 14.60 g. Some of the elite genotypes are being multiplied for further evaluation and distribution.

In almond, 30 exotic and indigenous genotypes have been established in the field gene bank with cultivar Pranyaj, recording highest yield of 2.9 t/ha followed by Waris with kernel recovery of 50-60 percent.

In apricot, 49 exotic and indigenous collections have been raised and most of these collections have been found very promising with high yield and TSS. The selection CITH-A-24 was found to be very sweet with high T.S.S followed by CITH-A-14.

In cherry, a field gene bank of 34 cultivars which include both exotic and indigenous selections has been established. Among genotypes, CITH-Cherry-05, CITH-Cherry-01, Bigarreau Napolean have been found very promising and they are being multiplied on clonal rootstocks and sour cherry seedlings.

A field gene bank of 28 varieties of peach and 2 of nectarine has been established and are being evaluated for flowering, yield, quality and other attributes. Among the varieties, Fantasia Nectarine, Crest Heaven, Red Globe, Elberta, July Elberta, Flemish Beauty and local selection CITH Peach-01 and Nimla have been found promising on the basis of physico-chemical and yield attributes.

In plum, a field gene bank of 25 genotypes, in pear 37 genotypes, in pomegranate 16 genotypes and other minor nuts have been established with both exotic and indigenous types. Out of which 2 varieties in plum and 3 varieties in pomegranate are found very promising and are being multiplied on large scale.

In Kiwi fruit, 5 exotic ones have been collected and planted in the field for evaluation. For popularization of kiwifruit cultivation, various demonstrations in Kashmir region have also been taken up under farmer's participatory research programme.

In grape, a field gene bank of eight indigenous as well as exotic varieties and rootstocks of grape have been collected from NRC for Grape, Pune and planted in the field and data on various plant growth

parameters is being recorded. In olive, a total of 19 exotic cultivars have been collected, conserved and are under evaluation for growth, yield and quality attributes. Among genotypes Pendolino, Coratina, Leccino, Frontoio, Cipressino and Messenese found promising yielding as high as 910 g/plant by Coratina.

In chilli, from 256 lines, 7 varieties and 18 hybrids tested, 10 elite lines, 4 varieties and 6 hybrids were found promising with rich colour and yield and are being multiplied. In sweet pepper, 7 lines among 26 genotypes, 8 genotypes among 21 lines in brinjal and 14 varieties and hybrids among 35 tomato genotypes have also been identified having superior yield and quality attributes.

A collection of 36 genotypes of onion, 23 genotypes of garlic, 2 in leak , 23 genotypes of lettuce , 2 in asparagus, 85 in Kale, 36 in peas, 64 in tomato, 43 in carrot, 38 in brinjal, 2 in swiss chard, 3 in Chinese cabbage, 6 each in broccoli and radish, 26 in turnip, 5 in cucumber, 8 in pran, 1 in brussels sprout, 2 in parseley and 2 in celery are also being evaluated and multiplied.

In saffron, a field gene bank of 32 accessions have been established, which comprises of accessions having varied pistil length and pistil weight while the saffron yield ranged from 3.0 to 4.2 kg/ha in 3$^{rd}$ year of planting.

In gerbera, among the lines tested the genotypes Dune, Rosaline and Dana Ellen in Kashmir conditions and genotypes G-7, 15,16,17,18 and 20 at Mukeshwer were found promising.

In ornamental, medicinal and aromatic plants a total collection of 98 genotypes have been evaluated and maintained for further breeding and for development of suitable technologies for growing under both protected and open field conditions.

In walnut, the floral biology studies indicated that 17 out of 33 genotypes studied were protogynous and rest as protandrous in nature with most of the genotypes having synchronized blooming of male catkins and female flowers.

To study the pollen compatibility an inter-varietal crosses in apple and cherry were attempted. In apple among cross combinations, more than 90% fruit set was recorded in Oregon spur × Golden Delicious, Silver Spur × Golden Delicious however in cherry Van × Double recorded more than 75 % fruit set. Pollen studies of major apple pollinizers indicated maximum pollen viability, germination and pollen tube growth in Golden Delicious followed by Gold Spur, Red Gold and Tydeman's Early Worcester.

Under crop diversification of high value vegetables and minor fruits, elite varieties in lettuce, kale, parsley, celery, Chinese cabbage, pran, artichoke, asparagus, swisschard, broccoli and sonchal and capegooseberry were identified and are being popularized.

In tissue culture, micro-propagation protocols for production of large scale planting material have been standardized in lilium, strawberry and cherry along with protocol for development of stigma like structure and micro corms in saffron under *in-vitro* condition. However, the work on apple and walnut protocol development is still under progress. Under molecular characterization DNA fingerprinting of 24 genotypes of apricot and 40 genotypes of garlic have been completed using RAPD markers and genetic diversity was assessed.

## Crop Production and Plant Propagation

A total of 1.02 lakh clonal/seedling rootstocks and 65000 grafted plants of apple, cherry, plum walnut, peach, pear, apricot and almond have been produced and supplied to State Development Department and progressive farmers of J&K, H.P., UK, Arunachal Pradesh and Tamil Nadu. A total quantity of 2.06 kg hybrid seed of cucumber, brinjal, chilli, capsicum and tomato and 488 kg of breeder/quality seeds of tomato, brinjal, capsicum, chilli, cucumber, pea, beans, spinach, carrot, cabbage, radish and onion were produced for supply to development departments and farmers. Besides this 2.5 lakh budwood and 1.5 lakh saffron corms were also produced and supplied.

**Apple:** To maximize production medium and high density planting on clonal rootstocks was tried. Maximum fruit yield and quality was recorded in Mollies Delicious at spacing of 1.5 x 3.0 m and Vista Bella at 2.0 X 3.0 m on M-9 rootstock. Similarly Starkrimson registered highest yield at 3x 3 m and Royal Delicious at 2.5 x 3.5 m spacing on MM-106 rootstock .Mollies Delicious and Starkrimson resulted in highest yield at 3.5 x 3.0 m and Red Delicious at

4 × 4.0 m respectively on MM-106 rootstock. Under integrated nutrient management in high density apple plantation the application of FYM 50 kg + vermi-compost 10 kg +50g N + 75 g $P_2O_5$ + 250 g $K_2O$ per plant was found to be the best combination. Experiment on different training systems such as Espalier, Cordon, Spindle Bush, Modified Central Leader, Central Leader, Head and Spread and Vertical Axis indicated that different systems showed variable impact on light interception, flowering, fruiting and yield attributes. Among water harvesting techniques, full moon system+ plastic mulch registered maximum fruit number and yield in Red Chief variety of apple under rainfed condition. Among various cropping systems, the treatment consisting of apple+methi followed by apple+garlic cropping system recorded highest apple equivalent yield 20.1t/ha.

**Almond:** Highest fruit number and yield was recorded in 3.5x3.5 m spacing in cultivar Waris under high density orcharding in almond however under medium density orcharding cultivar Pranyaj of almond performed better in terms of nut yield. Among various techniques of rain water harvesting and *in-situ* moisture conservation, maximum fruit number and yield (2148; 4.29 kg/tree and 2.68t /ha) were recorded in full moon structure with plastic mulch followed by half moon + plastic mulch (2096; 2.51 t/ha). In integrated nitrogen management studies highest nut yield (4.28 kg/tree) was recorded in T9 in variety Waris. Whereas, minimum nut yield (1.91kg/tree) was found with control. For rejuvenation of old and senile almond orchard, a technology involving pruning and top working with cultivar Waris supplemented with 50 kg FYM+NPK 500:250:700 g/tree and full moon water harvesting structure covered with polymulch was found best and recording highest nut yield/tree.

**Walnut:** A low cost polyhouse propagation using wedge grafting during middle of March resulted in higher success followed by tongue grafting.

**Cherry:** In cherry among five varieties tested at 2.5x2.5 m spacing the cherry cv. CITH-Cherry-01 registered highest yield (7.9 t/ha) while at 3.0x3.0 m cv CITH-Cherry-05 recorded highest yield and quality.

**Peach:** Under high density plantation (2.5 x 2.5m), maximum fruit yield was recorded in cv. Fantasia (12.90 kg) followed by Red Globe (9.86 kg), Crest Heaven (8.64 kg) and Gloheaven (8.45 kg) whereas at spacing of (3 x 3 m) maximum yield per tree was recorded in cv. Fantasia (15.18 kg) followed by Red Globe (11.90 kg), Gloheaven (11.31 kg) and Crest Heaven (9.81 kg) on seedling rootstock. Among six energy harvest systems, the peach/nectarine varieties viz. Crest Heaven, Gloheaven, Red Globe and Fantasia resulted in maximum fruit yield per tree and fruit quality in Tatura trellis (perpendicular V) followed by four scaffold system. Organic agro -techniques for peach under high density planting system in Kumaon Hill conditions indicated that vermicompost+mycorrhiza, Nadep+ mycorrhiza and FYM+ mycorrhiza found better over other tretments . The organically produced fruits were by and large superior in quality attributes than inorganically produced fruits.

**Strawberry:** In strawberry the early fruit availability by five weeks was made by using poly tunnel. The higest yield was obtained by variety Brighten while the variety Duglas with straw mulch gave the maximum yield (9.4 t/ha) followed by Howard under straw mulch (9.2 t/ha).

**Pomegranate:** The Sand+Soil (50:50) and Soil +FYM (80:20) rooting media and Semi-hardwood type of cutting treated with IBA 4000 ppm and wounding at the cuttings' base was found best for commercial multiplication. The pre-harvest application of plant nutrient and growth regulators on five cultivars (Dholka, Bedana, Kandhari, Jyoti and G-137) minimized fruit cracking. The minimum fruit cracking in all the varieties was recorded by spraying CaSo4 3000 ppm followed by CaSo4 2000 ppm.

**Saffron:** Standardized improved agro-techniques for maximization of saffron productivity sprinkler and drip irrigation methods caused early sprouting; early flowering with increased plant height and more no. of leaves and flowers per plant as compare to control (rain fed). Stigma fresh weight, stigma dry weight, stigma length and saffron yield per hectare were improved in sprinkler and drip irrigation methods as compare to control. Application of 1500 ppm NAA produced highest number of flower bearing corms (65.8%) and total corm yield (20.4 t/ha) after two years of planting.

**Cut flowers:** Under low cost polyhouse the carnation varieties Niva , Farida , Crimson Tempo and Master performed best with respect to growth and flowering parameters. In Fuchsia techniques for plug plant production have been standardized. Among five different combinations of media and three levels of NPK the fresh weight of plug plants was found maximum in medium containing peat moss +perlite (3:1) with a fertilizer dose of N-P-K: 12-1-1. In vase life study of gerbera,the cultivars Dune and Dana Ellen expressed longest vase life (16.30 and 15.53 days respectively) followed by Carambola, Kayak and Winter Queen. In gladiolus the higest number of florets was obtained using 20:10:10 g/$m^2$ NPK at spaing 30x30 $cm^2$ while maximum average weight of corm was recorded with *T.Viride* and $GA_3$ 100 ppm.

## Protected Cultivation of Vegetables

High value crops like tomato, capsicum and cucumber were raised under protected low cost polyhouses using different training systems and spacings. Among tomato hybrids Himsona, CITH-TH-1 and SH-TH-1 were found best. In cucumber Japanese Green Long and Green Express varieties and in hybrids, SH-CH-1 were found best having high yield and quality. In capsicum SH-SP-706 performed better. However, among hybrids NS-281, Bombay, Shalimar capsicum hybrid-1(Y) and Shalimar capsicum hybrid -2 (R) were found best. Among pruning and spacing levels double stem and 90x45 cm spacing in tomato, single stem and 120x60 cm spacing in cucumber and single stem and 20x50 cm spacing in capsicum were found best with highest fruit yield and quality.

## Plant Health Mangement

Wilt diseases in chilli is a major problem in the Kashmir valley. The maximum disease mitigation (61.7%) was recorded with *T. viride* seed priming, carbendazim root dip and soil drenching and solarization with transparent polythene followed by *T. viride* seed priming, Ridomil MZ root dip and soil drenching and solarization with transparent polythene.

For management of white grub, the soil application of *B. bassiana* formulation in maizemeal-sand medium under mild infestation conditions resulted in abatement of infestation upto 77.6 percent with application at 80g/tree in root zone of walnut trees however in apple soil application of *B. bassiana* formulation in maize meal-sand medium under mild infestation conditions resulted in abatement of infestation up to 62.0 percent with application at 80 g/ tree.

For management of apple scab in variety Benoni , spray of 0.05 percent Kresoxim methyl resulted in minimum infection of scab on terminal leaves 3.20% followed by 5.30 % on terminal leaves with spray of 0.03 % Kresoxim methyl and 9.40 % with 0.05 percent Hexaconazole as compared to 40.80 percent terminal leaf infection in check. Similar results were also obtained in other varieties of apple namely Red Gold and Golden Delicious .

For control of mites in apple, different, concentrations of acaricides were tried under glass house conditions where the plants which received treatment of 0.005% Fenpyroximate resulted in better plant growth while under field conditions, all the acaricide treatments recorded zero mite population after 7 days of treatment though counting of mite population just before the first spray was 3.53 to 5.10 mites/leaf. Fenpyroximate 5% SC @ 0.005% concentration was significantly superior to all other treatments at all the intervals of observations recording 0.0 to 0.67 mites/leaf without any phytotoxic effect on plants.

## Post Harvest Management

Under minimal processing and packaging the capsicum fruits washed and treated with sodium hypochlorite for 1 minute followed by 1% citric acid and packed in 25 µ semi permeable film stored for 32 days at room temperature and 50 days at low temperature (5 ± 2 °C, RH 90 %) showing minimum physiological loss in weight, retaining maximum vitamin C and firmness.

In cherry, edible coating of *Aloe vera* gel in the concentration of 1:1 and storage at low temperature (5 ± 2 °C, RH 90 %) extended the shelf life up to 36-40 days with least PLW, maximum ascorbic acid, TSS and firmness of fruits compared to control. In nectarine shrink wrapped Fantasia fruits kept at low temperature stored up to 40 days with least loss in

physiological weight and quality parameters. Similarly apple variety Mollis Delicious coated with 50% *Aloe vera* gel and shrink wrapped in 25 µ film followed by storing at low temperatures (5 ± 2°C) stored up to 68 days without deteriorating quality while in variety Red Chief, Golden Delicious and Red Fuji shrink wrapping with 25 µ film increased shelf life and retained quality as compared to control. The preharvest spray of GA+Ca EDTA+ post harvest salicylic acid also extended shelf life and retained quality in apple.

In apricot, pre-harvest application of calcium chloride (1.5 %) at 80% blooming, fruit set and 15 days before harvest was found most effective in minimizing the physiological loss in weight of apricot fruits during storage as compared to control. Among varieties CITH-A-1, Afgani and CITH-A-2 had maximum TSS and desirable acidity and retained shelf life up to 30 days under low temperature.

A technology was also developed for the preparation of quality Apricot fruit bar. The fruit bar had excellent texture, colour, aroma, taste chewing quality, no sticking character and has acceptable microbial load, least browning and spoilage which can be stored up to 9 months without loss in quality, nutrition and appeal. Similarly a technology for preparation of squash using minor fruits like rhododendron+galgal+ginger was also developed and evaluated and found superior in quality attributes. In tulip, the cold treatment of bulbs induced early flowering and extended blooming period while CCC and MH induced late flowering but increased flowering duration.

# Introduction

The existing production of temperate fruits in the country has reached to about 25.8 lakh tonnes while the demand as per the normal dietary requirement is about 44 lakh tonnes, resulting in a deficit of about 18 lakh metric tonnes. No doubt, there has been an increase in the area, production and productivity over the period, but this increase has not been concomitant with the increase in population. The productivity too is below the world average and much below the developed nations mainly because the indigenous genetic sources have remained unexplored and/or the exotic genetic sources and technologies are yet to be exploited fully. Considering the enormous natural resource availability as well as keeping in view the productivity and quality of crop produce compared to developed countries, there is a lot to be done in crop improvement, production, protection, post harvest management of temperate horticultural crops. With the increasing competition from other countries, climate change etc., technologies and the varieties/ hybrids suiting to both consumers and producers should be made available.

To exploit the vast potential of temperate horticultural crops and in their production and productivity, the research on temperate horticultural crops is being focused and concentrated at Central Institute of Temperate Horticulture, Srinagar and its Regional Station, Mukteshwar (Uttarakhand) with the following mandates and objectives.

## Mandate

- To act as national repository for 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 towards enhance productivity and quality.
- To serve as centre for training in human resource development and transfer of technology.

## Major Objectives

- To augment the existing germplasm with superior genotypes from indigenous as well as exotic

**Staff Position (2010-11)**

| Category | Sanctioned | Filled | Vacant |
|---|---|---|---|
| Scientific | 21+1 RMP | 13+1 RMP | 08 |
| Administrative | 14 | 9 | 05 |
| Technical including driver | 13 | 13 | 00 |
| Supporting | 15 | 09 | 06 |
| Total | 63+1RMP | 44+RMP | 19 |

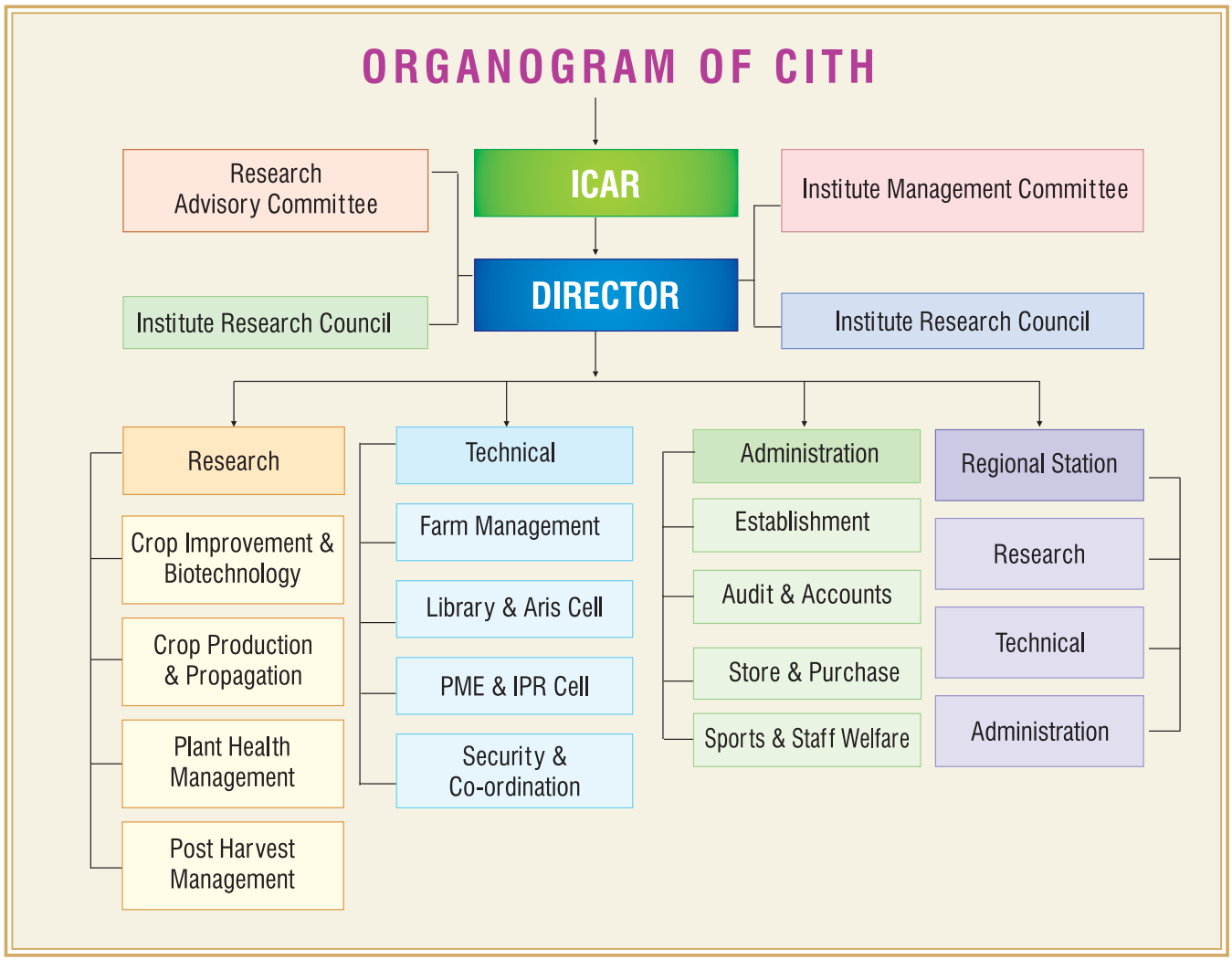
**Financial Statement (2010-2011)**

| S. No. | Sub-Head | Non-Plan | | Plan | |
|---|---|---|---|---|---|
| | | Allocation | Expenditure | Allocation | Expenditure |
| 1 | Establishment Charges | 224.27 | 222.41 | 2.00 | 1.99 |
| 2 | T.A. | 4.00 | 3.08 | 7.00 | 7.00 |
| 3 | Other charges | 104.73 | 102.19 | 189.41 | 189.41 |
| 4 | Works | 1.00 | 1.00 | 111.59 | 111.59 |
| 5 | Net work project | - | - | 40.00 | 40.00 |
| | **TOTAL** | **334.00** | **328.68** | **350.00** | **349.99** |

(Values in Lacs.)

sources having resistance to biotic and abiotic stresses.

- To devise efficient propagation and cost effective production technologies for increasing production, productivity and improving quality of temperate horticultural crops including intercropping and development of cropping systems.
- To develop eco-friendly disease and pest management techniques including mitigation of post harvest spoilage.
- To reduce post-harvest and storage losses to minimum level so as to generate more income through value addition and processing.
- To increase foreign exchange earnings through export and to reduce import of horticultural produce / products.



## Crop Improvement and Biotechnology

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

Collection of elite genotypes, their characterization, documentation and establishment in the field including their *in vitro* conservation has become increasingly important for any crop improvement programme. Under genetic resource management, as many as 1976 germplasm lines of temperate horticultural crops have been maintained and characterized both at morphological and molecular level (Table-1).

**Table 1: Germplasm collection and conservation at CITH**

| S.No. | Crop / Group | Total collection |
|---|---|---|
| 1 | Fruits | 799 |
| | Pome | 275 |
| | Stone | 131 |
| | Nuts | 273 |
| | Others | 120 |
| 2 | Vegetables | 930 |
| 3 | Ornamentals | 222 |
| 4 | Medicinal & aromatic plants | 25 |
| | **Total** | **1976** |

In apple, a total of 225 exotic and indigenous apple cultivars / genotypes have been collected, conserved and evaluated for their growth, yield and quality attributes. Highest fruit weight in apple selections was recorded in CITH AB-2 (25.99) and TSS (14.8 °B) in CITH – AB -3. The bud wood /graft wood of all the elite collections of Red Delicious , Ambri and Quince have been budded/or grafted on seeding root stocks for further evaluation. Among early varieties, evaluated at Srinagar (Table-2) Mollies Delicious yielded highest (21.1 t/ha) followed by Vista Bella (17.30 t/ha) and Anna (7.8 t/ha). While at Mukteshwar, among the 24 varieties (Table-3) the higher fruit fyield per tree was obtained wth prima (88 kgs) followed by Skyline supreme (82 kgs), Summer Red (81.5 kgs) and Red Spur Delicious (81 kgs). The cultivars namely True Ambri, Kasseri, Chamura, Saharanpuri, Razakwari were also

Elite apple genotypes

collected and multiplied. Besides varieties, a clonal root stock of *Prunus tomentosa* and a collection of nine variants of *Mallus baccata* have also been made and conserved in the field gene bank.

In walnut, a field gene bank of 402 mostly consisting indigenous genotypes have been established along with few exotic and indigenous varieties released by SKUAT(K) namely Hamdan and Suleiman and five varieties released by CITH namely CITH-Walnut- 1,2,3,4 and 5. Ninty genotypes out of 402 were assessed for various traits whose nut and kernel weight ranged from 7.67g to 27.93g and 4.22 to 14.60g respectively with the highest nut and kernel weight of

New promising cluster type walnut breeding lines.

A highly productive CITH walnut-I in full bearing

Promising genotype of apricot

27.93 g and 14.6g by CITH-W-1 followed by CITH-W-7 (24.72g) and CITH-W-11 (23.69g) and these are being multiplied for further evaluation and distribution.

A field gene bank of 30 exotic and indigenous varieties and genotypes of almond including some late blooming genotypes has been established and evaluated for yield and other morphological traits. Among the genotypes, the maximum yield (2.94 t/ha) was recorded in variety Pranyaj while the genotype CITH-10 performed well in respect to shell softness and kernel size.

In apricot, 49 exotic and indigenous varieties/ genotypes have been established and evaluated. Among these, three recently released cultivars namely CITH Apricot-1, 2 and 3 alongwith the exotic varieties i.e. Harcot and Erani were found very promising in terms of yield and TSS content. The selection CITH-A-24, was found to be very sweet in taste with highest (T.S.S. 28.36$^{0}$Brix) followed by CITH-A-14 and were found promising for table purpose. (Table-4).

In plum, 25 varieties (indigenous and exotic) have been established and evaluated for growth, yield and

Promising plum cv. Krassivica

**Table 2: Evaluation of early maturing apple cultivars**

| Variety | Date of ripening | Yield (t/ha) | Fruit weight (g) | T.S.S. ($^0$Brix) | Acidity (%) | Total sugar (%) |
|---|---|---|---|---|---|---|
| Mollies Delicious | 27/07 | 21.10 | 216.78 | 13.8 | 0.67 | 19.6 |
| Vista Bella | 05/07 | 17.30 | 138.33 | 16.06 | 1.70 | 13.4 |
| Benoni | 08/07 | 2.90 | 120.66 | 14.86 | 0.23 | 19.0 |
| June Eating | 11/07 | 4.78 | 52.67 | 13.43 | 0.43 | 12.4 |
| Anna | 16/07 | 7.88 | 63.99 | 14.36 | 0.50 | 16.2 |
| Summer Red | 28/07 | 2.63 | 151.79 | 9.83 | 0.50 | 6.0 |
| Gold Spur | 26/07 | 3.80 | 183.91 | 9.16 | 0.57 | 8.2 |
| Michael | 26/07 | 5.10 | 146.37 | 8.66 | 0.50 | 13.0 |
| Tyde Mans Early Worcestors | 27/07 | 3.87 | 160.33 | 10.1 | 0.60 | 7.0 |
| Black Ben Davis | 30/07 | 1.94 | 88.86 | 12.03 | 0.60 | 9.23 |
| Red Baron | 09/08 | 2.10 | 127.9 | 13.13 | 0.5 | 11.9333 |
| Scarlet Gala | 09/08 | 2.16 | 148.5 | 15.07 | 0.60 | 9.23333 |
| CD at 5% | —— | 0.16 | 22.71 | 1.05 | 0.30 | 1.33566 |
| SE mean Diff. | —— | 0.77 | 10.95 | 0.5 | 0.12 | 0.644048 |

quality. Maximum trunk cross-sectional area of plum tree was recorded in the variety Santa Rosa (Table-5 ). However, fruit number and yield was maximum (985 number, 20 kg/tree and 8 t/ha) in cv. Kubio. The total soluble solids (17.70 $^0$Brix) were maximum in cv. Krassivica.

In cherry, a field gene bank comprising 34 indigenous and exotic varieties has been established. Among the collections, ten genotypes have come to bearing which have been evaluated for yield and other traits (Table-6). The genotype, CITH-Cherry-05 registered highest yield upto 8.32 kg/plant followed by CITH-Cherry-01 (6.47 kg/plant) (Table-5). While among commercially grown cultivars Bigarreau Napoleon recorded highest yield (4.69 kg/tree) the TSS however (17.53 $^0$ Brix) was maximum in CITH -Cherry-05. All these elite genotypes are being multiplied on clonal rootstocks Colt, Mazzard and Mahaleb and sour cherry seedlings.

In peach and nectarine, a total of 30 exotic and indigenous cultivars have been collected and conserved while sixteen varieties were evaluated for growth, yield and quality attributes. Among these, 5 exotic varieties (Fanatasia, Crest Heaven, Red Globe, Glov Heaven, Early Red June) and 2 indigenous collections (CITH Peach-1 and Nimala) have been found very promising with respect to yield and fruit weight


(Table-7). Highest TSS content was recorded in Crest Heaven, Red Globe, Gloheaven, Elberta, July Elberta, Peshawari. Whereas, high content of vitamin C was recorded in Fantasia, Red Globe , K-209014, Elberta and Flemish Beauty.

In Olive, 19 varieties have been established in the field gene bank that include collections from USA, Egypt etc. The preliminary observations on plant growth and fruit yield indicated that varieties such as Pendolino, Coratina, Leccino, Frontoio, Cipressino and Messenese have been found to be best in terms of plant growth, fruit set and yield after their third year of

**Table 3: Physico-chemical characteristics of apple fruits of different promising cultivars**

| Cultivars | Fruit weigh(g) | Fruit length (cm) | Fruit Dia. (cm) | TSS ($^0$B) | Colour (Score) | Harvest days from full bloom | Ascorbic acid (mg/100g) | Firmness (kg/cm$^2$) | Yield (kg/tree) |
|---|---|---|---|---|---|---|---|---|---|
| Schlomit | 169.4 | 6.5 | 7.0 | 11.5 | 3.2 | 100 | 20 | 7.4 | 64.0 |
| Mayan | 160.7 | 6.3 | 6.9 | 11.7 | 3.8 | 102 | 20 | 7.2 | 61.0 |
| Michael | 158.9 | 5.8 | 6.6 | 11.0 | 3.4 | 100 | 22 | 7.4 | 63.3 |
| Vance Delicious | 191.3 | 7.1 | 7.7 | 12.4 | 4.0 | 110 | 16 | 7.8 | 75.3 |
| Mollies Delicious | 180.5 | 7.3 | 8.1 | 12.0 | 3.4 | 113 | 16 | 7.5 | 73.6 |
| Prima | 177.6 | 6.5 | 7.4 | 11.0 | 3.4 | 112 | 27 | 7.7 | 88.0 |
| Summer Red | 186.0 | 7.2 | 7.6 | 11.1 | 3.5 | 113 | 26 | 7.6 | 81.5 |
| Well Spur | 190.3 | 7.2 | 7.7 | 12.6 | 4.0 | 123 | 13 | 8.3 | 73.6 |
| Starkrimson | 188.3 | 7.1 | 7.4 | 12.6 | 4.0 | 118 | 13 | 8.4 | 78.0 |
| CITHRS Apple | 185.3 | 6.7 | 7.7 | 12.4 | 3.2 | 120 | 12 | 8.0 | 76.3 |
| Red Spur Delicious | 182.5 | 6.6 | 7.0 | 12.6 | 4.0 | 117 | 15 | 8.4 | 81.0 |
| Skyline Supreme | 186.9 | 6.7 | 7.5 | 12.8 | 4.0 | 118 | 12 | 8.3 | 82.0 |
| Oregon Spur | 185.7 | 7.4 | 7.8 | 12.9 | 3.8 | 117 | 12 | 8.2 | 72.0 |
| Red Chief | 193.6 | 7.1 | 7.6 | 13.0 | 4.0 | 120 | 12 | 8.8 | 70.4 |
| Rich-a-Red | 185.0 | 6.6 | 7.2 | 12.2 | 4.0 | 130 | 14 | 8.0 | 68.6 |
| Golden Spur Delicious | 188.5 | 7.1 | 7.7 | 12.5 | 3.5 | 135 | 24 | 7.9 | 79.4 |
| Stark Spur Delicious | 185.0 | 6.8 | 7.6 | 12.7 | 3.8 | 133 | 20 | 8.2 | 78.9 |
| Cooper 4 | 189.0 | 7.3 | 7.6 | 13.4 | 4.0 | 118 | 15 | 8.7 | 73.2 |
| Chaubattia Princess | 165.4 | 5.4 | 6.5 | 11.5 | 3.5 | 118 | 18 | 7.3 | 70.8 |
| Vermont Spur | 194.0 | 6.9 | 7.6 | 12.4 | 3.7 | 122 | 14 | 9.1 | 80.5 |
| Hardy Spur | 178.0 | 6.4 | 6.9 | 11.9 | 3.2 | 123 | 15 | 8.3 | 65.4 |
| Bright-N-Early | 183.0 | 6.7 | 7.5 | 12.3 | 4.0 | 119 | 14 | 8.6 | 74.8 |
| Gala Must | 186.0 | 6.5 | 7.5 | 12.3 | 3.6 | 121 | 16 | 8.2 | 71.5 |
| Closter | 105.0 | 5.4 | 6.4 | 13.2 | 3.6 | 115 | 15 | 7.0 | 69.7 |
| Top Red | 175.0 | 6.4 | 7.1 | 11.6 | 3.4 | 123 | 15 | 7.9 | 68.3 |

**Table 4: Evaluation of apricot varieties/ genotypes for fruit yield and quality**
(top twenty varieties)

| S.No | Variety/germplasm | Fruit wt(g) | No of fruit/pt | Yield (kg/pt) | TSS (°Brix) | Acidity (%) |
|---|---|---|---|---|---|---|
| 1. | CITH Apricot-1 | 96.20 | 905 | 87.06 | 17.9 | 0.128 |
| 2. | CITH Apricot-2 | 78.97 | 786 | 62.07 | 16.7 | 0.192 |
| 3. | CITH Apricot-3 | 59.27 | 895 | 53.45 | 17.0 | 0.256 |
| 4. | Harcot | 39.63 | 1489 | 59.23 | 14.90 | 0.192 |
| 5. | Erani | 68.6 | 919 | 63.12 | 17.4 | 0.192 |
| 6. | New Castle | 43.39 | 1131 | 49.78 | 17.1 | 0.128 |
| 7. | Turkey | 33.07 | 1452 | 48.46 | 15.2 | 0.192 |
| 8. | Heartly | 31.23 | 1505 | 47.24 | 20.6 | 0.128 |
| 9. | Balcota | 41.72 | 911 | 38.56 | 15.6 | 0.256 |
| 10. | Tokpopa | 60.80 | 543 | 36.98 | 18.5 | 0.128 |
| 11. | Fair | 32.46 | 1264 | 41.54 | 20.1 | 0.064 |
| 12. | Viva Gold | 49.69 | 61 | 3.68 | 21.05 | 0.128 |
| 13. | Afgani | 32.71 | 1437 | 47.87 | 22.4 | 0.192 |
| 14. | Communis | 56.33 | 835 | 47.24 | 16.2 | 0.256 |
| 15. | CITH Apricot-11 | 72.01 | 473 | 34.62 | 18.7 | 0.192 |
| 16. | CITH Apricot-14 | 31.07 | 580 | 18.43 | 22.6 | 0.128 |
| 17. | CITH Apricot-17 | 20.23 | 396 | 8.46 | 21.5 | 0.128 |
| 18. | CITH Apricot-23 | 27.97 | 608 | 17.63 | 20.5 | 0.128 |
| 19. | CITH Apricot-24 | 26.27 | 800 | 21.35 | 28.36 | 0.192 |
| 20. | CITH Apricot-37 | 35.95 | 585 | 21.45 | 19.20 | 0.192 |

**Table 5: Evaluation of different cherry cultivars for growth, yield and quality**

| Variety | Tree Height (m) | Trunk Girth (mm) | No. of Flowers/ | No. of Fruits/ plant | Yield/ plant (kg) | Fruit weight (g) | T.S.S. (°B) | Acidity (%) |
|---|---|---|---|---|---|---|---|---|
| Bigarreau Napoleon | 2.83 | 44.06 | 1541.67 | 1342.11 | 4.69 | 3.80 | 13.97 | 1.45 |
| Bigarreau Noir Grossa | 2.31 | 31.01 | 1384.67 | 1213.33 | 4.38 | 3.57 | 13.07 | 1.12 |
| CITH-Cherry-05 | 2.42 | 59.01 | 1322.00 | 1217.33 | 8.32 | 6.67 | 17.53 | 1.58 |
| CITH-Cherry -01 | 1.89 | 46.70 | 1118.70 | 1052.00 | 6.47 | 6.07 | 14.03 | 1.51 |
| CITH-Cherry -02 | 2.46 | 53.75 | 1201.89 | 1080.67 | 6.45 | 5.84 | 13.47 | 1.50 |
| CITH-Cherry -03 | 1.77 | 47.19 | 1011.83 | 910.67 | 3.33 | 4.25 | 16.52 | 1.60 |
| Van | 1.84 | 26.94 | 440.15 | 294.00 | 1.49 | 4.99 | 13.07 | 1.37 |
| Lapinus | 2.72 | 56.86 | 461.33 | 370.00 | 2.32 | 6.18 | 15.10 | 1.36 |
| Lambert | 2.60 | 73.14 | 440.67 | 338.33 | 1.27 | 4.11 | 13.13 | 1.23 |
| Bing | 3.05 | 80.25 | 183.67 | 96.67 | 0.30 | 3.90 | 14.53 | 1.67 |
| CD at 5 % | 0.29 | 4.31 | 162.43 | 158.43 | 0.58 | 1.03 | 1.32 | NS |
| SEm | 0.14 | 2.06 | 77.86 | 75.95 | 0.27 | 0.49 | 0.63 | NS |

Leccino

Pendolino

plantation (Table-8). The fruit yield was maximum in variety Corotina (910 g/ tree) followed by Leccino (268 g/tree) and *Pendolino* (239 g/tree).

In Kiwi fruit, five exotic genotypes have been collected and planted in the field for evaluation for different quantitative and qualitative traits in temperate region. Among the varieties Hayward, started flowering in the third year of planting. For popularization of kiwifruit cultivation, participatory demonstration trails at various sites (Baramulla, Uri, Salamabad, Srinagar, Budgam) in Kashmir region have also been established at farmer's fields whose results are very encouraging.

A field gene bank of eight varieties of pomegranate has been established for evaluation. The results indicated that the cv. Dholka, Bedana and Kandhari performed better under Karewa conditions of Kashmir valley with maximum fruit yield that is significantly higher when compared to Kashmiri local cultivar (Table-9). Maximum TSS and ascorbic acid content were observed in Jyoti, Dholka and Kandhari, while minimum fruit cracking was recorded in Chawla, Mirdula and Jyoti. Pest incidence (Annar butterfly) was maximum in local Kashmiri.

In chilli, germplasm of 256 genotypes have been collected and evaluated. Among the selections, few promising lines have been identified on the basis of colour and yield characters. In sweet pepper, eight lines among 54 genotypes are very promising with excellent fruit quality traits.

A collection of 36 genotypes in onion (red, white, yellow, bunching and multiplier types), 23 genotypes in garlic, 2 in leak, 23 in lettuce, 2 in Asparagus, 85 in kale, 36 in peas, 64 in tomato, 43 in carrot, 38 in brinjal, 2 in swisschard, 3 in chinese cabbage, 6 each in broccoli, and radish, 26 in turnip, 5 in cucumber, 8 in pran, 1 in brussels sprouts, 2 in parsely and 2 in celery are being evaluated and multiplied. From among the genotypes, one genotype in onion, two advance breeding lines of chilli, two selections in kale and two elite clones of garlic have been introduced in AICRP vegetable trials for their performance evaluation in multi locations across the country.

A field gene bank of 32 accessions of saffron has also been made which comprise of accessions having pistil length of 42-64 mm, pistil weight of 6.0-8.2 mg. and saffron yield of 3.0 to 4.2 kg/ha in the 3rd year of field trial.

**Table 6: Evaluation of plum varieties for yield and quality**

| S.No. | Variety /cultivar | TCA ($cm^2$) | No. of fruit / plant | Fruit Wt.(g) | Yield (kg / tree) | Yield (t / ha) | T.S.S. ($^0$ Brix) |
|---|---|---|---|---|---|---|---|
| 1. | Kubio | 16.13 | 985 | 20.32 | 20.00 | 8.00 | 12.30 |
| 2. | Methely | 50.56 | 707 | 18.40 | 13.00 | 5.20 | 12.30 |
| 3. | Krassivica | 31.05 | 339 | 24.52 | 8.35 | 3.32 | 17.70 |
| 4. | Prune | 42.11 | 258 | 11.66 | 3.67 | 1.20 | 16.90 |
| 5. | Kanto-5 | 31.21 | 452 | 27.04 | 12.20 | 4.88 | 9.50 |
| 6. | Au-Rosa | 28.74 | 436 | 44.80 | 19.50 | 7.80 | 13.60 |
| 7. | Red Plum | 32.90 | 149 | 40.37 | 6.15 | 2.40 | 11.10 |
| 8. | Santa Rosa | 43.45 | 183 | 87.12 | 15.00 | 6.00 | 16.30 |
| 9. | Black Amber | 17.32 | 152 | 46.06 | 7.45 | 2.80 | 11.60 |
| 10. | Burbank | 12.44 | 309 | 25.90 | 8.20 | 3.20 | 11.10 |
| 11. | Beauty | 25.79 | 137 | 36.58 | 5.20 | 2.00 | 14.50 |
| 12. | Grand Duke | 33.0 | 467 | 34.25 | 16.23 | 6.40 | 12.20 |
| 13. | Tarkol | 18.75 | 309 | 45.29 | 14.56 | 5.60 | 9.53 |

**Table 7: Phenological, yield and qualitative traits of different varieties of peach/nectarine**

| No. of Genotypes Density 2.5 × 2.5 | Date of bud burst | 75% flowering | No. of fruit/ plants | Yield (t/ha) | Fruit weight (gm) | TSS ($^0$ Brix) | Acidity (%) | Ascorbic acid (mg/100g) | Stone wt. (mg/ 100g) |
|---|---|---|---|---|---|---|---|---|---|
| Fantasia | 13.310 | 19.3.10 | 204 | 36.22 | 111.667 | 12.43 | 0.312 | 6.30 | 6.26 |
| Crest Heaven | 15.3.10 | 21.3.10 | 155 | 15.10 | 97.92 | 15.22 | 0.320 | 5.36 | 7.01 |
| Red Globe | 17.3.10 | 19.3.10 | 153 | 25.21 | 103.33 | 13.20 | 0.285 | 6.60 | 7.88 |
| Nimla | 17.3.10 | 21.3.10 | 423 | 57.33 | 140.35 | 11.18 | 0.249 | 4.80 | 8.20 |
| Gloheaven | 17.3.10 | 20.3.10 | 145 | 35.81 | 96.52 | 14.23 | 0.254 | 5.70 | 6.53 |
| Elberta | 16.3.10 | 21.3.10 | 55 | 5.53 | 63.66 | 7.20 | 0.021 | 8.40 | 3.60 |
| Snow queen | 19.3.10 | 22.3.10 | 28 | 1.44 | 32.78 | 10.43 | 0.401 | 6.01 | 2.50 |
| Flemish Beauty | 17.3.10 | 22.3.10 | 32 | 2.53 | 61.00 | 14.10 | 0.254 | 6.61 | 8.73 |
| Summerglo | 18.3.10 | 23.3.10 | 26 | 12.91 | 57.86 | 12.27 | 0.333 | 6.51 | 3.50 |
| Quaita | 17.3.10 | 20.3.10 | 142 | 14.38 | 62.01 | 50.31 | 0.133 | 4.81 | 3.77 |
| K-209014 | 18.3.10 | 22.3.10 | 173 | 6.68 | 59.77 | 13.10 | 0.213 | 5.31 | 3.44 |
| Fertillia | 13.3.10 | 22.3.10 | 94 | 12.21 | 81.27 | 13.28 | 0.191 | 6.01 | 7.10 |
| Peshawari | 17.3.10 | 21.3.10 | 73 | 3.73 | 35.21 | 12.08 | 0.205 | 6.24 | 3.03 |
| Kanto-5 | 16.3.10 | 20.3.10 | 90 | 10.93 | 76.10 | 12.33 | 0.286 | 5.71 | 4.52 |
| Early Red June | 13.3.10 | 18.3.10 | 135 | 19.43 | 90.37 | 9.10 | 0.266 | 3.81 | 6.35 |
| CITH P-1 | 15.3.10 | 21.3.10 | 220 | 44.00 | 8.20 | 13.43 | 0.211 | 4.81 | 2.91 |

**Table 8: Varietal performance of olive genotypes**

| Variety | Plant height (cm) | Stem girth (mm) | No. of branches | Date of bud burst | Date of flowe-ring | No. of inflorescence /branch | No. of fruits/ inflore-scence | Final fruit retention/ on plant | Yield/ plant (gm) |
|---|---|---|---|---|---|---|---|---|---|
| Pendolino | 168.16 | 30.04 | 50.33 | 15$^{th}$ March | 1$^{st}$April | 12 | 20 | 80 | 239.2 |
| Coratina | 150.00 | 22.34 | 12.00 | 17$^{th}$ march | 3$^{rd}$April | 15 | 28 | 200 | 910.0 |
| Leccino | 158.66 | 16.43 | 18.16 | 18$^{th}$ march | 4$^{th}$April | 14 | 30 | 100 | 268.0 |
| Frontoio | 143.75 | 21.11 | 37.50 | 12$^{th}$ march | 3$^{rd}$April | 20 | 40 | 30 | 38.10 |
| Cipressino | 138.83 | 20.96 | 18.83 | 16$^{th}$ march | 5$^{th}$April | 15 | 35 | 70 | 165.90 |
| Messenese | 143.16 | 14.64 | 22.16 | 17$^{th}$ march | 2$^{nd}$April | 16 | 25 | 10 | 20.64 |

In ornamental, medicinal and aromatic plants, a total of 98 genotypes have been collected, evaluated and maintained for further breeding as well as development of suitable technologies for growing under protected and open field conditions.

In grape a total of eight varieties were evaluated for growth, yield and quality traits. The variety Hussaini and Sahibi were found best in terms of fruit yield and quality with maximum berry weight in Hussaini (1.5g) followed by Sahibi (1.3 g).

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

Fruit set and compatibility studies of inter varietal crosses indicated that in apple, Golden Delicious as a tester when crossed with other lines resulted in highest fruit set while with rest of testers there was differential cross compatibility (Table-10). Among the crosses the cross combinations Red Delicious x Oregon Spur, Red Delicious x Silver Spur, Red Delicious x Cooper IV, Lal Ambri x Silver Spur and Lal Ambri x Cooper IV showed least compatibility with minimum fruit set ranging from 0 to 7 percent. In other crosses, except for crosses Ambri x *M. floribunda* and Lal Ambri x Benoni, rest of the crosses showed moderate to high fruit set and were partially to fully compatible.

In cherry, Van x Double, Lambert x Stella, Stella x Mishri, Stella x Bing, Bing x Mishri and Bing x Bing registered more than 50 % fruit set and were found highly compatible while in rest of the crosses, it varied from 28-49 percent (Table-11).

## Assessment of pollen viability, germination and tube growth in commercial apple pollinizers

The pollen morphological homogencity varies with the pollinizers. The highest pollen morphological homogencity was obtained in Golden Delicious

Fig-1: Golden Delicious pollen morphological homogeneity under fluorescence microscope at 40x

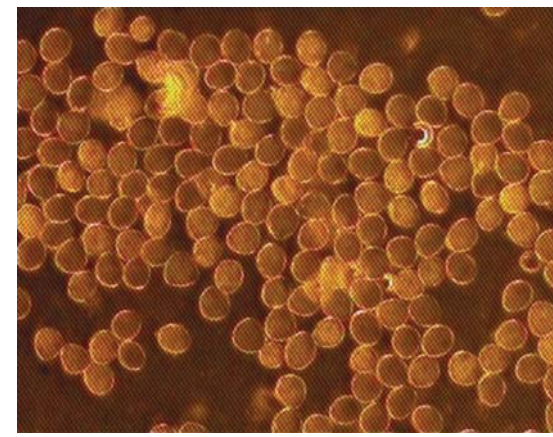


Fig-2: Golden Delicious pollen viability test with aceto-carmine stain under fluorescence microscope at 10x

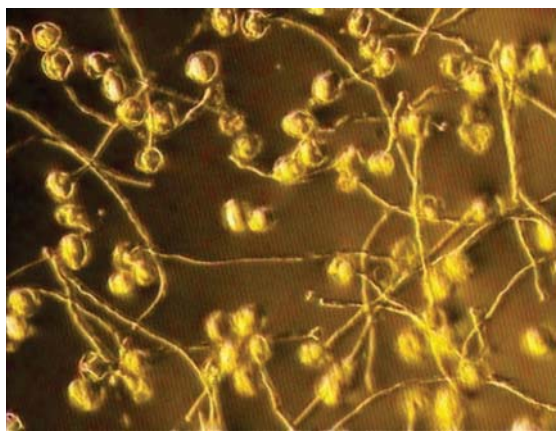


Fig-3: Golden Delicious pollen tube length in 10% sucrose solution in agar plat test under fluorescence microscope at 20x

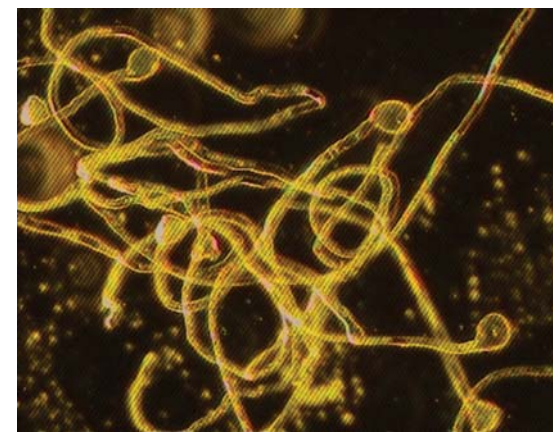


Fig-4: Golden Delicious pollen germination rate at 15% sucrose solution in hanging drop test under fluorescence microscope at 10x

**Table 9: Varietal evaluation of pomegranate cultivars for plant growth, yield and quality traits**

| Cultivar | Plant height (cm) | Plant spread (cm) | Av, fruits wt.(g) | Yeld (t/ha) | TSS (°B) | Vit. C (mg/ | Cracking (%) incidence | Annar butterfly |
|---|---|---|---|---|---|---|---|---|
| Chawla | 160.83 | 127.25 | 210.12 | 6.60 | 13.2 | 10.42 | 34.56 | 14.00 |
| Mridula | 75.38 | 85.39 | 223.23 | 2.56 | 14.1 | 10.24 | 33.87 | 16.00 |
| Jyoti | 125.44 | 126.38 | 234.06 | 5.34 | 14.54 | 12.27 | 33.77 | 12.25 |
| G-137 | 122.85 | 112.85 | 230.37 | 6.83 | 13.98 | 11.60 | 38.63 | 18.76 |
| Dholka | 130.55 | 124.69 | 252.22 | 10.90 | 14.59 | 12.78 | 41.85 | 16.12 |
| Dedana | 124.89 | 128.66 | 242.13 | 9.15 | 13.90 | 11.54 | 37.68 | 15.27 |
| Kandari | 128.6 | 119.28 | 245.92 | 9.74 | 14.17 | 12.51 | 45.68 | 19.25 |
| Local Kashmiri | 124.66 | 119.24 | 195.61 | 5.42 | 13.69 | 10.01 | 49.12 | 32.2 |

**Table10: Intervarietal crosses and cross compatibility studies in apple**

| Cross combinations ( Line X Tester) | Fruit set (%) |
|---|---|
| Mollies Delicious X Red Delicious | 57.75 |
| Oregon Spur X Red Delicious | 3.28 |
| Silver Spur X Red Delicious | 4.82 |
| Granny Smith X Red Delicious | 55.37 |
| Coe Red Fuji X Red Delicious | 39.76 |
| Top Red X Red Delicious | 40.63 |
| Cooper IV X Red Delicious | 1.33 |
| Mollies Delicious X Golden Delicious | 75.33 |
| Oregon Spur X Golden Delicious | 90.64 |
| Silver Spur X Golden Delicious | 96.81 |
| Granny Smith X Golden Delicious | 72.00 |
| Coe Red Fuji X Golden Delicious | 70.49 |
| Cooper IV X Golden Delicious | 73.50 |
| Mollies Delicious X Ambri | 49.99 |
| Oregon Spur X Ambri | 32.31 |
| Silver Spur X Ambri | 44.88 |
| Granny Smith X Ambri | 36.92 |
| Coe Red Fuji X Ambri | 55.00 |
| Cooper IV X Ambri | 63.86 |
| Mollies Delicious X Lal Ambri | 40.14 |
| Oregon Spur X Lal Ambri | 34.28 |
| Silver Spur X Lal Ambri | 7.00 |
| Granny Smith X Lal Ambri | 15.55 |
| Coe Red Fuji X Lal Ambri | 64.01 |
| Cooper IV X Lal Ambri | 0.00 |
| **Other crosses** | |
| Top Red x Golden Delicious | 22.64 |
| Gala Mast x Golden Delicious | 53.98 |
| *M. Floribunda* x Ambri | 15.20 |
| Snow Drift x Ambri | 68.05 |
| Maharaji x Ambri | 55.16 |
| Top Red x Ambri | 62.67 |
| Gala Mast x Ambri | 35.30 |
| Snow Drift x Lal Ambri | 23.33 |
| Benoni x Lal Ambri | 14.17 |
| Top Red x Lal Ambri | 21.84 |
| Oregon Spur x Lal Ambri | 34.28 |
| Manchurian x Lal Ambri | 23.33 |
| CD at 5% | 3.14 |
| S.E (mean diff.) | 1.57 |

followed by Red Gold, Granny Smith, Gold Spur, Tydmans Early respectively. The highest pollen viability of commercial apple pollinizers was obtained in the acetocarmine in all the varieties followed by IKI. In hanging drop method with 15% sucrose solution maximum pollen germination was recorded in Golden Delicious followed by Gold Spur, Granny Smith, Red Gold, Tydman Early respectively. In agar plate germination with 15% sucrose solution, maximum germination was observed in Golden Delicious followed by Tydeman's Early, Granny Smith, Red Gold, Gold Spur, respectively. Maximum tube growth was recorded in Golden Delicious with 15% sucrose in hanging drop method while in agar plate germination method, maximum pollen tube length was recorded in Golden delicious with 10% sucrose. Pollen production (total no. pollen /flower) was highest in Golden Delicious than Gold Spur, Tydemans Early, Red Gold, and Granny Smith respectively.

## Evaluation of walnut genotypes in relation to floral biology and yield attributing traits

To find out the flowering physiology of walnut and to select the suitable pollinizers, thirty three genotypes were evaluated during 2010-11. Among these, 17 genotypes were found protogynous where as 16 were protoandrous. Male flower blooming ranged from 7 days to 23 days in different genotypes where as female

**Table 11: Influence of diallel cross combinations on fruit set and quality of cherry cultivars**

| Cross Combinations | Per cent fruit set | Fruit weight(g) | Fruit length(mm) | Fruit dia.(mm) | T.S.S. (ºB) | Acidity (%) |
|---|---|---|---|---|---|---|
| Mishri x Mishri | 30.98 | 5.57 | 20.33 | 20.55 | 15.10 | 1.15 |
| Mishri x Van | 28.78 | 5.64 | 21.76 | 22.50 | 16.65 | 1.25 |
| Mishri x Double | 40.37 | 3.93 | 20.54 | 21.09 | 14.60 | 1.24 |
| Mishri x Lambert | 31.08 | 3.89 | 20.17 | 21.35 | 14.96 | 1.25 |
| Mishri x Stella | 32.45 | 3.92 | 19.96 | 21.22 | 13.60 | 1.49 |
| Mishri x Bing | 47.73 | 4.40 | 20.36 | 21.18 | 13.93 | 1.30 |
| Van x Mishri | 44.74 | 5.18 | 19.92 | 18.96 | 13.30 | 1.41 |
| Van x Van | 40.78 | 5.25 | 18.01 | 20.01 | 15.56 | 1.22 |
| Van x Double | 76.06 | 4.20 | 19.78 | 18.89 | 14.40 | 1.27 |
| Van x Lambert | 31.92 | 3.86 | 16.92 | 17.30 | 18.23 | 1.28 |
| Van x Stella | 34.54 | 2.98 | 16.46 | 12.46 | 11.33 | 1.24 |
| Van x Bing | 32.67 | 4.21 | 19.02 | 17.71 | 14.30 | 1.21 |
| Double x Mishri | 40.64 | 3.88 | 19.80 | 19.08 | 16.26 | 1.33 |
| Double x Van | 38.42 | 4.63 | 20.64 | 21.98 | 15.10 | 1.21 |
| Double x Double | 44.44 | 5.32 | 19.74 | 20.55 | 15.26 | 1.29 |
| Double x Lambert | 39.07 | 4.18 | 19.99 | 18.15 | 14.50 | 1.28 |
| Double x Stella | 37.68 | 4.50 | 20.00 | 18.40 | 15.70 | 1.41 |
| Double x Bing | 42.69 | 3.66 | 18.92 | 19.17 | 14.00 | 1.34 |
| Lambert x Mishri | 38.48 | 4.18 | 19.38 | 19.47 | 15.80 | 1.19 |
| Lambert x Van | 42.27 | 4.16 | 19.22 | 18.38 | 15.00 | 1.23 |
| Lambert x Double | 39.02 | 4.21 | 19.95 | 18.57 | 15.23 | 1.27 |
| Lambert x Lambert | 44.57 | 5.24 | 19.32 | 20.71 | 15.00 | 1.17 |
| Lambert x Stella | 54.12 | 3.51 | 19.36 | 19.65 | 15.86 | 1.38 |
| Lambert x Bing | 42.18 | 3.99 | 19.34 | 18.18 | 15.80 | 1.39 |
| Stella x Mishri | 50.53 | 4.94 | 20.25 | 20.96 | 15.00 | 1.41 |
| Stella x Van | 49.72 | 4.32 | 20.19 | 20.32 | 15.03 | 1.33 |
| Stella x Double | 39.99 | 5.30 | 2041 | 19.69 | 15.33 | 1.28 |
| Stella x Lambert | 44.27 | 4.76 | 20.27 | 20.42 | 14.63 | 1.21 |
| Stella x Stella | 40.47 | 5.18 | 20.35 | 21.33 | 15.76 | 1.29 |
| Stella x Bing | 50.53 | 4.37 | 20.01 | 20.50 | 14.63 | 1.34 |
| Bing x Mishri | 54.95 | 4.42 | 19.40 | 20.47 | 14.26 | 1.38 |
| Bing x Van | 43.16 | 4.44 | 19.38 | 20.45 | 14.36 | 1.19 |
| Bing x Double | 47.22 | 4.59 | 19.27 | 20.25 | 15.03 | 1.27 |
| Bing x Lambert | 46.15 | 4.17 | 19.47 | 20.34 | 14.20 | 1.39 |
| Bing x Stella | 46.63 | 4.20 | 19.13 | 20.24 | 14.30 | 1.23 |
| Bing x Bing | 50.23 | 4.39 | 19.26 | 20.21 | 14.20 | 1.17 |
| LSD at 5% | 12.49 | 0.65 | 0.76 | 0.75 | 0.59 | 0.20 |
| SEM | 6.26 | 0.32 | 0.38 | 0.37 | 0.29 | 0.10 |

flower bloom ranged from 6 days to 34 days. The highest blooming duration was recorded with CITH-W-23 where as BP-3 recorded maximum male flower blooming period. Maximum synchronization of male and female bloom was recorded wth 16 days in CITH-W-26 where as minimum of 2 days synchronization was recorded in Wussan -2. No synchronization of male and female flowers was observed with Opex-Culchery, Turtle, Wussan -8 and FPTBr-1 which shows that these varieties needs other genotypes for pollination and fruit set (Table-12).

## Breeding for development of superior varieties/ hybrids in solanaceous vegetables

To identify and develop suitable varieties / hybrids of chilli, capsicum, tomato and brinjal, 256 advance breeding lines 7 varieties and 8 hybrids of chilli, 26 advance breeding lines of capsicum, 11 varieties and




Elite Chilli Selections

### 1. Chilli promising lines/ varieties/ hybrids identified

| Programme | No. of lines | Promising lines/ varieties/ hybrids |
|---|---|---|
| Evaluation of CITH lines | 256 | CITH -Sel-69 CITH -Sel-71 CITH -Sel-221 CITH -Sel-222 CITH -Sel-84 CITH -Sel-222, SH-KC-23CITH -Sel-100 CITH -Sel-331, CITH-P-2 |
| Chilli varieties | Chilli varieties (7) under AICRP | SH-KC-12, AKC-406 , ACS-06-02, ACS-06-01 |
| Chilli hybrids | Chilli hybrids (18) under AICRP | ARCH-228,CCH-4,VNR-332,Arka Harita, SHP-4884, Kashi Anmol (OPC) |

### 2. Promising hybrids/varieties identified in tomato

| Programme | No of varieties / hybrids | Promising varieties/ hybrids |
|---|---|---|
| Varieties evaluated (AICRP) | 11 | DVRT-2, Roma,VTG-106, UR-415, CO-3, VTG-90, DARL-305 |
| Hybrids evaluated (AICRP) | 16 | ARTH-3, BCTH-4, NTH-1389 |
| CITH hybrids evaluated | 8 | CITH-TH-1, CITH-TH-2, SH-TH-1, CITH-TH-3 |

### 3. Promising hybrids/varieties identified in capsicum

| Programme | No of varieties / hybrids | Promising varieties/ hybrids |
|---|---|---|
| Varieties/hybrids evaluated | 26 | SH-SP-603, NS 284( R) Sel. Nishat-4, SH-SP-24, SH-SP-706, Orobell and SH-SP-1 |



Promising capsicum selections

### 4. Promising lines identified in brinjal

| Programme | No of varieties / hybrids | Promising lines |
|---|---|---|
| Line evaluation | 21 | CITH-B-4-16, CITH-B-4-9-1, CITH-B-4-15, CITH-B-4-15-1, CITH-B-4-16-1, CITH-B-113, CITH-B-4-8-1, CITH-B-SB-8 |

24 hybrids of tomato and 21 advance breeding lines of brinjal were evaluated for fruit yield and yield attributing traits. On the basis of evaluation, promising lines and hybrids in each crop have been identified and given as below.

At Mukteshwar after evaluation of advanced segregating lines of capsicum in experimental as well as farmers field, two lines have been introduced in state varietal trial of Uttarakhand for multi-location testing.

Performance of capsicum under farmer's field

**Table 12: Blooming behaviour of walnut genotypes**

| | Genotype | Periodicity of male bloom | Days of male bloom | Periodicity of female bloom | Days of female blook | Maturity of male and female parts | No. of synchronous days of bloom |
|---|---|---|---|---|---|---|---|
| 1 | CITH-W-1 | 19 April-02 May | 13 | 7-27April | 20 | protogynous | 9 days |
| 2 | CITH-W-2 | 17 April -03 May | 17 | 2-27April | 26 | Protogynous | 10 days |
| 3 | CITH-W-3 | 27 April -10 May | 14 | 11 April-10 May | 30 | Protogynous | 17 days |
| 4 | CITH-W-4 | 07-17 April | 11 | 20 April-06 May | 17 | protandrous | 4 days |
| 5 | CITH-W-5 | 22 April -10 May | 19 | 26 April-07 May | 12 | Protandrous | 12days |
| 6 | CITH-W-6 | 17 April -03 May | 8 | 2-27April | 26 | Protogynous | 11days |
| 7 | CITH-W-7 | 12-19 April | 11 | 22 April-13 May | 6 | protandrous | - |
| 8 | CITH-W-8 | 5-22 April | 18 | 19 April-8 May | 19 | protandrous | 4 days |
| 9 | CITH-W-9 | 16- 30 April | 15 | 30 Mar-27 April | 29 | Protogynous | 12 days |
| 10 | CITH-W-10 | 21 -29 April | 9 | 23 April -15 May | 23 | protandrous | 7 days |
| 11 | CITH-W-11 | 31 Mar-19 April | 20 | 13April-4May | 22 | protandrous | 7 days |
| 12 | CITH-W-12 | 18 -30 April | 13 | 4-28 April | 25 | Protogynous | 11 days |
| 13 | CITH-W-13 | 9-28 April | 20 | 24 April-11May | 18 | protandrous | 5 days |
| 14 | CITH-W-14 | ———— | | 4-27 April | 24 | Protogynous | - |
| 15 | CITH-W-15 | 20-29 April | 10 | 23 April-11 May | 19 | protandrous | 7 days |
| 16 | CITH-W-16 | 15 April -3May | 19 | 8-27 April | 20 | Protogynous | 13 days |
| 17 | CITH-W-17 | 20 April -1 May | 12 | 12-27April | 16 | Protogynous | 8 days |
| 18 | CITH-W-18 | 11-20 April | 10 | 18 April-12May | 24 | protandrous | 3 days |
| 19 | CITH-W-19 | 21-30 April | 10 | 7-29 April | 23 | Protogynous | 9 days |
| 20 | CITH-W-23 | 19 April -2 May | 13 | 7 April-10 May | 34 | Protogynous | 13 days |
| 21 | CITH-W-24 | 16-30 April | 15 | 27April-12May | 16 | protandrous | 4 days |
| 22 | CITH-W-25 | 11 -28 April | 18 | 22 April-11 May | 20 | protandrous | 7 days |
| 23 | CITH-W-26 | 20 April -5May | 16 | 13April-6 May | 24 | protandrous | 16 days |
| 24 | CITH-W-27 | 17-28 April | 12 | 1-26 April | 26 | Protogynous | 10days |
| 25 | Hamdan | 19-28 April | 10 | 5-19April | 11 | protogynous | 1 day |
| 26 | Opex Cul. | 11-17 April | 7 | 24-30April | 7 | protandrous | - |
| 27 | Tutle | - | - | 16-28April | 8 | protogynous | - |
| 28 | WUSSAN-1 | 1-9April | 9 | 18-26April | 9 | protandrous | - |
| 29 | WUSSAN-2 | 17-27April | 11 | 4-18April | 15 | Protogynous | 2 days |
| 30 | WUSSAN-8 | 5-13April | 9 | 15-25April | 11 | protandrous | - |
| 31 | VL-2 | 12-24April | 13 | 1-14April | 14 | Protogynous | 3 days |
| 32 | FPTBr-1 | 17-26April | 10 | 2-11April | 10 | protogynous | - |
| 33 | BP-3 | 13-25 April | 23 | 20 April-10 May | 20 | protandrous | 6 days |

## Improvement in onion and garlic

At Mukteshwar, a very promising line namely Mukteshwar Garlic Sel-2 having large size bulbs and good keeping quality under long day conditions was developed and tested at AVT-II under All India Network Research Project (AINRP) on onion and garlic. The variety was found superior than national as well as local checks in Himachal Pradesh at IARI-regional station, Katrain and Uttarakhand conditions at VPKAS, Almora and CITH-RS, Mukteshwar (Table-13) and is expected to be identified for temperate hills.

Another garlic selection, Mukteshwar Garlic Selection-9, was also evaluated under long day conditions of Uttarakhand and was found superior than local checks. At Srinagar, sixteen genotypes of onion and six genotypes of garlic (long day types) were selected on the basis of variable traits and these genotypes are further evaluated and multiplied.

The varietal evaluation of onion indicated that among the 36 entries tested under IET and AVT-I trials, AOLD-RB-09-29 recorded highest plant height (79.80cm) and number of leaves/plant. The entry AOLD-RB-09-22 recorded largest size of bulb (115.50 g) and highest gross yield (770.00q/ha) followed by AOLD-RB-09-12 with 113.1g bulb weight and 754.00q/ha. Other entry's such as AOLD-RB-09-016 and AOLD-RB-09-3 recorded highest marketable bulbs (98%) along with highest marketable yields i.e. 625.89 q/ha and 623.86q/ha, respectively and were on par with AOLD-RB-09-22 (616.00q/ha). However, AOLD-RB-09-18 recorded highest % of A grade bulbs (45%). In the storage trials entry, AOLD-RB-09-24 recorded minimal total loss (33%) followed AOLD-RB-09-27 and AOLD-RB-09-28 with 36.50 % and 38.50% respectively.

In garlic, among the 23 entries, CGLD-RB-09-09 recorded highest plant height (60.34 cm), largest average bulb weight (36.34g) , maximum TSS (34.62 $^0$ Brix), and highest total yield (226.25q/ha) as well as marketable yield (221.73q/ha) which was closely followed by CGLD-RB-08 with 42.63 cm plant height, 27.26g average bulb weight, 204 q/ha total and 200.8 q/ha of marketable yield. Entries like CGLD-RB-09-05, CGLD-RB-09-02, CGLD-RB-09-03 were also superior to check in respect to total and marketable yield. However, CGLD-RB-09-01 recorded minimum total loss during storage after four months of harvesting.

## Hybridization of long day onions with short day types for higher yield and quality

To develop high yielding colored varieties with better shelf life hybridization programme was initiated involving six long day types (*viz, A1*, B2, C3, D4, E5 and F6) and nine short day types (*viz,* G7, H8, I9, J10, K11, L12, M13, N14, & O15). One hundred $F_1$'s were produced and the segregants with ideal traits are being isolated for higher yield and better shelf life .

## Performance of exotic vegetables under Kumaon hill conditions

Under this project, broccoli varieties-KTS-1, Palam Vichitra, Punjab Broccoli, Palam Kanchan and Aishwarya; Knol khol varieties-Winner, Tender Knob and Parsley variety-Moss curled were evaluated under open field conditions of Kumaon hills. Maximum yield (165 q/ha) in broccoli was recorded in Punjab broccoli-1 (Table-14). In Knol khol variety-Winner (134.68 q/ha) highest yield was recorded. The Parsley variety-Moss curled however, yielded 259.60 q/ha.

**Table 13: Performance of Mukteshwar Garlic Sel-2 in multi-location trial**

| | Almora | Solan | Mukteshwar | Katrain |
|---|---|---|---|---|
| Phule Baswant | 84.2 | 87.5 | 61.5 | 94.8 |
| NRCWG3 | 124 | 79.2 | 87.8 | 144.4 |
| NRCWG4 | 112 | 82.5 | 86.9 | 53.7 |
| Mukteshwar Sel-2 | 149.1 | 82.5 | 173.2 | 216.7 |
| AFP (G313) | 98.1 | 70 | 160.2 | 164.8 |
| Local (C) | 108.2 | 80.8 | 46.9 | 161.1 |
| G-41 (C) | 120.3 | 62.5 | 86.2 | 140.7 |
| G-282 (C) | 94.4 | 69.2 | 81 | 135.2 |
| VLG-1(C) | 103.6 | 83.3 | 34.6 | 114.8 |
| Source: Annual report, AINRP on onion and garlic 2009-10 pp 36 | | | | |

**Table 14: Performance of broccoli genotype in open field conditions under NWH conditions**

| Character or parameters | Varieties | | | | |
|---|---|---|---|---|---|
| | KTS-1 | Palam Vichitra | Punjab Broccoli | Palam Kanchan | Aishwarya |
| Av Curd Weight (g) | 248 | 446 | 374 | 294 | 146 |
| Total Yield (q/ha) | 92.00 | 165.02 | 138.38 | 165.02 | 108.78 |

## Improvement and production of saffron

Under saffron improvement programme, as many as 32 elite clones were evaluated for economic traits such as fresh pistil weight, dry weight, perianth size, style and stigma length along with weight. A total of ten best clones having high saffron yield/ hectare in their initial planting year were indentified (Table-15). They include CITH-125 (4.1 kg/ha), CITH-S-123 (4.0 kg/ha), CITH-S-124 (3.90 kg/ha), CITH-S-122 (3.80 kg/ha), CITH-S-1277 (3.80 kg/ha), CITH-S-121 (3.7 kg/ha), CITH-S-107 (3.7 kg/ha), CITH-S-120 (3.5 kg/ha), CITH-S-104 (3.4 kg/ha) and CITH-S-117 (3.4 kg/ha) having high saffron yield / hectare in their initial planting year.

Besides improvement, by following the production technologies developed under various projects about 3 lakh healthy corms were produced. Out of these, 1-1.5 lakh corms have been sold/distributed to the farmers along with package of technologies for increasing saffron production and productivity. While the rest of the corms are reused for different experiments during 2010 or further replanted for multiplication.

## Diversification with off-season high value vegetables for increasing farm income in temperate region

To identify suitable crops and varieties of high value temperate vegetables, four varieties of asparagus, two of artichoke, seven of lettuce, six of broccoli, three of chinese cabbage, two each of celery and parsley, thirty four of kale, three of swiss chord and four of pran were introduced and evaluated during main as well as off season for yield and quality. Among the crops varieties tested, the best cultivars in each crop with highest yield (q/ha) were identified (Table-16) and their seeds are being multiplied for their popularization in farmers field for realizing higher income and better nutrition to consumers.

High value vegetables growing in open field

## Diversification in temperate fruit production through introduction of new fruit crops

### Introduction and Evaluation of Cape gooseberry collections/genotypes for adaptation to temperate climate

Introduction and adaptation of new crops contribute to an increase in diversity of agriculture systems and also offers new alternatives to farmers and markets, with crops that may have a high value and for which generally there is no over production. Therefore, new crops can result in an increase of income for farmers, contribute to a more eco-friendly agriculture, reduces the risk of crop failure and increase botanical knowledge. Therefore many new crops from other agro climatic zones can present desirable attribute to be introduced as new crop in our temperate climates.

Cape gooseberry (*Physalis peruviana*) is an herbaceous crop grown for its edible fruits. Its wide range of adaptation and versatile use as table purpose and processing form along with increasing demand in exotic fruit market gives good prospectus for the expansion of Cape gooseberry as a new cash crop in temperate region. Keeping its importance and scope

Genetic diversity of cape gooseberry


Product diversification of cape gooseberry

in consideration 20 accessions collected from various/ diverse parts /regions were introduced and evaluated for their adaptation under temperate region grown in summer season.

Evaluation results of Cape gooseberry given in Table-17 revealed that the genotype CITH –S-13 had maximum plant height (114.7 cm) followed by CITH-S15 (107.7 cm). Maximum no. of fruits per single plant were recorded in CITH-S-16 (73) and CITH-S-20 (72) while maximum single fruit weight was recorded in CITH –S-12 (16.44 g) followed by CITH-S-20 (15.33 g). Yield per plant was recorded highest in CITH-S-20 (1145g/plant) followed by CITH-S-9 (925 g/plant). Significant differences were recorded in case of TSS of the fruits (ranging from 9.71 f Brix in CITH-S-1 to 6.92 f Brix in case of CITH-S-10). Similarly variation was also recorded in case of ascorbic acid content of the fruits. Maximum vitamin C (ascorbic acid) was recorded in CITH-S22 (79 mg/100g) followed by CITH-S17 (22.66 mg/100g).

The trial will be continued for this year in order to further confirm the previous year results.

## Diversity of Rose hips

Survey was made locally for collection of Rose Hips and Thaw Horn genotypes. A lot of variability was found in terms of fruit size, quality etc. The fruits of two promising genotypes of Rose Hip and one type of Thaw Horn were analysed for quality composition. In case of rose hip genotypes, the weight of single fruit was found in the range of 0.74 g to 1.88 g and TSS was found in the range of 18.8 to 21.32 while ascorbic acid in the range of 72 to 90 mg/100g. The fruits of Jhaw horn selection were found have 19.2 $^{0}$B of TSS and 72

**Table 15: Evaluation of saffron clonal selections for growth, yield and quality**

| Selections | Foliage length (cm) | No. of leaves | Perianth length (cm) | Stigma length (cm) | Style length (cm) | Pistil length (cm) | Fresh wt. of pistil (mg) | Dry wt. of pistil (mg) | Saffron yield (kg/ha) |
|---|---|---|---|---|---|---|---|---|---|
| CITH-S-125 | 25 | 22 | 5.6 | 3.8 | 1.8 | 5.6 | 40.5 | 8.2 | 4.1 |
| CITH-S-123 | 26 | 22 | 7.0 | 4.5 | 1.9 | 6.4 | 40.2 | 8.0 | 4.0 |
| CITH-S-124 | 27 | 20 | 6.2 | 3.9 | 1.5 | 5.4 | 39.5 | 7.9 | 3.9 |
| CITH-S-122 | 25 | 20 | 6.5 | 4.0 | 1.8 | 5.8 | 37.5 | 7.6 | 3.8 |
| CITH-S-12 | 24 | 27 | 6.4 | 3.4 | 2.4 | 5.8 | 38.8 | 7.76 | 3.8 |
| CITH-S-121 | 24 | 22 | 6.8 | 4.2 | 1.5 | 5.7 | 37.2 | 7.4 | 3.7 |
| CITH-S-107 | 27 | 29 | 7.5 | 4.0 | 2.4 | 6.4 | 37.8 | 7.5 | 3.7 |
| CITH-S-120 | 22 | 28 | 5.7 | 3.9 | 1.8 | 5.7 | 35.5 | 7.0 | 3.5 |
| CITH-S-104 | 26 | 13 | 6.8 | 3.7 | 2.1 | 5.8 | 33.9 | 6.9 | 3.4 |
| CITH-S-117 | 24 | 22 | 6.2 | 3.3 | 2.1 | 5.4 | 34.5 | 6.8 | 3.4 |
| CITH-S-112 | 18 | 14 | 6.4 | 3.0 | 2.2 | 4.2 | 33.8 | 6.7 | 3.3 |
| CITH-S-113 | 22 | 24 | 6.2 | 3.2 | 1.8 | 5.0 | 32.5 | 6.5 | 3.2 |
| CITH-S-119 (Tetra Stigma) | 16 | 25 | 4.2 | 3.0 | 1.2 | 4.2 | 32.5 | 6.5 | 3.2 |
| CITH-S-118 | 18 | 26 | 5.8 | 3.2 | 2.0 | 5.2 | 34.3 | 6.5 | 3.2 |
| CITH-S-10 | 24 | 22 | 5.5 | 2.9 | 2.1 | 5.0 | 32.5 | 6.5 | 3.2 |
| CITH-S-103 | 22 | 16 | 6.3 | 3.1 | 2.2 | 5.3 | 32.1 | 6.4 | 3.2 |
| CITH-S-43 | 27 | 16 | 6.2 | 3.2 | 2.1 | 5.3 | 32.0 | 6.4 | 3.2 |
| CITH-S-114 | 19 | 22 | 5.8 | 3.4 | 1.9 | 5.3 | 32.0 | 6.2 | 3.1 |
| CITH-S-115 | 18 | 18 | 4.9 | 3.2 | 2.0 | 5.2 | 31.0 | 6.0 | 3.0 |
| CITH-S-105 | 24 | 17 | 6.5 | 3.1 | 2.2 | 5.3 | 31.0 | 6.0 | 3.0 |
| CITH-S-106 | 21 | 21 | 6.9 | 3.4 | 2.6 | 6.0 | 29.4 | 6 | 3.0 |
| CITH-S-102 | 22 | 14 | 6.5 | 3.1 | 2.3 | 5.4 | 29.3 | 6.0 | 3.0 |
| CITH-S-108 | 22 | 18 | 6.2 | 3.4 | 2.2 | 5.6 | 29.5 | 5.9 | 2.9 |
| CITH-S-11 | 18 | 19 | 6.2 | 3.3 | 2.4 | 5.7 | 28.2 | 5.64 | 2.9 |
| CITH-S-116 | 23 | 18 | 5.4 | 2.9 | 2.1 | 5.0 | 30.0 | 5.8 | 2.9 |
| CITH-S-13 | 19 | 18 | 6.7 | 3.4 | 2.1 | 5.5 | 29.0 | 5.8 | 2.9 |
| CITH-S-101 | 28 | 15 | 6.2 | 3.7 | 2.0 | 5.7 | 28.6 | 5.7 | 2.9 |
| CITH-S-3 | 22 | 19 | 6.2 | 3.4 | 2.3 | 5.7 | 28.0 | 5.6 | 2.8 |
| CITH-S-111 | 18 | 17 | 5.2 | 3.2 | 1.7 | 4.9 | 27.8 | 5.4 | 2.7 |
| CITH-S-110 | 17 | 19 | 5.8 | 2.8 | 1.8 | 4.6 | 27.0 | 5.2 | 2.6 |
| CITH-S-76 | 24 | 18 | 5.9 | 3.2 | 2.2 | 5.4 | 26 | 5.2 | 2.6 |
| CITH-S-109 | 19 | 21 | 5.5 | 2.7 | 1.7 | 4.4 | 25.6 | 4.6 | 2.3 |

**Table 16: Performance of high value vegetable crops and the best varieties identified**

| S. No. | Crops | No. of varieties/hybrids | Yield range (q/ha) | Best varieties/hybrids identified |
|---|---|---|---|---|
| 1 | Lettuce | 7 | 245 to 520 | LS-2 (520 q/ha) Grand Rapids (489q/ha) |
| 2 | Kale | 34 | 199-1653 | CITH-K-28 (1653 q/ha) CITH-K-3 (1233 q/ha)CITH-K-10 (1120 q/ha)CITH-K-26 (1083q/ha) |
| 3 | Parsley | 2 | 116-261 | CITH-P-4 (261.7 q/ha) |
| 4 | Celery | 2 | 118-226 | Ford Hook (226.4 q/ha) |
| 5 | Chinese Cabbage | 3 | 498-1037 | CITH-CC-1 (1037 q/ha) |
| 6 | Pran | 4 | 357-674 | CITH-Pran-2 (674 q/ha) CITH-Pran-4 (572 q/ha) |
| 7 | Artichoke | 2 | 200-250 | CITH-GA-1 (250 q/ha) |
| 8 | Asparagus | 2 | 65-73 | CITH-A-1 (73q/ha) |
| 9 | Swisschard | 3 | 270-370 | CITH_Green (370 q/ ha) |
| 10 | Broccoli | 6 | 135-194 | Palam Kanchan (192.5 q/ha), Green Head (177.0 q/ha) |
| 11 | Sonchal | 3 | 188-211 | CITH-S-1 (211 q/ha) |

mg of ascorbic acid/100 gm of fruit. Plants were collected and kept in nursery for planting in main fruit block in coming season. Technology was also standardized for preparation of quality loose jelly and preserves of these fruits.

## Product Diversification

For product diversification: process technology was developed for making novel value added products of Cape gooseberry. During the period of investigation technology was developed and standardized for making novel value added products of Cape gooseberry and Rose hips jam, sauces, osmo dehydrated products having excellent taste, aroma, and appeal and over all acceptability for consumers.

Besides cape goose berry and rose hips, a survey was made locally for collection of fig, black berry etc. and we could collected nine varieties of rubus, four of ribes, ten species of husk tomato, twenty seven varieties of fig, one genotype each of black current, red raspberry and black berry. The plants are under hardening for further introduction in the field. Rooted plants of pistachio collections, hassel nut, pecan nut were also collected and planted in the minor fruit block for further evaluation.

## Collection and evaluation of gerbera genotypes for protected conditions

At Mukteshwar, fifty genotypes of gerbera were evaluated. The data revealed that all the genotypes differed significantly with respect to growth and flowering characteristics. However, the genotypes viz., G 7, G 15, G 16, G 17, G 18 and G 20 were found to be promising in respect to cut flower characters (Table-18).

At Srinagar to identify, suitable variety both for polyhouse and field conditions a total of ten different germplasm lines were evaluated for growth, flowering and yield characteristics.

Under polyhouse condition, among all the germplasm lines, Dune, Rosalin and Dana Ellen yielded maximum number of flowers per plant i.e. 59.89, 54.37 and 50.86 respectively (Tabel-19). Whereas, the plant height was found maximum in Dune (44.63 cm) followed by Salvadore (40.58 cm) and Winter Queen (39.76 cm). Stalk length was found to be maximum (68.47 cm) in cv. Dune and it was also good in respect of vase life in preservative solution. 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 (Table-20). The germplasm lines, Dune and Winter Queen

Diversity of rose hips in temperate regions

Novel value added products of rose hips

Promising gerbera selections (G-167, G-16, G-15 & G-18)

maximum plant height was recorded. 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 as compare to open condition.

## *In vitro* micropropagation of cherry

In cherry, clonal root stock *Mazzard* (*Prunus avium* L), which is very difficult to root under *in vivo* conditions was used for standardization of micropropagation protocol. Different phytohormone combinations were tried to optimize the best combination for development of fast and efficient micropropagation technique. Meristem was cultured on MS medium supplemented with different concentrations of BAP+ IBA, BAP + $GA_3$ and IBA + NAA for shoot initiation, shoot multiplication and rooting respectively (Table-21). Medium containing BAP + IBA

**Table 17: Physical and chemical characters of different varietal selections of Cape gooseberry**

| Variety/ Characters | No. of fruits per plant | Yield per plant (gm) | Fruit Weight (g) | Firmness | Juice (%) | TSS ($^0$B) | Acidity (%) | Vitamin C (mg/100g) | Carotene (mg/100g) |
|---|---|---|---|---|---|---|---|---|---|
| **CITH-S1** | 40.00 | 424.34 | 15.15 | 38.55 | 60.97 | 9.71 | 0.53 | 19.57 | 1.57 |
| **CITH-S2** | 57.66 | 825.58 | 14.20 | 49.57 | 59.41 | 8.16 | 0.28 | 22.72 | 1.63 |
| **CITH-S3** | 36.33 | 686.83 | 19.10 | 39.59 | 62.17 | 8.76 | 0.47 | 21.24 | 1.56 |
| **CITH-S4** | 32.00 | 199.67 | 6.51 | 63.30 | 61.19 | 8.62 | 0.52 | 21.31 | 1.66 |
| **CITH-S5** | 57.33 | 548.57 | 9.27 | 53.65 | 59.35 | 9.14 | 0.47 | 19.54 | 1.62 |
| **CITH-S6** | 61.00 | 496.53 | 8.14 | 39.28 | 61.33 | 9.25 | 0.56 | 24.31 | 1.67 |
| **CITH-S7** | 38.66 | 386.44 | 9.86 | 59.70 | 60.51 | 9.06 | 0.61 | 22.68 | 1.64 |
| **CITH-S8** | 45.66 | 464.33 | 10.17 | 63.34 | 58.20 | 9.30 | 0.56 | 22.71 | 1.59 |
| **CITH-S9** | 67.66 | 924.81 | 13.52 | 32.13 | 61.10 | 8.77 | 0.51 | 22.36 | 1.46 |
| **CITH-S10** | 64.00 | 467.06 | 7.40 | 61.70 | 61.67 | 6.92 | 0.44 | 19.61 | 1.72 |
| **CITH-S11** | 60.33 | 484.02 | 7.90 | 56.54 | 60.13 | 8.75 | 0.53 | 21.21 | 1.58 |
| **CITH-S12** | 42.66 | 715.67 | 16.44 | 41.69 | 62.77 | 8.43 | 0.58 | 22.68 | 1.56 |
| **CITH-S13** | 26.00 | 347.86 | 13.47 | 64.33 | 61.32 | 8.30 | 0.58 | 19.63 | 1.48 |
| **CITH-S14** | 60.66 | 428.71 | 7.03 | 56.34 | 63.17 | 7.29 | 0.47 | 21.20 | 1.61 |
| **CITH-S15** | 36.00 | 337.99 | 9.37 | 57.29 | 58.14 | 8.15 | 0.58 | 22.75 | 1.52 |
| **CITH-S16** | 73.00 | 552.95 | 7.63 | 53.51 | 58.23 | 9.28 | 0.53 | 21.23 | 1.47 |
| **CITH-S17** | 62.00 | 684.45 | 11.29 | 61.60 | 56.20 | 9.13 | 0.47 | 22.66 | 1.58 |
| **CITH-S18** | 58.00 | 511.58 | 8.72 | 60.18 | 58.43 | 9.22 | 0.44 | 19.55 | 1.55 |
| **CITH-S19** | 63.00 | 721.08 | 11.51 | 62.18 | 57.01 | 8.11 | 0.67 | 22.79 | 1.59 |
| **CITH-S20** | 72.66 | 1145.03 | 15.33 | 62.66 | 61.07 | 7.31 | 0.42 | 19.55 | 1.63 |
| **CD** | 3.818* | 116.95* | 1.35* | 0.59* | 1.90* | 0.29* | 0.011* | 0.30* | N.S. |
| **SE(d)** | 1.879 | 57.54 | 0.66 | 0.29 | 0.93 | 0.14 | 0.005 | 0.14 | 0.14 |
| **SE(m)** | 1.329 | 40.69 | 0.47 | 0.20 | 0.66 | 0.10 | 0.004 | 0.10 | 0.10 |
| **CV** | 4.364 | 12.41 | 7.34 | 0.67 | 1.90 | 2.06 | 1.302 | 0.84 | 11.08 |

* Significant at 5%

*In vitro* micropropagation of cherry

proved to be best medium for initial establishment. Maximum number of shoot (32) and elongated shoots (10 cm) were observed on MS media supplemented with BAP + $GA_3$. Maximum root induction (18.8) and root length (9.6 cm) was obtained on MS media containing IBA + NAA and IBA + NAA, respectively (Table-22). Further, growing shoots during the rooting phase, conditioning the plantlets for a good survival and quality. Rooted plantlets were transferred to pots containing perlite: cocopeat (1:1) for acclimatization for a period of four weeks, and further on soil. On average 60% of the acclimatized plantlets survived after three months of transferring into the soil.

## *In vitro* corm multiplication in saffron

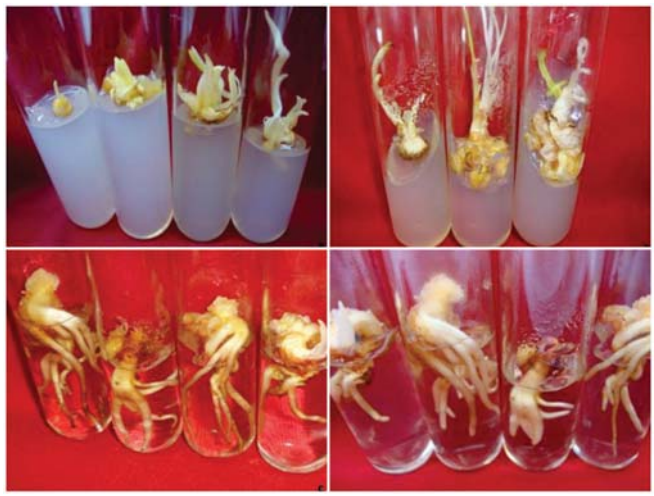
Saffron (*Crocus sativus* L.) being triploid and sterile in nature is propagated by vegetative means through corms. The natural propagation rate of such plant species is relatively low, therefore an *in vitro* multiplication technique like micropropagation has been used as an alternative method of propagation for saffron. In the present investigation 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 was observed on MS media supplemented concentration with BAP + NAA + paclobutrazol (Table-23).

**Table 18: Plant and flower characteristics of promising genotypes of gerbera**

| Genotype | Plant Ht. (cm) | No. of leaves | Stem length (cm) | Flower diameter (cm) | Vase-life winter (days) | Vase-life (summer) (days) | Yield (No of flower/$m^2$) |
|---|---|---|---|---|---|---|---|
| G-6 | 8.5 | 11.50 | 38.54 | 7.5 | 19.00 | 11 | 216 |
| G-15 | 20.54 | 17.5 | 42.58 | 10.6 | 20 | 9 | 162 |
| G-16 | 16.85 | 18.65 | 56.25 | 13.5 | 13 | 9 | 324 |
| G-17 | 20.89 | 19 | 66.25 | 14.41 | 14 | 10 | 162 |
| G-18 | 20.54 | 21.52 | 45.33 | 13.44 | 25 | 18 | 338 |
| G-19 | 13.98 | 11.87 | 42.74 | 11.52 | 14 | 10 | 172.8 |
| G-20 | 16.74 | 12.85 | 69.23 | 14 | 22 | 20 | 288 |

**Table 19: Performance of gerbera cultivars under polyhouse conditions**

| Germplasm | Plant height (cm) | Plant spread (cm) | Flower stalk length (cm) | Flower stem dia.(mm) | No. of flower/ plant | No. of leaves/ plant | Flower size dia. dia. | Av. Length of leaves (cm) |
|---|---|---|---|---|---|---|---|---|
| Cacharell | 25.12 | 53.25 | 56.12 | 5.89 | 37.11 | 27.23 | 11.86 | 33.12 |
| Salvadore | 40.58 | 52.23 | 52.23 | 7.73 | 36.52 | 25.45 | 10.03 | 34.36 |
| Scope | 32.36 | 57.36 | 46.32 | 7.50 | 28.32 | 26.63 | 11.06 | 42.11 |
| Dana Ellen | 28.11 | 60.12 | 54.67 | 7.39 | 50.86 | 25.44 | 12.41 | 48.19 |
| Sunway | 34.32 | 55.31 | 55.68 | 8.13 | 42.30 | 24.64 | 12.35 | 52.11 |
| Kayak | 25.39 | 55.12 | 48.32 | 8.19 | 33.08 | 29.18 | 09.58 | 34.65 |
| Carambola | 34.11 | 55.32 | 58.23 | 7.46 | 25.32 | 16.47 | 11.63 | 41.57 |
| Dune | 44.63 | 53.29 | 68.47 | 7.83 | 59.89 | 27.78 | 12.88 | 38.91 |
| Rosalin | 33.69 | 58.77 | 59.12 | 7.35 | 54.37 | 29.21 | 10.31 | 45.34 |
| Winter Queen | 39.76 | 62.38 | 48.12 | 7.84 | 34.09 | 31.30 | 12.51 | 45.58 |



*In vitro* corm multiplication in saffron

Cultural conditions under light or in dark did not affect the corm formation and growth. Shoot and root regeneration was observed in the microcorms developed under *in vitro* conditions. Maximum number of shoot (11.6) and length of shoots (11.4 cm) was also observed on MS media supplemented with NAA + BAP. Maximum number of roots (11) and length of roots (11.4 cm) was obtained on G-5 media containing NAA + BAP (Table-24). The above observations are expected to make a possible road way for production of quality planting material in saffron.

## Micropropagation of strawberry

For obtaining basic material for the establishment of large scale, stable and high yielding strawberry plantlets for cultivation requires mass production of uniform propagules. Micropropagation is one of the effective means to achieve this goal. Continuous planting of runners from old mother plants for five or more years that are prone to diseases & viruses and the lack of ideal planting materials are the main causes of low productivity of strawberry. The rate of strawberry propagation through conventional

**Table 20: Performance of gerbera under field condition**

| Germplasm | Plant height (cm) | Plant spread (cm) | Flower stalk length av. (cm) | Flower stem dia.(mm) | No. of flower/ plant | No. of leaves/ plant | Flower size Dia (cm) | Length of leaves (cm) |
|---|---|---|---|---|---|---|---|---|
| Cacharell | 21.30 | 50.12 | 51.23 | 6.21 | 27.30 | 25.74 | 10.30 | 28.36 |
| Salvadore | 25.36 | 51.89 | 47.89 | 6.77 | 25.11 | 21.55 | 8.32 | 29.16 |
| Scope | 30.12 | 54.36 | 42.15 | 7.20 | 17.86 | 24.65 | 9.60 | 37.36 |
| Dana Ellen | 25.57 | 57.79 | 49.32 | 7.01 | 42.34 | 23.81 | 11.19 | 42.01 |
| Sunway | 30.11 | 50.12 | 50.68 | 8.02 | 39.09 | 23.02 | 10.32 | 46.12 |
| Kayak | 20.12 | 52.01 | 43.22 | 8.21 | 25.36 | 26.45 | 09.56 | 30.68 |
| Carambola | 31.11 | 53.22 | 53.11 | 7.18 | 17.82 | 15.12 | 10.36 | 36.31 |
| Dune | 37.16 | 48.34 | 60.12 | 7.63 | 41.02 | 22.37 | 11.58 | 32.73 |
| Rosalin | 28.10 | 55.65 | 52.98 | 7.23 | 37.82 | 26.80 | 09.10 | 40.43 |
| Winter Queen | 37.15 | 58.74 | 44.57 | 7.67 | 24.36 | 27.17 | 10.67 | 41.19 |

**Table 21: Effects of different BA and $GA_3$ concentrations on shoot proliferation in *Mazzard***

| Treatents | | Shoot length (cm) | Number of shoots | Leaf length | Number of leaves |
|---|---|---|---|---|---|
| BA (mg $l^{-1}$) | $GA_3$ (mg $l^{-1}$) | | | | |
| 0.5 | 0.5 | $3.26^{f}$±0.34 | $5.20^{g}$±0.86 | $1.10^{d}$±0.05 | $7.60^{d}$±0.40 |
| 0.5 | 0.4 | $4.44^{e}$±0.23 | $10.60^{f}$±0.40 | $1.40^{d}$±0.12 | $8.00^{d}$±0.45 |
| 0.5 | 0.3 | $5.60^{d}$±0.30 | $13.20^{bef}$±0.58 | $2.10^{bc}$±0.12 | $10.80^{c}$±0.37 |
| 0.5 | 0.2 | $7.82^{b}$±0.28 | $16.80^{d}$±0.58 | $2.10^{bc}$±0.39 | $12.20^{b}$±0.49 |
| 0.5 | 0.1 | $6.96^{c}$±0.24 | $31.80^{a}$±2.22 | $3.20^{a}$±0.09 | $14.80^{a}$ ±0.58 |
| 1.0 | 0.5 | $10.18^{a}$±0.50 | $22.20^{bc}$±0.86 | $2.50^{b}$±0.18 | $13.00^{b}$ ±0.45 |
| 1.0 | 0.4 | $5.34^{d}$±0.15 | $24.20^{b}$±0.86 | $2.40^{b}$±0.13 | $12.00^{b}$±0.45 |
| 1.0 | 0.3 | $4.06^{e}$±0.17 | $20.80^{c}$±0.86 | $2.00^{bc}$±0.08 | $10.00^{c}$±0.32 |
| 1.0 | 0.2 | $2.96^{gf}$±0.17 | $15.80^{de}$±0.86 | $1.60^{cd}$±0.14 | $7.40^{d}$±0.24 |
| 1.0 | 0.1 | $2.38^{g}$±0.14 | $12.00^{f}$±0.55 | $1.50^{d}$±0.05 | $5.00^{e}$±0.32 |

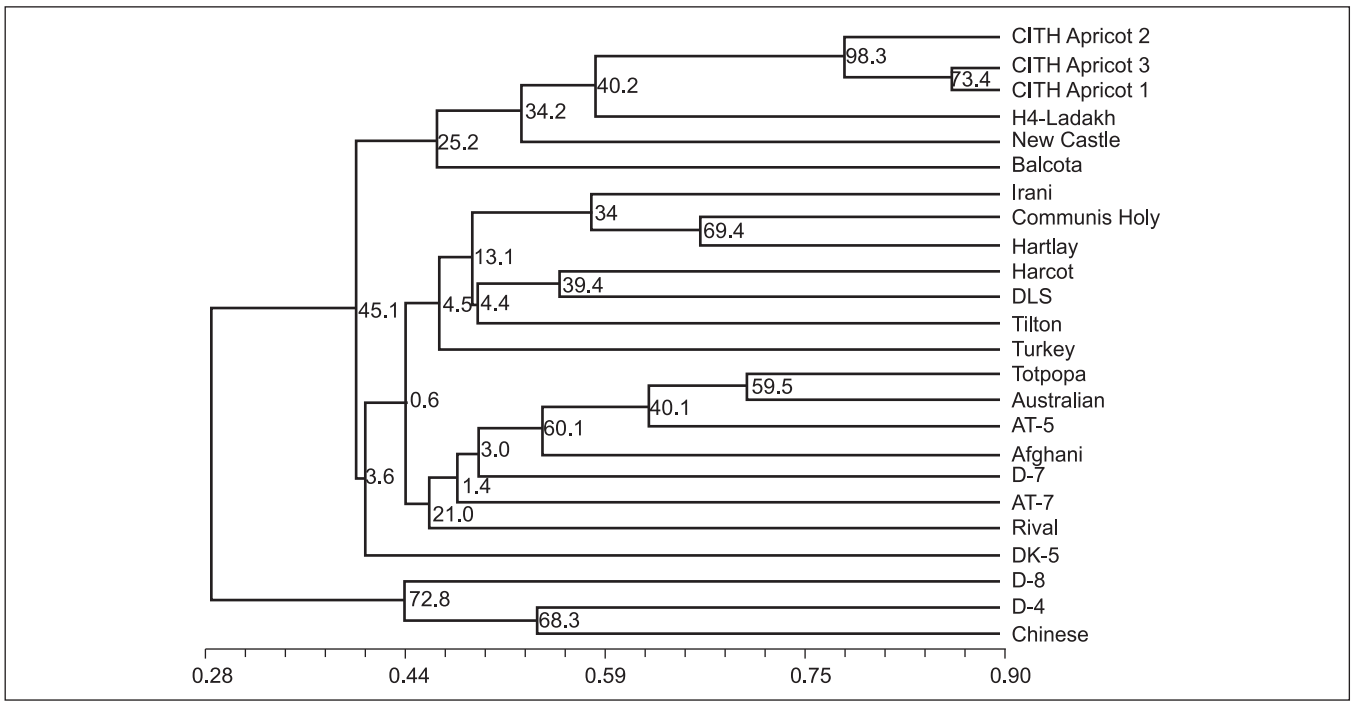
Means followed by the same letter within the columns are not significantly different ($P$= 0.05) using Duncan's multiple range test


Micropropagation of strawberry

technique is quite low and it is difficult to maintain plant material during the summer months. Efficient method for shoot regeneration, proliferation and rooting from nodal segments of strawberry cultivars Chandler, Oso-Grande and Cama-Rosa was developed. After six weeks of incubation maximum regeneration of 90 per cent was recorded in cv. Chandler on MS medium with BA + NAA (Table-25). In all cultivars maximum mean number of shoots per explant was observed in MS + BA + NAA. Maximum length (10.18 cm) and number of shoots (10.4) were observed in cv Chandler on MS Media supplemented with BA and NAA. The regenerated shoots were rooted on MS basal medium with different concentrations IBA (Table-26). The maximum frequency of rooting, highest number of roots (10) and maximum length of roots (7.5 cm) was observed in cv Chandler on MS medium containing IBA. The plantlets, thus developed were hardened and successfully established in soil.

## Genetic diversity analysis in apricot (*Prunus armeniaca* L.) germplasm

Twenty four apricot genotypes from different geographic origins were studied by means of RAPD markers. The aim of the study was to determine the genetic relationships among genotypes from different eco-geographical regions. A total of 43 decamer primers were used in this study. All of them were polymorphic in the set of cultivars studied and allowed every genotype to be unambiguously distinguished. Genetic diversity in the population was analyzed using several variability parameters. A dendrogram based on UPGMA analysis grouped the 24 genotypes into four main clusters with Jaccard's similarity coefficient ranging from 0.14 to 0.86 with an average of 0.40. Principal Coordinate (PCO) analysis was comparable to the cluster analysis. RAPD markers have proved to be an efficient tool for fingerprinting of cultivars and conducting genetic- diversity studies in apricot. The




UPGMA dendrogram showing clustering pattern of apricot (*Prunus armeniaca* L) genotypes. The bootstrap values are given on the nodes.

**Table 22: Effects of different BA and IBA concentrations on rooting in *Mazzard***

| Treatments | | Root length (cm) | Number of roots |
|---|---|---|---|
| NAA (mg $l^{-1}$) | IBA (mg $l^{-1}$) | | |
| 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 |

**Table 23: *In- vitro* corm multiplication in saffron from apical buds**

| Treatments | | | Paclobutrazol mg $l^{-1}$ | Number of microcorms | Weight of corm (g) |
|---|---|---|---|---|---|
| Medium | BAP mg$l^{-1}$ | NAA mg $l^{-1}$ | | | |
| 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 24: *In- vitro* root and shoot regeneration in saffron from apical buds**

| Treatments | | | Shoot length (cm) | Number of shoots | Root length (cm) | Number of roots |
|---|---|---|---|---|---|---|
| Medium | NAA (µM) | BA (µM) | | | | |
| 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

**Table 25: Effect of BA and NAA on shoot regeneration and multiplication of Strawberry**

| Treatment (mg/l) | | Shoot number | | | Shoot length (cm) | | |
|---|---|---|---|---|---|---|---|
| BA | NAA | Chandler | Oso-Grandy | Camarosa | Chandler | Oso-Grandy | Camarosa |
| 1.0 | 0.5 | 3.4$^{ab}$±0.51 | 2$^{a}$±0.32 | 1.8$^{ab}$±0.37 | 3.26$^{b}$±0.33 | 2.32$^{b}$±0.12 | 1.84$^{b}$±0.15 |
| 1.0 | 0.1 | 4.2$^{b}$±0.58 | 2.2$^{ab}$±0.37 | 2.25$^{ab}$±0.43 | 4.44$^{c}$±0.23 | 4.42$^{d}$±0.10 | 3.64$^{d}$±0.10 |
| 1.5 | 0.5 | 6.6$^{cd}$±0.51 | 4$^{cd}$±0.45 | 2.8$^{bc}$±0.37 | 5.6$^{d}$±0.30 | 4.92$^{e}$±0.09 | 3.9$^{d}$±0.19 |
| 1.5 | 0.1 | 7.4$^{cd}$±0.60 | 5.2$^{d}$±0.66 | 3.6$^{c}$±0.51 | 7.82$^{f}$±0.27 | 6.26$^{f}$±0.19 | 5.08$^{e}$±0.09 |
| 2.0 | 0.5 | 10.4$^{e}$±0.51 | 7.8$^{e}$±0.66 | 7.2$^{d}$±0.37 | 10.18$^{g}$±0.49 | 8.3$^{g}$±0.15 | 7.18$^{g}$±0.05 |
| 2.0 | 0.1 | 7.6$^{d}$±0.51 | 5.4$^{d}$±0.51 | 2.8$^{bc}$±0.37 | 6.96$^{e}$±0.23 | 4.98$^{e}$±0.21 | 5.8$^{f}$±0.31 |
| 2.5 | 0.5 | 6$^{c}$±0.32 | 3.6$^{bc}$±0.51 | 2.4$^{b}$±0.51 | 5.34$^{d}$±0.15 | 4.48$^{d}$±0.12 | 3.82$^{d}$±0.12 |
| 2.5 | 0.1 | 4.4$^{b}$±0.51 | 3.2$^{abc}$±0.37 | 2.4$^{b}$±0.24 | 4.06$^{c}$±0.16 | 3.38$^{c}$±0.16 | 2.58$^{c}$±0.10 |
| 3.0 | 0.5 | 3.8$^{b}$±0.37 | 2.2$^{ab}$±0.37 | 1.6$^{ab}$±0.24 | 2.96$^{ab}$±0.16 | 2.18$^{b}$±0.05 | 1.72$^{b}$±0.13 |
| 3.5 | 0.1 | 2.2$^{a}$±0.37 | 2$^{a}$±0.32 | 1.2$^{a}$±0.20 | 2.38$^{a}$±0.13 | 1.48$^{a}$±0.20 | 1.22$^{a}$±0.09 |

**Table 26: Effect of different IBA concentrations on root proliferation in strawberry**

| Treatment (mg/l) | Root number | | | Root length (cm) | | |
|---|---|---|---|---|---|---|
| IBA | Chandler | Oso-Grandy | Camarosa | Chandler | Oso-Grandy | Camarosa |
| 0.3 | $1.6^{a}\pm0.24$ | $1.8^{a}\pm0.37$ | $1.2^{a}\pm0.20$ | $1.7^{ab}\pm0.12$ | $1.68^{b}\pm0.06$ | $1.42^{ab}\pm0.07$ |
| 0.6 | $1.6^{e}\pm0.24$ | $1.4^{a}\pm0.24$ | $1.2^{a}\pm0.20$ | $1.52^{a}\pm0.16$ | $1.24^{a}\pm0.10$ | $1.2^{a}\pm0.08$ |
| 0.9 | $2.8^{c}\pm0.37$ | $1.6^{a}\pm0.24$ | $2.2^{bc}\pm0.20$ | $3.36^{d}\pm0.36$ | $2.28^{c}\pm0.09$ | $1.66^{bc}\pm0.15$ |
| 1.2 | $3.4^{a}\pm0.50$ | $2.2^{ab}\pm0.37$ | $1.6^{ab}\pm0.24$ | $2.56^{c}\pm0.13$ | $2.7^{de}\pm0.14$ | $2.04^{c}\pm0.10$ |
| 1.5 | $5.4^{c}\pm0.50$ | $5.2^{de}\pm0.37$ | $2.6^{c}\pm0.40$ | $4.78^{e}\pm0.25$ | $3.34^{e}\pm0.13$ | $2.82^{d}\pm0.09$ |
| 1.8 | $7.4^{b}\pm0.39$ | $3.6^{c}\pm0.50$ | $2.4^{bc}\pm0.24$ | $5.76^{f}\pm0.26$ | $5.16^{g}\pm0.24$ | $4.64^{g}\pm0.14$ |
| 2.0 | $10^{c}\pm0.70$ | $6.4^{e}\pm0.67$ | $5.2^{d}\pm0.37$ | $6.38^{f}\pm0.18$ | $4.02^{f}\pm0.15$ | $4.16^{f}\pm0.25$ |
| 2.3 | $5.8^{ab}\pm0.37$ | $4.2^{cd}\pm0.52$ | $1.8^{abc}\pm0.37$ | $7.58^{g}\pm0.26$ | $7.08^{h}\pm0.21$ | $5.6^{h}\pm0.20$ |
| 2.6 | $5.2^{ab}\pm0.37$ | $3.4^{bc}\pm0.50$ | $1.8^{abc}\pm0.37$ | $4.86^{e}\pm0.35$ | $4.4^{f}\pm0.11$ | $3.52^{e}\pm0.16$ |
| 2.9 | $2.8^{d}\pm0.73$ | $2^{a}\pm0.31$ | $1.6^{ab}\pm0.24$ | $2.26^{bc}\pm0.10$ | $1.94^{bc}\pm0.09$ | $1.58^{ab}\pm0.14$ |

level of genetic variability or relatedness obtained from this analysis will enable the future crossing or breeding in apricot.

## RAPD profile based grouping of garlic (*Allium sativum*) germplasm with respect to photoperiodism

Forty garlic genotypes were evaluated using RAPD markers to determine the genetic relationship among the genotypes showing morphological variations. Eighteen decamer primers were used in this study. All of them were polymorphic in the set of cultivars studied enabling the genotype to be distinguished. Genetic diversity in the population studied was analyzed using several variability parameters. A dendrogram based on UPGMA analysis that grouped the forty genotypes into three main clusters with Jaccard's similarity coefficient ranging from 0.00 to 0.75 with an average of 0.25 (Table-27).

Principal Coordinate (PCO) analysis was comparable to the cluster analysis. Finally, the investigation of the genetic variation of garlic with RAPD indicated that this marker is suitable tool for assessing polymorphism with respect to day length requirement and estimating the genetic similarity.

Work on further characterization of almond, walnut and olive using RAPD and SSR markers is under progress.

**Table 27: RAPD profile of 40 garlic genotypes used for genetic diversity analysis**

| Primer | PIC | Rp | MI |
|---|---|---|---|
| OPA1 | 0.321237 | 0.414634 | 0.321237 |
| OPA2 | 0.449732 | 0.682927 | 0.449732 |
| OPA4 | 0.20122 | 0.231707 | 0.20122 |
| OPA3 | 0.156454 | 0.178862 | 0.156454 |
| OPA5 | 0.323171 | 0.47561 | 0.323171 |
| OPA9 | 0.244646 | 0.353659 | 0.244646 |
| OPA7 | 0.103064 | 0.109756 | 0.103064 |
| OPA8 | 0.069304 | 0.073171 | 0.069304 |
| OPA11 | 0.342653 | 0.439024 | 0.342653 |
| OPA12 | 0.024093 | 0.02439 | 0.024093 |
| OPA14 | 0.135634 | 0.146341 | 0.135634 |
| OPA17 | 0.055027 | 0.056911 | 0.055027 |
| OPA18 | 0.232005 | 0.268293 | 0.232005 |
| OPA19 | 0.086333 | 0.091463 | 0.086333 |
| OPA20 | 0.441701 | 0.658537 | 0.441701 |
| OPV2 | 0.092802 | 0.097561 | 0.092802 |
| OPV3 | 0.047591 | 0.04878 | 0.047591 |
| OPV7 | 0.047293 | 0.04878 | 0.047293 |

## Crop Production and Propagation

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

#### Quality rootstock/ seedling material production

A total of 1.02 lakh clonal /seedlings of apple rootstocks (MM – 106, EMLA – 106, MM-111, M.9, M.26, M.27), cherry (Mazzard, Mahaleb, seedling), peach, plum, walnut, apricot and almond seedlings have been produced. These have been supplied to state Development Department and farmers and have also been used for budding and grafting with elite commercial varieties.

#### Quality planting material through budding and grafting

About 65000 plants of elite varieties were produced through budding, grafting, cutting, layering etc. in apple (10000 Nos.), almonds (20000 Nos.) Pear (10000Nos.) Cherry (2500- Nos.), Apricot (4500Nos.) Plum (1000Nos.) and peach (3500 No) strawberry (20000) and walnut (2500)and material has been supplied to Department of Horticulture and Network centers of J&K, H.P. Uttarakhand, Arunachal Pradesh TN and growers of these regions. Besides root stock and budded / grafted plants, a large quantity of bud wood/ graft wood (2.50 lakhs) was also produced and part of it was distributed to state departments, nursery men and farmers. At Mukteshwar, a total of 10,000 grafted plants/bud wood of apple cultivars Oregon Spur, Starkrimson, Skyline Supreme, Red Chief, Vance Delicious, Mollies Delicious, Top Red, Well Spur, Spur Type Red Delicious, Red Gold, Golden Delicious, Golden Spur, Tydeman's Early and other cultivars were produced and distributed to local farmers and KVK's.


Planting material production at CITH

Bud wood of superior apple and peach cultivars were distributed to farmers. Multiplication of apple clonal rootstocks such as MM-106, MM-111 and M-9 is in progress. Observatios on different quality standards and characteristics of grafted plants has also been recorded for production of high quality planting material of apple plants.

## Production of quality seeds / seedlings of improved vegetable varieties / hybrids of commercially important vegetable crops

To popularize new varieties and hybrids, a total quantity of 2.06 kg hybrid seed of cucumber brinjal, chilli, capsicum and tomato were produced, seedlings, raised and distributed to farmers under HTM project. In addition, 488 kg of breeder/quality seeds of tomato, brinjal, capsicum, chilli, cucumber, pea, beans, spinach, carrot, cabbage, radish and onion were also produced for supply to development departments and farmers. For early raising of crops, 1.7 lakh seedlings of different summer and rabi vegetable crops were raised and distributed to kitchen gardeners and farmers.

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

To standardize the most suitable scion wood, environmental conditions and grafting techniques an experiment was carried out with different scion types that were grafted using wedge and tongue at different timings under three environmental conditions. Three scion types namely, top, middle and botton with 3-4 buds and two grafting techniques (wedge & tongue) were evaluated at four different dates (15$^{th}$ February, 01$^{st}$ March, 15$^{th}$ March, 01$^{st}$ April) under three environmental conditions (Polyhouse, Polytrench & open field). Among scion types the scion wood taken from middle portion recorded highest sprouting and grafting success in wedge graft under polyhouse conditions when done during middle of March. Among different timing of grafting, 15$^{th}$ March was best suited for maximum graft success. Among different environments, low cost polyhouse or polytrench were found ideal environments for maximum success due to better humidity and ideal temperature than open field conditions. Maximum number of leaves per plant and plant height was also found best when grafting was done from 1$^{st}$ to middle of March.

Walnut propagation under poly house

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

Among various treatments, chip budding of cv. Starkrimson on crab apple seedling and clonal root stock M-9 gave higher percentage of success in the month of February-March, July-August and September-October (71.4 -95%) in comparison to Tongue grafting (67.8-78%) or T-Budding (65.4-79%). Budding or grafting at height range of 8-10 cm and even upto 13-15 cm were found to be better (Table-28). Similarly in case of peach and pear, chip budding on seedling rootstock gave success as high as 90.4-96.3% in peach and 87.4-94.6% in pear during February-March, July-August and September-October. Budding/ Grafting during peak winter i.e. December- January gave relatively lesser success(Table-29).

## Effect of bio fertilizers on seedling growth of crab apple

In crab apple, the seedling were treated with *Azotobactor*, PSB and *Azosprillum* inorder to know the effect on growth and rooting of seedlings. Among the bio-fertilizer treatments, the crab apple plants treated with *Azosprillum* registered highest seedling height, girth, number of laterals and developed into budable size than other bio-fertilizers (Table-30).

**Table 28: Comparative performance of chip budding and other grafting/budding on apple seedlings and clonal root stock (M9) at different heights**

| Budding/ grafting time and height | Seedling rootstock: crab apple | | Clonal root stock:M9 | |
|---|---|---|---|---|
| | Budding/ grafting success(%) | Plant Height (cm) | Budding/ grafting success(%) | Plant height (cm) |
| **Chip Budding** | | | | |
| **Dec-Jan** | | | | |
| 8-10cm | 65 | 132.1 | 63 | 102.4 |
| 13-15cm | 62.1 | 135.2 | 61.3 | 98.6 |
| 18-20cm | 45.3 | 122.5 | 42.6 | 88.4 |
| **Feb-Mar** | | | | |
| 8-10cm | 93 | 134.4 | 95 | 106.6 |
| 13-15cm | 90.2 | 136.4 | 88.5 | 103.2 |
| 18-20cm | 71.4 | 125.1 | 73.1 | 95.3 |
| **Jul-Aug** | | | | |
| 8-10cm | 91 | 110.9 | 89 | 85.4 |
| 13-15cm | 87.3 | 112.3 | 85.2 | 83.2 |
| 18-20cm | 77.6 | 108.5 | 75.3 | 75.8 |
| **Sep-Oct** | | | | |
| 8-10cm | 95 | 140.9 | 93 | 118.9 |
| 13-15cm | 89.5 | 137.8 | 87.4 | 112.7 |
| 18-20cm | 83 | 130.5 | 80.2 | 106.8 |
| **Tongue Grafting** | | | | |
| **Dec-Jan** | | | | |
| 8-10cm | 42 | 121 | 40 | 98.5 |
| 13-15cm | 45.3 | 118.6 | 38.3 | 95.7 |
| 18-20cm | 35.5 | 104.7 | 32.5 | 85.2 |
| **Feb-Mar** | | | | |
| 8-10cm | 78 | 124.4 | 75 | 101.5 |
| 13-15cm | 74.6 | 122.8 | 71.5 | 103.2 |
| 18-20cm | 67.8 | 108.9 | 63.6 | 93.4 |
| **T-budding** | | | | |
| **Jul-Aug** | | | | |
| 8-10cm | 79 | 120.3 | 78 | 85.3 |
| 13-15cm | 78.4 | 117.4 | 71.5 | 88.6 |
| 18-20cm | 72.1 | 104.3 | 65.7 | 74.6 |
| **Sep-Oct** | | | | |
| 8-10cm | 72 | 133.2 | 69 | 103.3 |
| 13-15cm | 70.3 | 130.4 | 63.7 | 100.1 |
| 18-20cm | 65.4 | 123.5 | 54.3 | 95.3 |

## Standardization of rooting media for quality planting material production of pomegranate under controlled conditions

The present study was conducted to determine the effect of rooting media and types of cuttings i.e. softwood, semi- hardwood and hardwood on quality planting material production of five genotypes (cv. Dholka, Bedana, Jyoti, Kandhari and G-137) of pomegranate. Stem cuttings (14-16 cm length) have been taken during dormant season i.e in the month of December-January and planted in black polybags containing rooting media in different proportions as Soil+FYM (80:20), soil+FYM+cocopeat (60:20:20), soil+FYM+sand+poultry (60:20:10:10), soil+FYM+ vermiculite+poultry (60:20:10:10), soil+FYM+ vermiculite+poultry+sand (50:20:10:10:10), soil+sand (50:50) and soil (100%) and grown under mist chambers.

The earliest mean number of days to sprouting (60 days), mean total numbers of primary (8) and secondary roots (32), length of longest root (28 cm), number of sprouts per cutting (10) and sprouting percentage (95%) were recorded to be significantly high with rooting media containing sand+soil (50:50 ), percentage of cutting success (90%), length of sprout ( 9 cm), leaves per cutting (30-40), mean length (15 cm) and diameter (1.75 mm) of root, root zone spread (20 cm) and survival percentage of rooted cutting (90%) were observed to be highest in soil +FYM (80:20) with semi- hardwood types of cuttings as compared to soft

**Table 29: Comparative performance of chip budding and other grafting/budding methods of peach and pear**

| Budding/ grafting method and time | Peach | | Pear | |
|---|---|---|---|---|
| | Budding/ grafting success(%) | Plant Height (cm) | Budding/ grafting success(%) | Plant height (cm) |
| **Chip Budding** | | | | |
| Dec-Jan | 37.9 | 140.2 | 40.3 | 134.3 |
| Feb-Mar | 90.4 | 145.6 | 89.5 | 137.5 |
| Jul-Aug | 93.4 | 130.1 | 87.4 | 125.4 |
| Sep-Oct | 96.3 | 148.4 | 94.6 | 143.2 |
| **Tongue Grafting** | | | | |
| Dec-Jan | 36.4 | 138.6 | 43.2 | 128.5 |
| Feb-Mar | 63.5 | 140.5 | 87.6 | 132.1 |
| **T-Budding** | | | | |
| Jul-Aug | 86.4 | 132.3 | 74.4 | 129.6 |
| Sep-Oct | 80.5 | 142.4 | 70.3 | 139.5 |

**Table- 30: Effect of bio fertilizers on seedling growth of crab apple**

| Treatment | Plant height(cm) | Plant girth(mm) | Buddable proportion (%) |
|---|---|---|---|
| Azotobactor | 36.528 | 2.998 | 8.385 |
| PSB | 47.765 | 5.065 | 25.168 |
| Azosprillum | 51.013 | 5.463 | 50.295 |
| C.D at 5% | 0.572 | 0.498 | 2.626 |

and hardwood cuttings in all the selected genotypes of pomegranate. From this investigation it is concluded that the sand+soil (50 : 50) mixture and soil + FYM (80:20) mixture play's an important role as rooting media for quality planting material production using semi-hard wood cutting in pomegranate genotypes.

## Role of exogenous hormonal rooting Co-Factor and basel injury in quality planting material production of pomegranate

The experiment was carried out to study the role of Indole -3- Butyric acid (IBA) as rooting co-factor and root promoting hormone with mechanical wounding at the base of stem cuttings of pomegranate genotypes. The treatments comprised of three types of cutting i.e. softwood, semi-hardwood and hardwood; five genotypes i.e. Dholka, Bedana, Jyoti, Kandhari and G-137 and three concentrations of IBA with wounding at the cuttings' base i.e. 2000 ppm, 3000 ppm, 4000 ppm all types of stem cutting were collected in dormant period i.e. December.-January and planted in black polybags containing media Soil+Sand (20:80) under mist-propagation chamber. Among various concentration of IBA, 4000 ppm with wounding at the cuttings' base has given best response in term of the earliest mean number of days to sprouting (58 days), mean number of primary roots per cutting (15), number of secondary roots per cutting (25%), length of longest root (30 cm), root zone spread (25cm) , survival percentage (95%), no. of leaves per cutting (40-45), sprouting % (90), length of sprout (9 cm) no. of sprouts per cutting (7), length and diameter of root (15, 1.84) with semi - hardwood types cutting in all the selected genotypes. From the study, semi-hardwood type of cutting treated with IBA 4000 ppm and wounding at the cuttings' base was found best in all the genotypes, which also induces fibrous root system essential for better establishment under field conditions as compared to other treatments and type of cuttings.

## Effect of PGR's and colchicine on corm production of saffron after two years of planting

Different concentrations of four growth regulators (NAA, GA3, BA and CCC) and colchicines were treated to know their effect on corm production and flower/' saffron yield. The results are very promising with NAA of 1500 ppm concentration produced highest number of flower bearing corms (65.8%) and total corm yield (20.4 t/ha) after two years of planting followed by CCC 2000 ppm which produced 53.1% flower bearing corms and 15.7 t/ha corm yield (Table-31).

**Tablle 31: Effect of PGR's and colchicine on corm production of saffron after two years of planting**

| S.No | Treatments | Av. no of corms/plant | Av. corm weight (g) | Flower bearing corms(%) | Foliage length (cm) | No of leaves | Total corm weight / plant(g) | Total corm yield (t/ha) |
|---|---|---|---|---|---|---|---|---|
| 1 | NAA 500 ppm | 10 | 2.9 | 39.8 | 37.0 | 9.0 | 29.8 | 9.9 |
| 2 | NAA 1000ppm | 11 | 3.4 | 37.6 | 41.0 | 8.0 | 37.8 | 12.6 |
| 3 | NAA 1500ppm | 14.9 | 4.2 | 65.8 | 47..0 | 11.5 | 62.9 | 20.4 |
| 4 | GA3 100ppm | 14.9 | 2.8 | 34.6 | 33.5 | 6.0 | 41.7 | 13.8 |
| 5 | GA3 200ppm | 9.4 | 2.9 | 43.1 | 35.5 | 6.5 | 28.8 | 9.6 |
| 6 | GA3 300ppm | 5.8 | 4.1 | 62.5 | 41.0 | 9.5 | 23.5 | 7.8 |
| 7 | BA 20 ppm | 14.8 | 2.9 | 26.7 | 27.0 | 5.5 | 43.0 | 14.3 |
| 8 | BA 40 ppm | 19.5 | 1.1 | 9.2 | 33.0 | 7.5 | 22.6 | 7.5 |
| 9 | BA 60 ppm | 13.8 | 3.4 | 46.6 | 38.5 | 9.0 | 47.2 | 15.7 |
| 10 | COL 1000ppm | 14.8 | 2.1 | 23.5 | 24.0 | 11.5 | 31.9 | 10.6 |
| 11 | COL 2000ppm | 11.5 | 2.2 | 16.5 | 25.5 | 13.0 | 25.7 | 8.5 |
| 12 | COL 3000ppm | 7.2 | 3.1 | 31.6 | 23.0 | 14.0 | 22.6 | 7.5 |
| 13 | CCC 1000ppm | 18.3 | 2.2 | 20.4 | 33.5 | 8.0 | 40.7 | 13.5 |
| 14 | CCC 1500ppm | 12.1 | 3.0 | 42.0 | 37.0 | 10.5 | 35.5 | 11.8 |
| 15 | CCC 2000ppm | 10.1 | 4.7 | 53.1 | 46.0 | 12.5 | 47.3 | 15.7 |
| 16 | CONTROL | 9.5 | 2.7 | 34.0 | 29.5 | 7.0 | 25.8 | 8.6 |
| CD at 5% | | 4.42 | 1.23 | 9.76 | 5.05 | 3.35 | 15.50 | 5.07 |

## Standardization of medium, medium-high and high density orcharding in temperate Fruits

### Performance of apple cultivars under high density planting system

The high density planting system in apple was started during 2002-03 with four varieties of apple grafted on M-9 root stock and two spacings (1.5 x 3.0 m and 2.0 x 3.0 m) involving Golden Delicious as pollinizer. Results indicated that among the varieties tested, the variety Mollies Delicious registered highest yield (35.46 t/ha) at 1.5 x 3.0 m spacing. Whereas, Vesta Bella at 2.0 x 3.0 m spacing (Table-32) followed by Gala Mast (38.058 t/ha).

**Table 32: Performance of apple cultivars under HDP on M-9 root stock (fruit yield t/ha)**

| Variety | Spacing | |
|---|---|---|
| | 1.5x3.0 m | 2.0 x 3.0 m |
| Starkrimson | 18.08 | 22.90 |
| Mollies Delicious | 35.46 | 20.94 |
| Golden Delicious | 47.43 | 7.06 |
| Gala Mast | 20.62 | 38.58 |
| Vista Bella | 12.37 | 42.54 |

On MM-106 root stock 12 varieties of apple were planted at 3 x 3 m spacing involving Golden Delicious as pollinizer. The results reveal that highest fruit weight (309.98 g/fruit) was recorded in Red Delicious (Table-33) followed by Cooper IV . However, yield per hectare was highest in Starkrimson (31.59 t/ha) followed by Mollies Delicious (31 t/ha) and Silver Spur (29.45 t/ha).

**Table 33: Yield of apple cultivars under HDP (3.0 X 3.0 m) on MM 106 rootstock**

| Variety | Weight (gm) | Yield/tree (kg) | Yield (t/ha) |
|---|---|---|---|
| Red Delicious | 309.98 | 20 . 50 | 22.7 |
| Mollies Delicious | 216.78 | 27.86 | 31.00 |
| Starkrimson | 230.55 | 28.43 | 31.59 |
| American Apirouge | 80.48 | 5.55 | 6.16 |
| Cooper IV | 242.18 | 11.38 | 12.64 |
| Silver Spur | 155.34 | 26.51 | 29.45 |
| Red Fuji | 191.91 | 7.86 | 8.74 |
| Firdous | 156.91 | 2.19 | 2.44 |
| Vance Delicious | 185.38 | 4.81 | 5.35 |
| Oregon Spur | 218.56 | 15.37 | 17.07 |
| Red Chief | 194.84 | 7. 46 | 8.28 |
| Golden Delicious | 226.34 | 30. 78 | 34. 19 |
| Gold Spur | 183.91 | 4. 65 | 5.16 |

At 2.5 x 3.5 m spacing ten apple cultivars were raised on MM 106 rootstock. It is evident from the results that highest yield t/ ha was recorded in Royal Delicious (34.27 t/ha) followed by 23.60 t/ha in Starkrimson and 19.65 t/ha in Rd Chief (Table-34).

**Table 34: Yield of apple cultivars under HDP (2.5 X 3.5 m) on MM 106**

| Variety | Weight (gm) | Yield (kg/tree) | Yield (t/ha) |
|---|---|---|---|
| Starkrimson | 230.55 | 20.67 | 23.60 |
| Mollies Delicious | 216.78 | 8.74 | 9.98 |
| Golden Delicious | 226.34 | 34.13 | 39.54 |
| Cooper IV | 242.18 | 11.46 | 13.08 |
| Lal Ambri | 247.0 | 0.7 | 0.79 |
| Red Chief | 194.84 | 17.21 | 19.65 |
| Royal Delicious | 213.9 | 30.01 | 34.27 |
| Gala Mast | 180.94 | 2.35 | 2.68 |
| Ambri | 193.16 | 14.16 | 16.17 |
| Vista Bella | 138.33 | 18.12 | 20.69 |

At 3.5 x 3.5 m spacing eight apple varieties were evaluated grafted on MM 106 rootstock involving Golden Delicious as pollinizer. The result of the experiment indicated that maximum fruit yield was recorded in Mollies Delicious variety of apple followed by Starkrimson (Table-35).

**Table 35: Yield of apple cultivars under HDP (3.5 X 3.0 m) on MM 106**

| Variety | Weight (gm) | Yield (kg/tree) | Yield (t/ha) |
|---|---|---|---|
| Starkrimson | 230.55 | 13.14 | 12.50 |
| Cooper iv | 242.18 | 2.14 | 2.03 |
| Lal Ambri | 247.0 | 2.79 | 2.65 |
| Vista Bella | 138.33 | 5.21 | 4.95 |
| Golden Delicious | 226.34 | 15.99 | 15.22 |
| Mollies Delicious | 216.78 | 13.29 | 12.65 |
| Red Chief | 194.84 | 4.93 | 4.69 |
| Gala Mast | 180.94 | 10.31 | 9.81 |
| Ambri | 193.96 | 1.80 | 1.71 |

### Performance of apple varieties on seedling roots stock at medium density planting of 4 x 4 m spacing

The experiments was under taken in 12 varieties of apple on seedling root stock during 2002-2003.The variety Red Delicious recorded highest fruit yield (39.65 t/ha) followed by Oregon Spur (32.43 t/ha) Red Chief (29.5 t/ha) Royal Delicious (25.82 t/ha) and Red Fuji (16.30 t/ha) (Table-36).

**Table 36: Yield of Apple cultivars under HDP (4.0 X 4.0 m) on seedling rootstock**

| Variety | Weight (gm) | Yield (kg/tree) | Yield (t/ha) |
|---|---|---|---|
| Shireen | 185.96 | 3.59 | 2.24 |
| Akber | 209.16 | 0.60 | 0.30 |
| Oregon Spur | 218.66 | 51.89 | 32.43 |
| Tydeman's Early Worester | 160.33 | 3.40 | 2.10 |
| Red Fuji | 191.91 | 26.09 | 16.30 |
| Top Red | 178.73 | 10.49 | 6.50 |
| Red Chief | 194.84 | 47.21 | 29.50 |
| Vance Delicious | 185.35 | 17.58 | 10.98 |
| Red Delicious | 309.98 | 63.44 | 39.65 |
| Royal Delicious | 213.90 | 41.32 | 25.82 |
| Golden Delicious | 226.34 | 50.17 | 31.35 |
| Red Gold | 147.33 | 25.53 | 15.95 |
| Benoni | 145.03 | 18.70 | 11.68 |

## Cherry

Five varieties were planted in 2002 – 2003 at 2.5 x 2.5 and 3 x 3 m spacing to study the performance of cherry cultivars. It is evident from the results that CITH-Cherry-01(Table-37), registered highest yield (7.9 t/ha) followed by Bigarreo Napoleon (6.66 t/ha) . at spacing 2.5x2.5m while highest T.S.S. was noted (16.64 °Brix ) in CITH-Cherry-05 In 3x3m spaing CITH-Cherry-05 registered highest yield ( 9.2 t/ha ) which was statistically at par with yield recorded by CITH-Cherry-01. Similarly CITH-Cherry05 recorded highest T.S.S. (17.50 °Brix ) followed by CITH-Cherry -03 during the year 2010 (Table-38).

### Standardization of medium high and high density orcharding in almond

The experiment has been laid out in 2003 using

**Table 37: Performance of cherry cvs. On high density planting (2.5x2.5m)**

| Variety | Fruit wt. (g) | Yield (kg/tree) | Yield (t/ha) | TSS (°Brix) |
|---|---|---|---|---|
| Bigarreau Napoleon | 3.43 | 4.16 | 6.66 | 14.39 |
| Bigarreau Noir Grossa | 4.19 | 3.23 | 5.15 | 13.04 |
| CITH Cherry- 05 | 4.08 | 3.18 | 5.09 | 16.64 |
| CITH-Cherry-01 | 5.20 | 5.11 | 7.93 | 13.54 |
| Van | 4.27 | 1.63 | 2.67 | 13.39 |
| LSD at 5 % | 0.98 | 0.73 | 0.145 | 1.01 |
| SEm | 0.43 | 0.31 | 0.63 | 0.44 |
| CV | 12.21 | 11.24 | 1.40 | 3.81 |

three indigenous developed varieties (Makhdoom, Shalimar and Waris) budded on seedling rootstock. The budded plants were planted at three different spacing viz., 2.5x2.5m (1600 pl/ha), 3x3m (1111 pl/ha) and 3.5x3.5m (816 pl/ha). The results of experiment indicated that trunk cross-sectional area of tree (Table-39) increases with decreasing the planting density from 1600 to 816 tree/ha. Maximum cross sectional area of tree (106.82 cm) was recorded in 3.5x3.5m spacing in Waris. Highest fruit number (1765.12) was recorded in 3.5x3.5m spacing in Waris. Maximum fruit yield (4.11 kg/tree) was recorded in Makhdoom variety of almond spaced at 3.5x3.5m. Highest yield (4.13 t/ha) was recorded in War is variety of almond.

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

The nine varieties viz. Makhdoom, Shalimar, Waris, Pranyaj, Primorskij, Non Pareil, Clafornia Paper Shell, Merced and IXL were evaluated for growth and yield of almond under Kashmir condition. The result of the experiment clearly indicated that maximum trunk cross-sectional area of almond tree (161.22 cm2) was recorded in Non Pareil variety while fruit number (1786.50) was maximum in Makhdoom. Nut yield per tree (4.71 kg/tree) and per hectare (2.94 t/ha) was however recorded in variety Pranyaj variety of almond (Table-40).

### Standardization of medium high and high density orcharding in peach

Under high density plantation of 2.5 x 2.5m spacing, maximum fruit weight was recorded in cv.

**Table 38: Performance of cherry cultivars at spacing of 3x3mHigh density planting in cherry spacing (3 x 3 m) year 2010**

| Variety | Tree height(m) | Trunk girth (mm) | AEG (cm) | No. of flowers/ plant | No. of fruit/ plant | Fruit set (%) | Yield (kg/ plant) | Fruit yield (t/ha) | Fruit weight (g) | T.S.S. ($^0$Brix) |
|---|---|---|---|---|---|---|---|---|---|---|
| Bigarreau Napoleon | 2.37 | 44.06 | 69.33 | 1524.33 | 1319.67 | 86.52 | 5.10 | 5.73 | 3.80 | 13.97 |
| Bigarreau Noir Grossa | 2.29 | 31.00 | 56.00 | 363.00 | 202.33 | 55.91 | 0.74 | 0.82 | 3.57 | 13.07 |
| CITH-Cherry 05 | 2.46 | 31.67 | 70.00 | 1523.33 | 1255.67 | 82.42 | 8.31 | 9.20 | 6.67 | 17.53 |
| CITH-Cherry-01 | 1.84 | 46.70 | 56.66 | 1540.33 | 1363.00 | 88.51 | 8.27 | 9.15 | 6.07 | 14.03 |
| CITH-Cherry-02 | 1.84 | 53.74 | 62.00 | 1331.00 | 1181.67 | 88.77 | 6.60 | 7.33 | 5.84 | 13.47 |
| CITH-Cherry-03 | 1.88 | 41.88 | 67.33 | 1274.00 | 1120.33 | 88.13 | 4.40 | 4.96 | 4.25 | 16.52 |
| Van | 2.16 | 38.70 | 68.33 | 422.67 | 237.00 | 56.07 | 1.10 | 1.21 | 4.99 | 13.07 |
| Lapinus | 2.28 | 38.20 | 72.66 | 178.67 | 65.33 | 36.59 | 0.38 | 0.41 | 6.18 | 15.10 |
| Lambert | 2.09 | 44.59 | 66.33 | 86.67 | 59.33 | 68.78 | 0.30 | 0.32 | 4.11 | 13.13 |
| Bing | 2.22 | 53.52 | 57.00 | 159.67 | 70.00 | 43.80 | 0.27 | 0.29 | 3.90 | 14.53 |
| CD at 5 % | 0.24 | 5.36 | 9.88 | 116.85 | 95.71 | 5.02 | 0.38 | 2.31 | 1.03 | 1.32 |
| SEM± | 0.11 | 2.55 | 4.70 | 55.62 | 45.55 | 2.39 | 0.18 | 1.10 | 0.49 | 0.63 |

**Table 39: Plant growth and yield under different densities in almond**

| Cultivars | Density | TCA ($cm^2$) | Nut wt(g) | Nut Number | Nut yield (kg/tree) | Nut yield (t/ha) |
|---|---|---|---|---|---|---|
| Makhdoom | 2.5x2.5 m | 73.97 | 2.71 | 1464.50 | 2.57 | 4.11 |
| | 3x3 m | 93.12 | 2.16 | 711.50 | 2.65 | 2.94 |
| | 3.5x3.5 m | 94.21 | 2.16 | 1518.33 | 4.11 | 3.35 |
| Shalimar | 2.5x2.5 m | 68.81 | 1.62 | 1640.66 | 2.35 | 3.76 |
| | 3x3 m | 85.65 | 1.53 | 1301.33 | 2.59 | 2.87 |
| | 3.5x3.5 m | 88.81 | 2.40 | 1660.66 | 3.59 | 3.22 |
| Waris | 2.5x2.5 m | 82.64 | 2.03 | 1713.25 | 2.58 | 4.13 |
| | 3x3 m | 97.53 | 2.04 | 1496.50 | 3.59 | 3.98 |
| | 3.5x3.5 m | 106.82 | 2.30 | 1765.12 | 3.81 | 3.11 |
| CD at 5% | - | 22.65 | 0.35 | 525.23 | 0.50 | 0.23 |

**Table 40: Performance of almond varieties under medium density planting (4x4m spacing)**

| Varieties | TCA ($cm^2$) | No. of nuts/tree | Nut wt (g) | Nut yield (kg/tree) | Nut yield (t/ha) | Kernel recovery(%) | Shell softness |
|---|---|---|---|---|---|---|---|
| Makhdoom | 89.88 | 1786.50 | 1.89 | 3.38 | 2.11 | 53.50 | Soft shelled |
| Shalimar | 136.46 | 1522.83 | 2.49 | 3.79 | 2.37 | 56.62 | papery |
| Waris | 171.41 | 1735.16 | 2.57 | 4.45 | 2.78 | 52.97 | Soft shelled |
| Pranyaj | 160.22 | 1640.83 | 2.87 | 4.71 | 2.94 | 59.91 | Soft shelled |
| Primorskij | 111.36 | 1459.00 | 1.77 | 2.58 | 1.61 | 55.07 | Papery |
| Merced | 118.62 | 1501.23 | 2.77 | 4.16 | 2.60 | 63.48 | Papery |
| IXL | 106.65 | 1562.33 | 2.64 | 4.12 | 2.58 | 43.47 | Soft shelled |
| Non Pareil | 161.22 | 1625.25 | 1.51 | 2.45 | 1.53 | 65.69 | Papery |
| California Paper Shell | 154.14 | 1050.50 | 2.40 | 2.52 | 1.58 | 42.92 | Papery |
| CD at 5% | 28.25 | 255.25 | 2.12 | 0.51 | 3.15 | 6.45 | - |

Fantasia (99.25g) followed by Crest Heaven (96.18g), Red Globe Gloheaven (84.59g) and Red Globe (82.24g). The maximum fruit yield was recorded in cv. Fantasia (12.90 kg) followed by Red Globe (9.86 kg), Crest Heaven (8.64 kg) and Gloheaven (8.45 kg). However, under medium high density plantation on seedling at spacing of 3 x 3 m maximum yield per tree was recorded in cv. Fantasia (15.18 kg) followed by Red Globe (11.90 kg) , Gloheaven (11.31 kg) and Crest Heaven (9.81 kg) in 3 year old trees of peach/nectarine on seedling rootstock. On the basis of performance and fruit quality of peach/nectarine genotypes, it was observed that cultivars: Fantasia and Red Globe are promising under high and medium high density in the initial years.

## Technique for rejuvenation of old and senile almond plantations in Kashmir valley

The productivity of almond in India is much below its expected potential, which understandably attributed to the prevalence of old and unproductive orchards of seedling origin with no varietal identity. Viewing the poor yield and quality of almond having and great potential for its production, it is an immediate need to initiate fresh almond plantations with new elite varieties in non -traditional areas suitable for its plantation which takes 8-10 years to attain commercial bearing, while the other option is to revive almond orchards through rejuvenation as it is more effective horticultural technique for improving the yield potential of the old existing senile orchards, as techniques will bridge up the production gap in shortest possible time in comparison to fresh plantations. Rejuvenation is the promising technique of converting old and unproductive trees into productive ones Its foremost advantage is that the rejuvenated trees requires less time as compared to fresh plantation in attaining commercial bearing and the old trees are being already established in adverse soil condition, have developed resistance, which can also be harnessed through this technique. Almond trees are also having more gestation period than other stone fruits, replacement strategy will have serious impact on socio-economic conditions and alternate land use planning will have adverse impact on environment as well as on acreage. Almond tree have strong renewable ability and the rejuvenation technique if done skillfully with scientific approach one can get greater success. The rejuvenation is mainly done, to convert low yielding and inferior quality old trees into superior and high yielding trees; to increase inter row light interception ; to exploit the plants surviving in the adverse soil and climatic condition; to lessen the damaged part and disease load; to increase the tree vigor and economic age of old tree and to increase orchard income.

Rejuvenation: A promising technique for reviving old almond orchards

Highest grafting success and nut yield was obtained with pruning of second order branches supplemented with 50kg FYM + NPK 500: 250 : 700 g/ tree and full moon water harvesting structure covered with polymulch. The rejuvenated tree registered yield 1.2kg/tree after one year of grafting. Among varieties, the scion cultivar Waris gave highest success than exotic Pranyaj.

## Integrated nutrient management in high density apple plantation

The INM studies in apple indicated that during 5$^{th}$ year, the application of FYM 50 kg + vermi-compost 10 kg +50g N + 75 g $P_2O_5$ + 250 g $K_2O$ per plantwas found to be the best 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 (Table-41).In 6$^{th}$ 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

**Table 41: Fruit quality and tree growth parameters as affected by different integrated nutrient treatments and mulching**

| Treatment | Fruit set (%) | Fruit weight (g) | TSS (° B) | Plant Height (m) | Trunk Dia.(cm) | Newshoot growth(cm) | Yield (kg/Tree) | Yield (t/ha) |
|---|---|---|---|---|---|---|---|---|
| **5th Year** | | | | | | | | |
| $T_7$ | 45.5 | 171.2 | 13.0 | 2.0 | 6.1 | 68.3 | 5.5 | 8.8 |
| $T_8$ | 44.0 | 162.5 | 13.2 | 1.74 | 6.3 | 66.0 | 5.8 | 9.3 |
| $T_{10}$ | 47.5 | 186.0 | 12.6 | 1.83 | 5.4 | 63.6 | 5.7 | 9.1 |
| $T_{11}$ | 45.6 | 188.5 | 13.0 | 1.85 | 5.7 | 69.3 | 5.4 | 8.6 |
| **6th Year** | | | | | | | | |
| $T_7$ | 44.5 | 198.3 | 13.4 | 2.4 | 6.6 | 70.3 | 8.1 | 13.0 |
| $T_8$ | 31.0 | 200.6 | 13.6 | 2.6 | 6.5 | 72.0 | 8.8 | 14.1 |
| $T_{10}$ | 35.0 | 195.3 | 13.7 | 1.98 | 6.4 | 70.2 | 8.5 | 13.6 |
| $T_{11}$ | 34.0 | 197.2 | 13.5 | 2.5 | 6.6 | 72.5 | 9.0 | 14.4 |
| **7th year (Low production year)** | | | | | | | | |
| $T_7$ | 33.1 | 198.6 | 13.3 | 2.7 | 6.7 | 69.5 | 3.1 | 5.0 |
| $T_8$ | 29.2 | 202.4 | 13.6 | 2.8 | 6.7 | 73.0 | 4.3 | 7.0 |
| $T_{10}$ | 32.0 | 192.1 | 13.5 | 2.7 | 6.6 | 72.3 | 3.8 | 6.1 |
| $T_{11}$ | 30.0 | 200.4 | 13.4 | 2.6 | 6.8 | 70.5 | 3.7 | 6.0 |
| **8th year (High production year)** | | | | | | | | |
| $T_7$ | 40.1 | 200.6 | 13.6 | 3.0 | 7.1 | 79.5 | 33.0 | 52.8 |
| $T_8$ | 39.2 | 202.0 | 13.7 | 2.9 | 6.7 | 73.0 | 34.3 | 54.9 |
| $T_{10}$ | 39.5 | 199.3 | 13.7 | 2.9 | 7.3 | 78.3 | 30.4 | 48.6 |
| $T_{11}$ | 38.0 | 200.4 | 13.6 | 2.7 | 7.2 | 80.5 | 29.8 | 47.7 |

g $P_2O_5$ + 300 g $K_2O$, irrespective of black polythene or leaf mould mulching. In the 7th year (year of low yield) 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 ( if year of high yield): FYM 70 kg/plant + vermi-compost 19 kg/plant +165g N+ 178 g $P_2O_5$ + 548 g $K_2O$ was found as the best 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. Mulching with leaf mould or black polythene was found to be very crucial during the late winter, spring and summer season.

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

### Rain water harvesting techniques for almond production under rain fed conditions of karewa land

For conservation and utilization of rain water, the water harvesting techniques like full moon, half moon, cup and plate and trench system have been created during December, 2008 and different type of mulch materials were also used for more moisture conservation under rainfed conditions. Control plots were 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 x 4m. The data on nut yield and soil moisture status were recorded. Maximum fruit number and yield (2147.25 Nos, 4.29 kg/tree and 2.68t /ha) were recorded in full moon structure + plastic mulch (Table-42) followed by half moon + plastic mulch (2096.45 Nos, 4.03 kg/tree, 2.51 t/ha) and minimum in control (1095.24 Nos, 1.67 kg/tree, 1.04 t/ha) plots. The soil moisture status was recorded from nut set to maturity at 0-30 cm depth. The maximum soil moisture content (15.02%) was recorded in full moon structure + plastic mulch followed by half moon + plastic mulch (14.15%) and minimum in control (11.41%) during April, 10 and similar trends were also observed in subsequent month during growth and development of nut.

### Water harvesting techniques in apple

For conservation and utilization of rain water in apple, efficient the water harvesting techniques like full moon, half moon, cup and plate and trench system

**Table 42: Effect of water harvesting techniques and mulching on fruit yield of almond.**

| Treatment | Nut wt (g) | No of nuts/tree | Nut yield (kg/tree) | Yield (t/ha) | Nut size (cm) | |
|---|---|---|---|---|---|---|
| | | | | | Length | Diameter |
| Half moon | 1.83 | 1633.25 | 2.98 | 1.86 | 38.52 | 23.20 |
| HM+Organic mulch (OM) | 1.86 | 1997.36 | 3.71 | 2.32 | 39.40 | 24.81 |
| HM+ Plastic mulch (PM) | 1.95 | 2069.45 | 4.03 | 2.51 | 42.61 | 24.21 |
| Trench | 1.75 | 1375.32 | 2.41 | 1.51 | 35.53 | 19.93 |
| Trench+OM | 1.79 | 1436.67 | 2.57 | 1.61 | 36.29 | 19.92 |
| Trench+ PM | 1.85 | 1527.89 | 2.83 | 1.77 | 37.41 | 19.29 |
| Cup& Plate | 1.71 | 1385.56 | 2.37 | 1.48 | 32.51 | 19.11 |
| Cup& Plate +OM | 1.75 | 1466.36 | 2.42 | 1.51 | 33.69 | 19.22 |
| Cup& Plate + PM | 1.82 | 1630.09 | 2.66 | 1.66 | 37.90 | 20.64 |
| Full moon | 1.89 | 1725.72 | 3.08 | 1.93 | 32.51 | 20.03 |
| Full moon +OM | 1.94 | 2035.35 | 3.35 | 2.09 | 36.29 | 21.53 |
| FM+PM | 2.11 | 2147.25 | 4.29 | 2.68 | 38.74 | 22.67 |
| Control | 1.53 | 1095.24 | 1.67 | 1.04 | 31.15 | 18.22 |
| Control+ OM | 1.62 | 1175.34 | 1.90 | 1.18 | 32.32 | 19.10 |
| Control+ PM | 1.66 | 1215.32 | 2.01 | 1.25 | 33.15 | 19.52 |
| CD at 5% | 0.21 | 375.23 | 0.75 | 0.34 | 4.35 | 2.15 |

have been created during December, 2009 and different type of mulch materials were also used for more moisture conservation under rainfed conditions. 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 apple variety Red Chief has been planted at a spacing of 4 x 4m. The data on fruit number, yield and quality were recorded. Maximum fruit number (61.60), fruit weight (230.5 g), fruit size (7.85x8.25 cm) and yield (14.19 kg/tree) were recorded in full moon system+ plastic mulch. The soil moisture status was recorded from fruit set to maturity at 0-30 cm depth. The maximum soil moisture content (15.47%) was recor ded in full moon structure + plastic mulch followed by half moon + plastic mulch (15.35%) and minimum in control (11.12%) during April, 10 and similar trends were also observed in subsequent month during growth and development of fruit.

Water harvesting system in apple

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

Integrated nitrogen management studies were conducted on almond variety Waris. The fertilizers were applied as per the treatment in almond field during February, 2010. The treatment 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 + 15tFYM/ha, $T_8$- 100% RDF + 10TFYM/ha , replicated thrice under RBD. Maximum plant height and stem girth (3.53 m and 30.23 cm) was recorded in T3. Highest nut yield (4.28 kg/tree) was recorded in T9 treatment. Whereas, minimum nut yield (1.91 kg/tree) was in control.

## 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 the other treatments. The physico-chemical attributes and antioxidant activities of fruits were also analyzed. The organically produced fruits were by and large were superior in quality attributes than control (Table-43).

**Table 43: Performance of peach under various organic nutrient management regimes**

| S. No. | 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/plant) |
|---|---|---|---|---|---|---|---|---|---|
| 1. | FYM | 06.11.09 | 9.42 | 1.79 | 2.73 | 05.03.10 | 15.03.10 | 57.33 | 3.84 |
| 2. | Nadep | 05.11.09 | 11.27 | 1.98 | 2.89 | 02.03.10 | 11.03.10 | 58.80 | 3.10 |
| 3. | Vermi-compost | 10.11.09 | 11.19 | 1.83 | 1.32 | 04.03.10 | 08.03.10 | 63.71 | 3.95 |
| 4. | Mycorrhiza | 08.11.09 | 9.88 | 2.08 | 2.79 | 23.02.10 | 30.02.10 | 68.00 | 3.76 |
| 5. | FYM+Nadep | 10.11.09 | 11.51 | 2.11 | 2.58 | 24.02.10 | 05.03.10 | 67.05 | 3.27 |
| 6. | FYM+ Vermi | 09.11.09 | 10.84 | 2.05 | 3.81 | 27.02.10 | 05.03.10 | 63.35 | 2.94 |
| 7. | FYM+ Myco | 15.11.09 | 12.43 | 2.17 | 2.47 | 25.02.10 | 01.02.10 | 58.47 | 4.21 |
| 8. | Nadep+ Vermi | 09.11.09 | 9.87 | 2.30 | 2.32 | 30.02.10 | 08.03.10 | 57.89 | 3.57 |
| 9. | Nadep+ Myco | 18.11.09 | 13.38 | 2.41 | 3.75 | 21.02.10 | 27.02.10 | 68.62 | 4.86 |
| 10. | Vermi+ Myco | 17.11.09 | 14.75 | 2.76 | 2.13 | 23.02.10 | 29.02.10 | 72.36 | 5.38 |
| 11. | Conventional | 10.11.09 | 10.38 | 2.27 | 2.34 | 02.03.10 | 11.03.10 | 75.64 | 4.08 |

The physico-chemical and antioxidant attributes of organically produced peach fruits were also studied during 12 days storage period at ambient conditions. In general, fruit firmness was found to be decreased through out the study period. On the other hand, TSS, reducing and total sugars, total carotenoids contents, ascorbic acid and total antioxidant capacity increased initially but decreased at the end of storage period. However, total phenol was found to increase with the passage of time.


Organically grown peach fruits

## Space and energy harvest under polyhouse through genotype selection, training and pruning in tomato, capsicum and cucumber.

To identify suitable varieties/ hybrids and agro techniques for protected cultivation, the high value crops like tomato, capsicum and cucumber were raised under protected low cost polynet houses. In tomato, six hybrids were evaluated under poly house conditions at two spacing's and three pruning levels. Among hybrids Himsona, CITH-TH-1 and SH-TH-1 were found best, while among three levels of pruning's double stem recorded highest yield than single stem or natural. Among two spacings, the spacing 90 x 45 cm recorded highest yield of 642.2 q/ha than wider spacing 90 x 60 cm. In cucumber, three varieties and

Cucumber and capsicum under poly/net houses

three hybrids were evaluated under poly house conditions with two spacings and three pruning levels. Among the varieties, Japanese Green Long Green and Express were found best. While in hybrids, SH-CH-1 was the best having high yield and quality. While among pruning levels, single stem recorded highest yield than double stem or natural. Among spacings the spacing 120 x 60 cm recorded highest yield 706.465 q/ha than wider spacing 100 x 75 cm.

In capsicum, two varieties and seven hybrids were introduced and evaluated under net house conditions with two spacing's and three pruning levels. Among these the varities SH-SP-706 performed better. However, among hybrids NS-281, Bombay, Shalimar capsicum hybrid-1(Y) and Shalimar capsicum hybrid - 2 (R) were found best. While among prunings, natural unpruned plants recorded highest yield than single or double stem. Among spacing's the spacing of 20 x 50 cm recorded highest yield of 512.189 q/ha than wider spacing of 30 x 50 cm. However , average fruit weight was highest in single stem and in hybrid Bombay.

## Integrated nutrient management module for onion

To increase productivity in onion, ten integrated nutrient management modules viz Local recommendation without bio-fertilizer, Local recommendation with bio-fertilizer, 150:50:80:50 kg NPKS+ 20 t FYM /ha (DOGR recommendation); 110:40:60:40: kgs NPKS +15t FYM/ha, 110:40:60:40: kgs NPKS + 7.5t Poultry manure/ha, 110:40:60:40: kgs NPKS + 7.5t Vermicompost /ha; 110:40:60:40: kgs NPKS + 7.5t FYM + 2.5t poultry manure/ha; 110:40:60:40: kgs NPKS + 7.5t FYM + 2.5t vermicompost/ha, 110:40:60:40: kgs NPKS + 3.5.5t poultry manure + 3.5t vermicompost/ha; 110:40:60:40: kgs NPKS + 7.5.5t FYM + 2.5 t poultry manure + 2.5t Vermicompost/ha for onion were tested on variety N-2-4-2 at spacing of 15x10cm with plot size 6.0 x 2.0 m. Among different treatments, local recommendation (with bio-fertilizer), recorded maximum bulb size (72.87g) and highest total (48.57 t/ha) and marketable (47.23t/ha) yield. However treatment $T_7$ 110:40:60:40: kgs NPKS + 7.5t FYM + 2.5t poultry manure/ha recorded highest percentage (37.20%) A grade marketable bulb with minimum total storage loss (31%) after four months of storage. Maximum nutrient gain in soil was observed with treatment $T_{10}$ as compared to other treatment combinations.

## Weed management studies in onion

Eight treatment combinations of weedicides i.e. (1.) Oxyflurofen 23.5% EC (Goal) application before planting and second application at 30 days after transplanting. (2.) Oxyflurofen 23.5% EC(Goal) application before planting + Quizalofop Ethyl 5EC (Targa Super) application at 30 days after transplanting, (3.) Combined spray of Oxyflurofen 23.50% EC and Quizalofop Ethyl 5 % EC ( Targa Super ), (4.) Pendimethilin 30 EC (stomp) application before planting and second application after 30 days of transplanting. (5.) Pendimethilin 30 EC (stomp) application before planting + Quizalofop Ethyl 5EC (Targa Super) application at 30 days after planting, (6.) Combine spray of Pendimethilin 30 EC (Stomp) + Quizalofop Ethyl 5 EC (Targa Super) at time of planting and second application after 30 days of planting, (7.) DOGR recommended practices (Oxyflurofen 23.5% EC application before planting + one hand weeding after 40- 60 days and 8. weedy check. were evaluated to find out the suitable weed control means for onion production.

Among the different treatment combinations, $T_3$ recorded highest total bulb yield (447.69q/ha) marketable bulb yield (436.49q/ha), with maximum weed control efficiency (92.30%). However, minimum storage loss was observed with treatment T2 (29.30 %) as compare to other treatment combinations.

## Development of model for organic baby corn production and evaluation of its fodder value

Technology for organic baby corn production with VL baby corn-1 was standardized. among the different treatment used in bed size of 5 $m^2$ : Vermi (1.92 kg / bed ) + Biospirillum (10 ml/kg of seed) + Biophos (10 ml/kg of seed) + Biopotash (10 ml/kg of seed) was found to very effective for higher yield (19.80 q/ha) of baby corm.

## 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 .It matures in first week of May in the Kashmir valley. Being a succulent fruits its availability period is very short. Thus, there was a need to evaluate

A field view of strawberry

A field view of inter crops with apple

strawberry varieties under different growing conditions to extend the availability span with superior fruit yield and quality *vis a vis* higher benefits to the farmers. Twenty two varieties were evaluated under four 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 217 days to 254 days from date of transplanting i.e. 15th October. The earliest harvesting was obtained under poly tunnel (217days) from date of transplanting while maximum number of days (254.24 days) was taken by control. Thus period of availability was enhanced up to 5 weeks (37 days) by using different growing conditions. The highest yield was obtained in respective of varieties under straw mulch (65.04 q/ha) which was closely followed black polyethylene mulch (53.44 q/ha). The lowest yield was harvested in control (30.17 q/ha). There were no significant differences among the varieties for days to first harvest. However, the variety Brighten recorded highest yield among the all tested varieties. Considering varieties and growing conditions it was observed that variety Douglas with straw mulch gave the highest yield (93.98 q/ha) followed by Howard under straw mulch (92.37 q/ha).

## Development of apple based cropping system with legumes, spices, forages and medicinal and aromatic plants

Among the copping sequences, treatment consisting of apple +red clover recoded highest fruit weight (191.48g) with maximum fruit colour (85%) closely followed by apple + lentil, apple + peas and apple + methi, where as maximum TSS and lower acidity was recorded with apple + coriander trials apple + lentil cropping system recoded maximum annual shoot extension and yield of apple. The highest apple equivalent yield (201.18q/ha) was recorded with apple + methi followed by apple + garlic (186.35q/ha) copping systems (Table-44).

**Table 44: Yield of apple and intercrop in apple based intercropping systems**

| Treatments | Intercrop yield (q/0.7ha) | Apple yield (q/ha) | Apple equivalent yield (q/ha) |
|---|---|---|---|
| T(1) - Apple+Methi | 20.80 | 52.49 | 201.18 |
| T(2) - Apple+Onion | 153.41 | 35.41 | 144.32 |
| T(3) - Apple+Lentil | 15.40 | 81.50 | 118.28 |
| T(4) - Apple+ Garlic | 48.92 | 66.36 | 186.35 |
| T(5) - Apple+Coriander | 11.10 | 66.33 | 144.54 |
| T(6) - Apple+Peas | 60.66 | 69.57 | 127.40 |
| T(7) - Apple+Lucerne | 215.9 | 64.44 | 100.55 |
| T(8) - Apple+Red Clover | 220.00 | 73.87 | 100.49 |
| T(9) - Apple+Swiss chord | 225.00 | 48.83 | 124.50 |
| T(10) - Apple+Mustard | 22.00 | 42.82 | 63.80 |
| T(11) - Apple | - | 60.27 | 59.36 |

## Energy harvest through plant architectural engineering for increasing source and sink relationship in apple and other temperate fruits

To harness solar energy, different training systems were tried at different spacing on the M9 root stock during 2008-09. Among the training systems Espalier resulted in highest yield as compare to the Single axis. Coe Red Fuji and Granny Smith recorded highest yield 58.31 and 48.07 t/ha and 24.47 and 17.12t/ha

respectively in both the training systems during the year 2010 (Table-45).

In case of Spindle Bush, Head and Spread and Modified Leader, the cultivar Golden Delicious, Mollies Delicious and Starkrimson resulted in highest yield in all the training systems (Table 46).

**Table 45: Impact of training system and spacing on yield( t/ha) of apple at 3 years old plantation**

| Variety | Training System/ Spacing | |
|---|---|---|
| | Vertical axis (0.75 x 1.5 m) | Espalier system (3.0 x 1.5 m) |
| Coe Red Fuji | 24.47 | 58.31 |
| Granny Smith | 17.12 | 48.07 |
| Spartan | 11.02 | 22.24 |
| CD at 5% | 8.34 | 8.04 |
| SEM ± | 3.00 | 2.89 |

**Table 46: Impact of training systems and varieties on yield of apple at 3.0 x 1.5 m spacing on M-9 root stock**

| Variety | Training System/Spacing | | |
|---|---|---|---|
| | Spindle bush | Head & Spread | Modified Central Leader |
| Starkrimson | 38.85 | 37.29 | 46.96 |
| Mollies Delicious | 44.06 | 39.41 | 49.73 |
| Gala Mast | 31.63 | 27.65 | 37.68 |
| Vista Bella | 33.72 | 29.88 | 37.68 |
| Golden Delicious | 53.43 | 46.44 | 58.66 |
| CD at 5% | 3.75 | 3.98 | 3.34 |
| SEM ± | 1.62 | 1.71 | 1.44 |

## Training in peaches/nectarines

Among various training systems , in the first year in all the varieties maximum fruit set, fruit yield per tree, fruit yield/ha and fruit quality recorded in Tatura trellis (perpendicular V) followed by four scaffold system of training in 2.5x2.5 m planting density. Under 3x3 m planting density in all the varieties maximum fruit set, fruit yield per tree, fruit yield/ha and fruit quality recorded in four scaffold followed by Tatura trellies (perpendicular V) system of training. Light interception data has been recorded and maximum light penetration in the canopy at different height was recorded in Tatura trellies (perpendicular V) followed by four scaffold system. The experiment is under progress.

## Development of saffron based intensive cropping system involving almond

Three types of almond varieties namely erect, semi-erect and drooping type were planted in saffron at a spacing of 4 x 4 m. Data on vegetative and flower characteristic of saffron and almond are being recorded. In the first year, there is no significant impact of almond on saffron yield and quality as almond plantation is in its initial stage.

## Standardization of improved agro-techniques for maximization of saffron productivity

A field experiment was laid out in split plot design involving three irrigation methods (drip, sprinkler and control), three planting methods (raised bed , ridge & furrow and flat bed) and 3 planting densities ( 5,10 and

Saffron field with planting densities, irrigation and planting methods

15 lakh corm/ ha) with two replications. In first year trial, among all the treatments, sprinkler and drip irrigation methods caused early sprouting; early flowering with increased plant height and more no. of leaves and flowers per plant as compare to control (rain fed). Stigma fresh weight, stigma dry weight, stigma length and saffron yield per hectare were improved in sprinkler and drip irrigation methods as compare to control (Table-47). Among planting methods, raised beds resulted in early sprouting; early flowering with increased plant height and more no. of leaves and flowers per plant as compare to ridge & furrow and flat bed systems. After one year, planting density 15 lakh corms/ha. resulted in significant improvement in saffron yield (2.5 kg/ha) as compare to planting density of 10 lakh corms/ha (1.8 kg/ha.) and planting density 5 lakh corm/ha (1.0 kg/ha.) in raised bed system with sprinkler irrigation.

## Standardization of cost effective production technology for cut flower production in carnation

Among sixteen varieties of carnation (Dianthus *caryophyllus*) namely, Firato, Prado Mint, Master, Liberty, Charmant, Niva, Laurella, Tabor, Dark Rendezvous, Raggio de Sole, Frivote, Tempo, Farida, Vienna, Crimson Tempo and Cool as evaluated under low cost polyhouse for different characters suitable for cut flower production, the data revealed that all the genotypes differed significantly with respect to growth and flowering parameters (Table-48). Earliest flower bud induction was recorded in cv. Cool while cv.Vienna took maximum number of days for flower bud induction. Cultivar Laurella, Crimson Tempo, Dark Rendezvous and Cool recorded maximum plant height while cv. Niva and Master were found to bear maximum number of flowers/$m^2$. Cultivar Raggio desale recorded largest flower diameter (11.33cm) whereas stalk length

**Table 47: Effect of different irrigation regimes, planting methods and densities on growth, flowering and yield of saffron**

| Treatments | Sprouting % | Percent flowering | No. of flowers/ plant | Foliage height (cm) | No. of leaves/ plant | Stigma length (cm) | Stigma wt. (mg) | Pistil length (cm) | Yield (kg/ha) |
|---|---|---|---|---|---|---|---|---|---|
| T1 | 90 | 52.12 | 1.2 | 29.10 | 16.00 | 3.6 | 6.6 | 4.7 | 2.2 |
| T2 | 88 | 51.16 | 1.2 | 28.20 | 15.00 | 3.5 | 6.7 | 4.6 | 1.5 |
| T3 | 88 | 50.02 | 1.3 | 25.00 | 14.10 | 3.5 | 6.8 | 4.7 | 0.8 |
| T4 | 95 | 60.10 | 1.6 | 34.10 | 16.70 | 3.8 | 7.0 | 5.0 | 2.5 |
| T5 | 94 | 58.00 | 1.6 | 33.20 | 16.30 | 3.7 | 6.8 | 4.8 | 1.8 |
| T6 | 93 | 54.00 | 1.7 | 30.80 | 14.20 | 3.7 | 7.0 | 4.6 | 1.0 |
| T7 | 87 | 50.36 | 0.9 | 24.36 | 13.20 | 3.3 | 6.6 | 4.5 | 2.0 |
| T8 | 86 | 49.82 | 1.0 | 23.87 | 12.10 | 3.1 | 6.5 | 4.5 | 1.3 |
| T9 | 84 | 49.01 | 1.0 | 22.20 | 11.60 | 3.1 | 6.4 | 4.5 | 0.7 |
| T10 | 89 | 53.16 | 1.1 | 28.16 | 16.30 | 3.4 | 6.6 | 4.6 | 2.1 |
| T11 | 88 | 52.06 | 1.1 | 27.82 | 15.20 | 3.2 | 6.7 | 4.5 | 1.5 |
| T12 | 86 | 52.34 | 1.2 | 26.06 | 14.30 | 3.2 | 6.6 | 4.5 | 0.7 |
| T13 | 93 | 58.10 | 1.6 | 33.40 | 16.90 | 3.8 | 6.8 | 4.9 | 2.4 |
| T14 | 92 | 57.60 | 1.4 | 32.10 | 16.30 | 3.6 | 6.7 | 4.7 | 1.6 |
| T15 | 90 | 53.80 | 1.3 | 31.80 | 15.60 | 3.4 | 6.9 | 4.8 | 0.9 |
| T16 | 86 | 50.86 | 0.8 | 24.50 | 14.20 | 3.0 | 6.5 | 4.6 | 2.0 |
| T17 | 85 | 51.32 | 0.7 | 23.10 | 13.70 | 2.8 | 6.4 | 4.7 | 1.3 |
| T18 | 84 | 51.00 | 0.9 | 22.00 | 13.80 | 2.9 | 6.4 | 4.8 | 0.7 |
| T19 | 83 | 47.62 | 1.2 | 24.10 | 11.10 | 3.0 | 6.5 | 4.3 | 2.0 |
| T20 | 82 | 45.11 | 1.1 | 23.80 | 10.00 | 3.1 | 6.4 | 4.2 | 1.3 |
| T21 | 82 | 44.86 | 1.3 | 22.10 | 09.00 | 3.0 | 6.4 | 4.2 | 0.6 |
| T22 | 85 | 48.86 | 1.5 | 27.10 | 13.10 | 2.7 | 6.7 | 4.4 | 2.0 |
| T23 | 84 | 47.16 | 1.4 | 25.80 | 12.60 | 2.6 | 6.6 | 4.6 | 1.2 |
| T24 | 83 | 46.16 | 1.4 | 24.90 | 11.60 | 2.6 | 6.5 | 4.7 | 0.6 |
| T25 | 80 | 41.32 | 0.7 | 19.20 | 10.20 | 2.5 | 6.3 | 4.0 | 1.2 |
| T26 | 79 | 42.12 | 0.6 | 19.86 | 08.70 | 2.3 | 6.1 | 4.2 | 0.9 |
| T27 | 78 | 41.87 | 0.8 | 20.00 | 09.00 | 2.3 | 6.3 | 4.2 | 0.5 |

**Table 48: Flowering characters of carnation cultivars under low cost polyhouse**

| S. No. | Genotypes | Days to flower induction | Stemlength (cm) | Flower diameter(cm) | Vase-life (days) |
|---|---|---|---|---|---|
| 1. | Firato | 138.00 | 26.33 | 8.06 | 7.00 |
| 2. | Frivote | 162.00 | 26.66 | 8.10 | 7.00 |
| 3. | Prado Mint | 135.33 | 31.33 | 6.50 | 7.66 |
| 4. | Raggio de Sole | 177.33 | 32.33 | 11.33 | 8.33 |
| 5. | Tempo | 170.00 | 22.00 | 7.00 | 6.33 |
| 6. | Laurella | 171.66 | 41.00 | 7.26 | 8.33 |
| 7. | Dark Rendezvous | 141.33 | 34.00 | 7.03 | 7.66 |
| 8. | Tabor | 138.33 | 35.00 | 7.16 | 8.33 |
| 9. | Liberty | 146.66 | 35.00 | 8.53 | 8.00 |
| 10. | Master | 143.66 | 40.33 | 8.63 | 16.00 |
| 11. | Farida | 146.66 | 27.66 | 8.33 | 10.00 |
| 12. | Vienna | 180.66 | 21.66 | 5.83 | 7.33 |
| 13. | Niva | 146.33 | 22.66 | 6.83 | 12.00 |
| 14. | Charmant | 159.33 | 41.33 | 7.30 | 14.00 |
| 15. | Cool | 130.52 | 35.25 | 6.54 | 7.25 |
| 16. | Crimson Tempo | 135.68 | 45.25 | 7.87 | 8.24 |

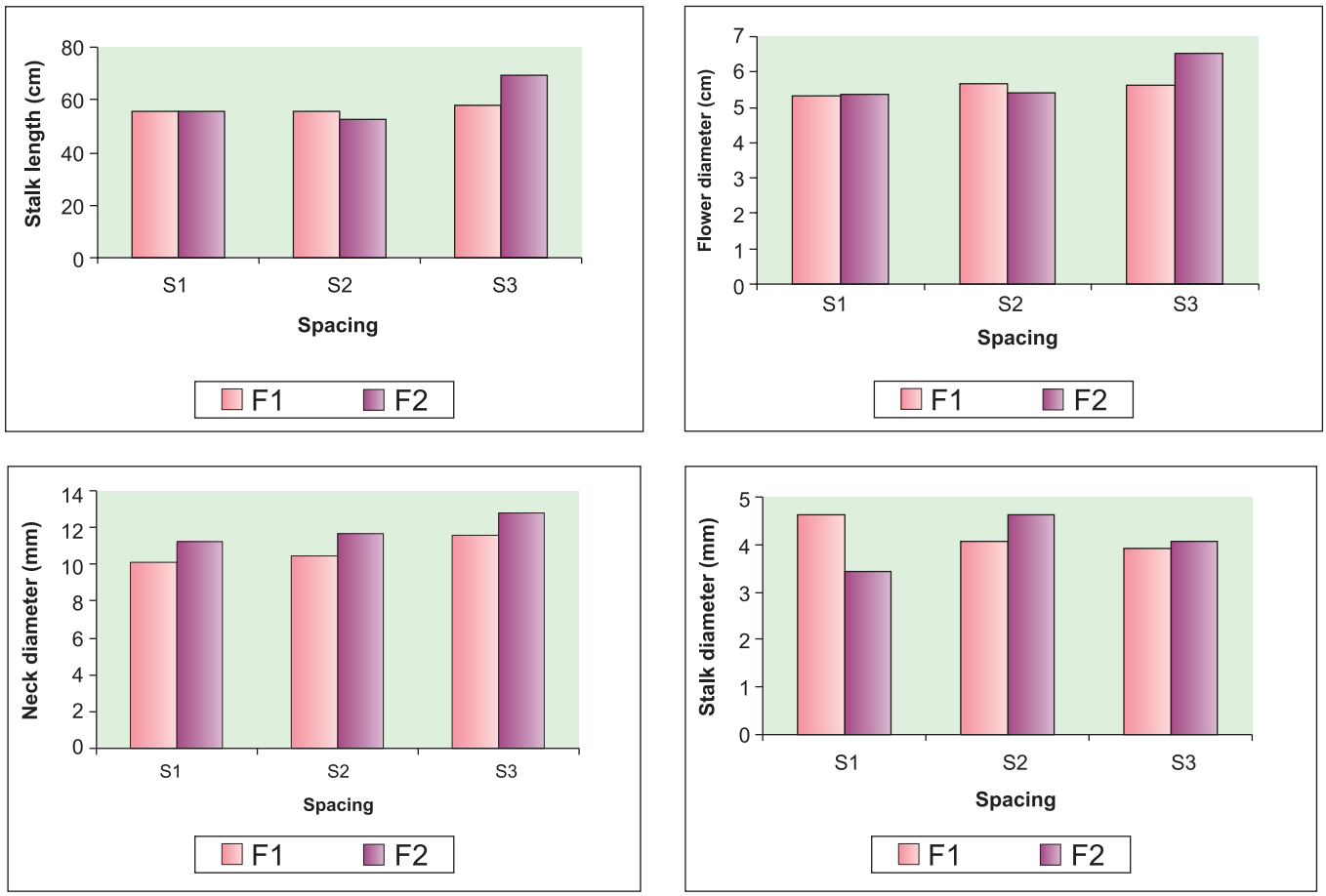



Fig-1-4: Effect of spacing and fertilizer on stalk length, flower diameter, neck diameter and stalk diameter of carnation var. Master.

was found to be maximum (45.25 cm) in cv. Crimson Tempo. Master was found superior with respect to vase-life of flowers.

Earliest flower bud induction (119 days) was recorded with S1 (15x10 $cm^2$). Stalk length, flower diameter and neck diameter of cut flower (Fig. 1-4)

## Standardization of technique for plug plant production in ornamentals

Medium containing sphagnum moss+cocopeat+ forest litter 1:1:2 recorded earliest rooting for Fuchsia cuttings, while better root length was recorded with the medium containing cocopeat + perlite + vermiculite in the ratio of 3:1:1 with fertilizer dose of 12:10:1 NPK.

## Study of vase life of different varieties of gerbera

Among all the gerbera cultivars Dune and Dana Ellen expressed longest vase life (16.30 and 15.53 days respectively) followed by Carambola, Kayak and Winter Queen. The vase life of flower also increased with increase in stem length (Table-49). There is variation in Vase life (varied from 10.58 to 16.30 days in 60 cm stem length) among the cultivars due to varietal characteristic. The experiment will be repeated for one more year for validation of results.

Table-49: Effect of different stem lengths on vase life of gerbera cut flower

| Variety | Vase life (days) Stem length | | | |
|---|---|---|---|---|
| | 30 cm | 40 cm | 50 cm | 60 cm |
| Sunway | 09.23 | 10.59 | 11.06 | 12.12 |
| Rosalin | 10.23 | 11.51 | 11.85 | 13.25 |
| Dana Ellen | 13.58 | 14.44 | 15.25 | 15.53 |
| Carambola | 13.51 | 14.76 | 15.45 | 15.49 |
| Cacharell | 12.12 | 13.68 | 14.11 | 14.55 |
| Kayak | 13.45 | 14.52 | 15.38 | 15.43 |
| Winter Queen | 13.22 | 14.44 | 15.00 | 15.12 |
| Dune | 14.39 | 15.23 | 16.23 | 16.30 |
| Salvadore | 12.25 | 13.86 | 14.11 | 14.45 |
| Scope | 09.12 | 09.54 | 10.45 | 10.58 |

## Standardization of agro-techniques for quality cut flower and corm production in gladiolus

Earliest sprouting (16.72 days) was observed in treatment comprising of spacing 20x25 $cm^2$ with 30:20:20 g/$m^2$ NPK or 30x30 $cm^2$ with 20:10:10 g/$m^2$ NPK. Longest spike (112.22 cm) was recorded in the treatment comprising 25x25 $cm^2$ spacing and 40x30x30g/$m^2$ NPK dose, while treatment comprising of spacing 30x30 and 20:10:10 g/$m^2$ NPK gave highest numbers of florets (Table-50). Efficacy of different bio agents as well as plant growth regulators showed

**Table 50: Effect of planting density and fertilizer dose on plant growth and quality of gladiolus spikes**

| Treatment | Days to sprout | Days to spike emergence | Plant ht (cm) | Leaf no. | Spike length (cm) | Rachis length (cm) | Floret no. | Floret dia. (cm) | Life of last flower | Vase-life (days) |
|---|---|---|---|---|---|---|---|---|---|---|
| T1 | 18.44 | 91.33 | 141.92 | 12.00 | 98.22 | 73.00 | 15.00 | 9.67 | 3.33 | 8.67 |
| T2 | 16.77 | 100.67 | 123.83 | 10.33 | 100.33 | 67.33 | 19.67 | 10.00 | 2.33 | 8.47 |
| T3 | 18.00 | 89.00 | 135.58 | 10.00 | 96.67 | 68.33 | 13.33 | 10.00 | 3.00 | 15.67 |
| T4 | 17.83 | 89.33 | 127.00 | 11.67 | 93.33 | 64.67 | 12.67 | 10.00 | 2.33 | 8.33 |
| T5 | 19.00 | 90.00 | 122.42 | 10.00 | 101.78 | 69.33 | 12.67 | 10.00 | 3.00 | 10.83 |
| T6 | 20.06 | 93.00 | 136.08 | 11.33 | 112.22 | 69.00 | 12.33 | 9.27 | 3.00 | 7.00 |
| T7 | 18.78 | 90.00 | 134.75 | 12.00 | 106.11 | 75.33 | 20.67 | 9.10 | 4.67 | 8.00 |
| T8 | 20.11 | 90.67 | 126.58 | 10.33 | 104.89 | 62.0 | 13.00 | 9.77 | 2.67 | 6.97 |
| T9 | 22.11 | 105.00 | 128.83 | 10.33 | 99.22 | 61.33 | 13.67 | 11.96 | 2.00 | 8.00 |
| T10 | 16.72 | 90.33 | 131.08 | 11.67 | 99.22 | 76.00 | 23.33 | 9.67 | 4.00 | 8.33 |
| T11 | 20.39 | 94.00 | 136.50 | 11.00 | 102.44 | 63.33 | 19.67 | 10.17 | 2.33 | 7.66 |
| T12 | 18.77 | 98.37 | 130.25 | 10.33 | 98.56 | 48.67 | 13.33 | 9.33 | 2.67 | 6.00 |

significant result in terms of enhanced corm and cormel production. Maximum average weight of corm was recorded with *Trichoderma viride* and $GA_3$ 100 ppm (Table-51).

**Table 51: Effect of growth regulators and bio-agents on plant growth and quality of gladiolus spikes**

| Treatment | Days to sprout | Plant ht (cm) | No. of leaves | Spike length(cm) | Rachis length(cm) | No. of florets | Spike weight(g) | Vase-life (days) |
|---|---|---|---|---|---|---|---|---|
| T1 | 16.44 | 120 | 9.5 | 80 | 47 | 15 | 60 | 10 |
| T2 | 16.77 | 115 | 9.33 | 80 | 47 | 15 | 68 | 10 |
| T3 | 18 | 105 | 10 | 75 | 47 | 15 | 68 | 9 |
| T4 | 11.83 | 124 | 11.67 | 85 | 54 | 16 | 65 | 10 |
| T5 | 14 | 115 | 10 | 80 | 55 | 16 | 75 | 11 |
| T6 | 14.06 | 110 | 11.33 | 75 | 48 | 16 | 60 | 11 |
| T7 | 13.78 | 120 | 12 | 85 | 45 | 17 | 72 | 10 |
| T8 | 14.11 | 125 | 10.33 | 85 | 57 | 18 | 70 | 10 |
| T9 | 14.11 | 115 | 10.33 | 85 | 50 | 15 | 80 | 10 |
| T10 | 12.72 | 125 | 10.67 | 80 | 54 | 17 | 75 | 10 |
| T11 | 14.39 | 120 | 10 | 85 | 51 | 16 | 80 | 9 |
| T12 | 14.77 | 110 | 9.33 | 80 | 45 | 16 | 72 | 8 |
| Control | 17 | 104 | 9.00 | 70 | 40 | 11 | 65 | 7 |

# Plant Health Management

## Management of chilli wilt

A field trial 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 total 27 modules including the check ( No Biocontrol, No Chemical, No solarization -$B_oC_oS_o$) was conducted during the year 2010-11. The seed priming with respective biocontrol agents was done before their sowing. The beds were solarized with requisite to polythene for about 40 days. The seedlings were root dipped in bioagents/chemical preparations before transplanting. Later about 40 days after 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.

The details of percent disease index and percent disease mitigation indicated that the maximum disease mitigation (61.76 %) was recorded with *T. viride* seed priming, carbendazim root dip and soil drenching and solarization with transparent polythene. It was closely followed by the treatment *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

**A** field trial on management of corm rot of saffron (*Fusarium oxysporum* f. sp. *gladioli*) following chemical seed treatment has been initiated during 2010-2011. The treatments are $T_1$ = 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 field trial on chemical seed treatment for management of corm rot is being maintained and plants are being examined for wilt symptoms. The experiment is in progress.

## Biological control of white grub

### i. Evaluation of *Beauveria bassiana* as soil application for the management of white grub in walnut

The formulation of *B. bassiana* prepared on the maizemeal-sand medium was used in the field trial. Five treatments of this formulation were given at the rate of 40 g/tree, 50 g/tree, 60 g/tree, 70 g/tree and 80 g/tree in first week of April along with control. Each treatment was replicated three times. The inoculum was mixed well in root zone of trees and watering was done to avoid desiccation. One hundred apical leaves in each tree were examined in second fortnight of June for infestation if any by the adults (beetles) of white grub. The results are presented in Table-52. The table shows that soil application of *B. bassiana* formulation in maizemeal-sand medium under mild infestation conditions resulted in abatement of infestation upto 77.6 percent with application at 80g/tree in root zone of walnut trees.

### ii. Evaluation of *Beauveria bassiana* as soil application for management of white grub in apple

The same formulation of *B. bassiana* prepared on the maizemeal-sand medium was used in the field trial in apple variety Red Delicious. Five treatments of this formulation were given at the rate of 40 g/tree, 50 g/tree, 60 g/tree, 70 g/tree and 80 g/tree in first week of April along with control and replicated three times. The inoculum was mixed well in rootzone of trees and watering was done to avoid desiccation. One hundred apical leaves in each tree were examined in second fortnight of June for infestation if any by adults (beetles) of white grub. The results are presented in Table-53. The table shows that soil application of *B. bassiana* formulation in maize meal-sand medium under mild infestation conditions resulted in abatement of infestation up to 62.0 percent with application at 80 g/tree in root zone of apple trees.

**Table 52: Plant infestation by white grub adults under different treatments of *Beauveria bassiana* in walnut**

| Treatment | Apical leaf damage* (%) | Infestation abatement $= \frac{C-T}{C} \times 100$ |
|---|---|---|
| $T_1$ = 40g/tree | 18.3 (25.3) | 26.8 |
| $T_2$ = 50g/tree | 14.0 (21.9) | 44.0 |
| $T_3$ = 60g/tree | 11.0 (19.3) | 56.0 |
| $T_4$ = 70g/tree | 8.3 (16.7) | 66.8 |
| $T_5$ = 80g/tree | 5.6 (13.6) | 77.6 |
| $T_6$ = CHECK | 25.0 (29.9) | — |
| C. D. P (0.05) | 1.36 | — |
| C. D. P (0.01) | 1.94 | — |

* Angular transformation values in parentheses

**Table-53: Plant infestation by white grub adults under different treatments of Beauveria *bassiana* in apple variety Red Delicious**

| **Treatment** | **Apical leaf damage* (%)** | Infestation abatement $= \frac{C-T}{C} \times 100$ |
|---|---|---|
| $T_1$ = 40g/tree | 26.3 (30.8) | 16.7 |
| $T_2$ = 50g/tree | 24.3 (29.5) | 23.1 |
| $T_3$ = 60g/tree | 22.0 (27.9) | 30.3 |
| $T_4$ = 70g/tree | 15.3(23.0) | 51.5 |
| $T_5$ = 80g/tree | 12.0(20.2) | 62.0 |
| $T_6$ = CHECK | 31.6(34.2) | — |
| C. D. P (0.05) | 1. 63 | — |
| C. D. P (0.01) | 2.32 | — |

* Angular transformation values in parentheses

## Studies on efficacy of Kresoxim methyl against apple scab in Kashmir conditions

The apple trees were already sprayed with 1.5 percent horticultural mineral oil during second fortnight of March, 2010 for Sanjose scale/mite control and subsequently sprayed with 0.06 percent Dodine in first fortnight of May, 2010 for primary scab control. Two sprays of Kresoxim methyl @ 0.03 percent and 0.05 percent as well as Hexaconazole @ 0.05 percent were applied in second fortnight of May and first fortnight of June in the orchard for management of secondary scab infection along with unsprayed check. In each treatment comprises of four trees as an unit and replicated five times under randomized block design. The secondary scab infection on 50 leaves of ten terminal shoots per tree was recorded by the end of July, 2010. The disease incidence data was analysed statistically and the details of disease incidence and percent disease control are given in Table-54. In the variety Benoni , spray of 0.05 percent Kresoxim methyl resulted in minimum infection of terminal leaves i.e. 3.20 percent followed by 5.30 percent terminal leaf infection with spray of 0.03 percent Kresoxim methyl and 9.40 percent terminal leaf infection with 0.05 percent Hexaconazole as compared to 40.80 percent terminal leaf infection in Check. Similarly in the variety Red Gold also minimum infection of terminal leaves (5.0 %) was recorded with the spray of (0.05 %) Kresoxim methyl followed by 9.10 % terminal leaf infection with 0.03 % spray of Kresoxim methyl and 11.20 % terminal leaf infection in trees sprayed with 0.05 % Hexaconazole as compared to 43.20 % terminal leaf infection in Check. Similar trend was also recorded in apple variety Golden Delicious .In all of the three apple varieties maximum percent disease control was recorded with spray of 0.05 % Kresoxim methyl followed by 0.03 % Kresoxim methyl and 0.05 % Hexaconazole. The percent disease control of terminal leaf infection was 87.00, 78.93 and 81.00 % in Benoni, Red Gold and Golden Delicious, respectively with 0.03% Kresoxim methyl spray (Table-54)

Fruit number and yield per tree of all three varieties were analysed statistically for interpretation of results. In variety Benoni, spray of 0.05% Kresoxim methyl resulted in maximum sound fruits (92.95 fruit /tree) and yielded (11.28 kg /tree) followed by spray of 0.03 percent Kresoxim methyl (71.75 number and of 8.76 kg/tree) and 0.05 per cent Hexaconazole (49.50 number and 6.07 kg/tree) as compared to the control (37.30 number and 4.52 kg /tree). Similar trends were also noticed in Red Gold and Golden Delicious of apple (Table-55).

The fungicide (Kresoxim methyl 50% SC and Ergon 44.3% W/W SC) were also evaluated for their phytotoxic symptoms on apple variety Golden Delicious. Foliar spray in three concentrations i.e. 0.05%, 0.1% and 0.2% along with recommended dose of hexaconazole i.e. 0.05% and Check (water) were taken up. The sprayed trees of all of the five treatments were observed for appearance of phytotoxic symptoms viz. Necrosis, Vein clearing, Yellowing, Wilting,

Hyponasty and Epinasty in the foliage upto 15 days after spray. None of these symptoms on foliage were discernible (Table-56). It shows that all the treatments of foliar spray with Kresoxim methyl as well as standard check Hexaconazole were not phytotoxic to apple as foliar spray under Srinagar conditions.

**Table 54: Efficacy of kresoxim methyl 50% SC (Ergon 44.3% W/W SC) against development of apple scab in Srinagar conditions**

| Treatments | Av. Percent infection of terminal leaves* | | | Percent disease control | | |
|---|---|---|---|---|---|---|
| | Benoni | Red Gold | Golden Delicious | Benoni | Red Gold | Golden Delicious |
| $T_1$ =Kresoxim methyl 0.03% | 5.30(13.22) | 9.10(17.46) | 7.90(16.26) | 87.00 | 78.93 | 81.00 |
| $T_2$= Kresoxim methyl 0.05% | 3.20(10.18) | 5.00(12.86) | 3.80(11.18) | 92.15 | 88.42 | 90.86 |
| $T_3$ = Contaf (Hexaconazole)0.05% | 9.40(17.74) | 11.20(19.50) | 9.70(18.06) | 76.96 | 74.07 | 76.68 |
| $T_4$ = CHECK | 40.80(39. 64) | 43.20(42.24) | 41.60(40.16) | - | - | - |
| CD (p 0.05) | 2.42 | 3.12 | 1.92 | - | - | - |
| CD (p 0.01) | 3.40 | 4.38 | 2.69 | - | - | - |

*Angular transformation values in parentheses

**Table 55: Effect of Kresoxim methyl on apple yield due to scab abatement in Kashmir conditions**

| Treatments | Av. Number of sound fruits and their weight per tree | | | | | | Percent increase in yield due to scab abatement | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fruit number | | | Fruit weight (kg.) | | | Fruit number | | | Fruit weight (kg) | | |
| | Benoni | Red Gold | Golden Delicious | Benoni | Red Gold | Golden Delicious | Benoni | Red Gold | Golden Delicious | Benoni | Red Gold | Golden Delicious |
| $T_1$ =Kresoxim methyl 50% SC 0.03% | 71.75 | 60.60 | 48.65 | 8.76 | 7.43 | 9.74 | 92.35 | 33.92 | 42.04 | 93.80 | 39.39 | 47.35 |
| $T_2$= Kresoxim methyl 50% SC 0.05% | 92.95 | 94.90 | 61.30 | 11.28 | 11.77 | 12.31 | 149.19 | 109.72 | 78.97 | 149.55 | 120.82 | 86.23 |
| $T_3$ = Contaf (Hexaconazole) 5% EC 0.05% | 49.50 | 51.85 | 39.50 | 6.07 | 6.23 | 7.70 | 32.70 | 14.58 | 15.32 | 34.29 | 16.88 | 16.49 |
| $T_4$ = CHECK | 37.30 | 45.25 | 34.25 | 4.52 | 5.33 | 6.61 | - | - | - | - | - | - |
| C.D. (P 0.05) | 2.53 | 6.62 | 6.83 | 0.80 | 0.91 | 0.86 | - | - | - | - | - | - |
| C.D. (P 0.01) | 3.56 | 9.30 | 9.59 | 1.12 | 1.28 | 1.21 | - | - | - | - | - | - |

**Table 56: Effect of kresoxim methyl 50% SC ( Ergon 44.3% W/W SC ) on apple variety Golden Delicious for 15 days under Srinagar conditions**

| S. No. | Treatments | Phytotoxic symptoms discernible to naked eye | | | | | |
|---|---|---|---|---|---|---|---|
| | | Necrosis | Vein clearing | Yellowing | Wilting | Hyponasty | Epinasty |
| 1 | $T_1$ =Kresoxim methyl 50% SC | | | | | | |
| | (Ergon 44.3% W/W SC) 0.05% | ND | ND | ND | ND | ND | ND |
| 2 | $T_2$=Kresoximmethyl50% SC | | | | | | |
| | (Ergon 44.3% W/W SC) 0.1% | ND | ND | ND | ND | ND | ND |
| 3 | $T_3$ = Kresoxim methyl 50% SC | | | | | | |
| | (Ergon 44.3% W/W SC) 0.2% | ND | ND | ND | ND | ND | ND |
| 4 | $T_4$ = Contaf 5% EC 0.05% | | | | | | |
| | (Hexaconazole) | ND | ND | ND | ND | ND | ND |
| 5 | $T_5$ = CHECK (water) | ND | ND | ND | ND | ND | ND |

ND = Not discernible

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

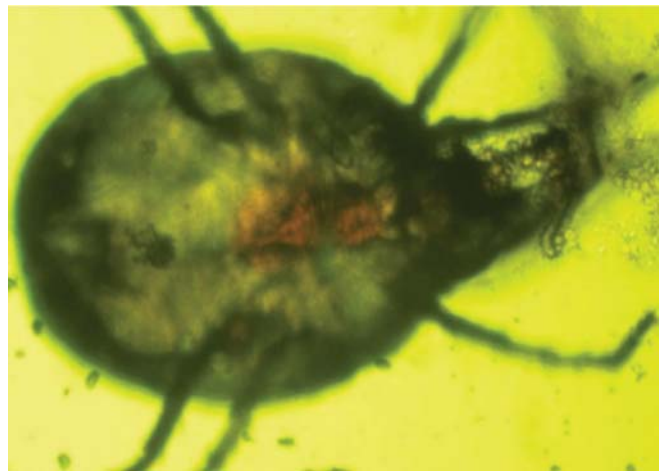
The work on mechanical transmission of apple mosaic virus to herbaceous indicators under Kashmir conditions as well as detection of apple mosaic virus with the use of commercially available ELISA kit has been initiated in 2011.

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

The seeds of tomato line Hemsona, Cucumber hybrid SH-CH-1 and Capsicum hybrid - SH-SPH-1 were treated with Carbendazim @ 2g/kg for management of damping off in seedlings. The seedlings have been raised and different seedling treatments are being evaluated for their efficacy under polyhouse conditions.

## Bio-efficacy of acaricides against phytophagous apple mites under glass house

Mite population was effectively controlled by application of two sprays of 0.005% Fenpyroximate closely followed by 0.00375% Fenpyroximate and 0.037% Dicofol. Sprays of 0.005% Fenpyroximate kept the mite population 0.00, 0.00, 0.25 and 0.72 mite/leaf on $7^{th}$, $14^{th}$, $21^{st}$ and $28^{th}$ day after first spray, respectively. Concentration of 0.00375% Fenpyroximate and 0.037% Dicofol with 0.81 and 0.00 mite/leaf on $7^{th}$ day, 1.37 and 1.60 mite/leaf on $14^{th}$ day and 1.79 and 2.98 mite/leaf on $21^{st}$ day, respectively (Table-57). Second spray on $28^{th}$ day again controlled the mite population to 0.00, 0.00 and 0.39 mite/leaf on $10^{th}$, $20^{th}$ and $30^{th}$ day after second spray, respectively. Fenpyroximate at 0.00375% also controlled mite population effectively with 0.38, 0.75 and 1.63 mite/leaf on the respective days after second spray. Vegetative response in terms of height increment, number of new shoot, new shoot growth, leaf area and retention of leaves were found to be significantly better on the plants which received 0.005% Fenpyroximate in comparison to the control and other treatments. Plant growth parameters of apple under glass house conditions showed that plants which received treatment of 0.005% Fenpyroximate resulted



in better plant growth in terms of plant height increment (23.00%), new shoot growth (31.10 cm), numbers of new shoots (4.67) and leaf area ( 46.27 $cm^2$). In other treatments viz., 0.00375%, 0.0025% Fenpyroximate and 0.037% Dicofol, 19.17%, 15.93% and 19.50% height increment; 26.47 cm, 20.07 cm and 25.70 cm new shoot growth; 3.33, 2.07 and 3.67 number of new shoots, and 35.00 $cm^2$ , 30.40 $cm^2$and 30.10 $cm^2$ leaf area were recorded, respectively. However, significantly very poor plant growth response was observed in the plants with maximum mite population load, which did not receive any acaricides treatments (14.43% height increment, 18.23 cm new shoot growth, 2.00 numbers of new shoots and 20.77 $cm^2$ leaf area). Leaf fall started very early 109 days after second spray in the plants which were treated as control (without any sprays), whereas in treatments 0.0025%, 0.00375% , 0.005% Fenpyroximate and 0.037% Dicofol it took 122, 139, 151 and 133 days respectively from the second spray.

**Table 57: Efficacy of two sprays of Fenpyroximate against phytophagous apple mites under glass house**

| Treatments | Pre treatment Nos. of mites/leaf | Post spray (Nos. of mite/leaf) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Days after first spray | | | | Days after second spray | | |
| | | 7 | 14 | 21 | 28* | 10 | 20 | 30 |
| 0.0025% Fenpyroximate | 5.97 | 1.80 (1.52) | 2.45 (1.72) | 2.79 (1.81) | 3.63 (2.03) | 1.45 (1.40) | 1.70 (1.48) | 3.60 (2.02) |
| 0.00375% Fenpyroximate | 5.87 | 0.85 (1.16) | 1.41 (1.38) | 1.82 (1.52) | 2.62 (1.77) | 0.40 (0.95) | 0.75 (1.12) | 1.67 (1.47) |
| 0.005% Fenpyroximate | 5.67 | 0.00 (0.71) | 0.00 (0.71) | 0.21 (0.85) | 0.72 (1.10) | 0.00 (0.71) | 0.00 (0.71) | 0.44 (0.97) |
| Dicofol 0.037% | 5.66 | 0.00 (0.71) | 1.52 (1.42) | 2.87 (1.83) | 9.67 (3.19) | 1.52 (1.42) | 4.83 (2.31) | 8.18 (2.94) |
| Control (Distill water spray) | 5.83 | 11.00 (3.39) | 13.33 (3.72) | 18.33 (4.34) | 30.00 (5.52) | 36.67 (6.10) | 41.667 (6.50) | 48.33 (6.99) |
| CD at 5% | 0.62 | 0.19 | 0.19 | 0.10 | 0.19 | 0.12 | 0.13 | 0.25 |
| SE(±) | 0.27 | 0.08 | 0.08 | 0.04 | 0.08 | 0.05 | 0.06 | 0.11 |

Second spray after counting mites/leaf;
Figures in the parenthesis are "x + 0.5 transformed values.

## Open field conditions

All the acaricide treatments recorded zero mite population at 7 days after treatment though counting of mite population just before the first spray recorded an average of 3.53 to 5.10 mites/leaf. Fenpyroximate 5% SC @ 0.005% concentration was significantly superior to all other treatments at all the intervals of observations recording 0.0 to 0.67 mites/leaf. This was closely followed by Fenpyroximate 5%SC @ 0.00375% (0.0 to 0.97 mites/leaf). The following best treatments were Fenpyroximate 5% SC @ 0.0025 % (0.0 to 1.73 mites/leaf) and Dicofol 18.5% EC @ 0.037% (0.0 to 2.10 mites/leaf). However, all the treatments were significantly superior to Control (6.43 to 11.50mites/leaf).

## Phytotoxicity

Under open conditions, the study on phytotoxic symptoms on apple viz., leaf injury, wilting, vein cleaning, leaf necrosis, epinasty and hyponasty revealed that all the treatments applied at specified concentrations were safe and non phytotoxic.

## Management of physiological disorders in temperate horticultural crops

The pre-harvest application of plant nutrient and growth regulators was accomplished on five cultivars of pomegranate (Dholka, Bedana, Kandhari, Jyoti and G-137) to minimize the fruit cracking. The minimum fruit cracking in all the varieties was recorded 22.53% with the treatment of $CaSo_4$ 3000 ppm (Fig.-1) followed by 22.59% with $CaSo_4$ 2000 ppm as compared to control (40.29%). The percentage of fruit cracking was also varied with the types of cultivars and among selected cultivars minimum fruit cracking % recorded in Bedana (26.01% ) followed by G-137 (27.02%) and Dholka(27.45%) . Thus it is recommended that fruit cracking in pomegranate cultivars could be minimized by a pre-harvest foliar spray of calcium sulpahte 2000-3000 ppm at fruit set and fruit active development stage under temperate condition.

# 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

Pre packing washing of capsicum var. Nishat with sodium hypochlorite as a sanitizing agent (100 ppm for 1 minute), followed by dipping in 1% citric acid for 30 seconds (as antioxidant) and packaging in semi permeable polyethylene film extended the shelf life in both the storage conditions i.e. room temperature and low temperature. However, significant results were obtained when capsicum fruits washed with 100 ppm sodium hypochlorite for 1 minute, treated with 1% citric acid and packaged in 25 µ semi permeable film. The capsicum fruits treated with this treatment can be stored for 32 days at room temperature and 50 days at low temperature (5 ± 2 °C, RH 90 %) showing minimum physiological loss in weight, retaining maximum vitamin C and firmness.

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

Fruits of cherry var. Mishri (Bigarreau Napolean) collected at optimum maturity stage and free from scars and defects after washing in 100 ppm sodium hypochlorite and treating with 1% citric acid were coated with *Aloe vera* gel in different concentrations and stored at low temperature (5 ± 2°C, RH 90 %)) and room temperature to see the quality retention and enhancement in shelf life. Edible coating of *Aloe vera* gel in the concentration of 1:1 and storage at low temperature (5 ± 2 °C, RH 90 %) extended the shelf life of cherry up to 36-40 with least PLW compared with control), maximum ascorbic acid (20.0 mg/100g) compared to control (8.0 mg/100g) and firmness of fruits (17.2) compared to control (8.6) and desirable TSS 13.8 °B compared with control (11.4 °B).

### Effect of shrink wrapping on quality maintenance and storage life of Nectarine cv. 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 (control) to study the level of quality retention and enhancement in shelf life.

The fruits which are shrink wrapped in semi permeable films showed enhancement in storage life compared to control in both the storage conditions. More specifically, 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 in the 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 when compared to control which retained up to 4 days only. The nectarine fruits if kept untreated at room temperature are highly perishable. 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

Mollies Delicious an early variety of apple has less shelf life where quality gets deteriorated with storage time after 2 weeks of harvesting. Trial was takenup to increase the shelf life of this apple fruits 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 fruit were coated with 50% *Aloe vera* gel and shrink wrapped in 25 µ film followed by storing at low temperatures (5 ± 2 C). The fruits with this treatment can be stored up to 68 days showing least PLW, maximum retention of quality and appeal, firmness (36.1) compared to control (30.9).

### Red Chief

In case of 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 as well as retain maximum quality parameters as firmness (20.1 and 21.7 resp) compared to control (12.3).

### Golden Delicious

Golden Delicious, a late maturing variety of apple is having an excellent demand in the market but looses its firmness and shape after 2 weeks of harvesting. To retain its shape , 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 this 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).

### Red Fuji

In case of apple variety Red Fuji, shrink wrapping of fruits with 25 µ semi permeable film was significantly effective to minimize the physiological loss in weight, retain quality parameters and firmness of fruits up to 89 days. The same treatment was effective to retain the quality, appeal and firmness up to 60 days at room temperature compared to control fruits where no shrink wrapping was done.

## Pre and post harvest management for quality maintenance, storage, processing and value addition

### Pomegranate

The varieties Dholka, Kandhari, G-137, Bedana, Jyoti and Kashmiri Local were harvested at full ripe stage and washed with $CaoCl_2$ and stored at room or low temperature condition. The observations indicated that, fruits of pomegranate cultivars could be stored safely without shriveling and with minimum decrease in fruit quality at 4°C up to 100 days as compared to room temperature for 70 days.

### Apricot

Pre-harvest application of calcium chloride (0.5, 1.0, and 1.5 %) and gibberalic acid (10, 20 and 30 ppm ) at 80% blooming, fruit set and 15 days before harvest were carried out on 5 years old trees of apricot Cv. Harcot. All the treatments significantly reduced physiological loss in weight, fruit diameter and fruit spoilage percentage during storage. However, $CaCl_2$ at 1.5% ppm was found most effective in minimizing the physiological loss in weight of apricot fruits during storage as compared to control. Fruits quality (TSS, titrable acidity, TSS/TA, Ascorbic acid, total sugar etc.) was also found better even after 8 days of storage at ambient condition in case of $CaCl_2$ 1.5% treatment as compared to control. Hence, it can be concluded that pre-harvest foliar application in apricot Cv. Harcot with $CaCl_2$ 1.5% at three stages i.e. 80% blooming, fruit set stage and 15 days before the harvest could enhance the shelf life from 3-5 days of storage to 8 days and could maintain maximum fruit quality under ambient storage condition up-to 8 days.

## 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 and 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 Stella (16.5). for storage studies fruits of different varieties having at optimum maturity 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) + 85 % RH. Studies were 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 compared to 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, storage and processing potential. The results reveal that maximum fruit size was recorded in variety CITH-A-2 (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 2 (21.9). Ascorbic content were found highest in CITH -A-3 (9.80 mg/100g) followed by CITH (18.40 mg/100g). After 29 days of storage at low temperature minimum PLW % was observed in CITH-A- 1 (5.25) and maximum in CITH-A-3 (7.32) where as maximum fruit firmness was recorded in CITH-A-2 (19.0) closely followed by CITH-A-1 (17.0) and minimum in CITH-A-3 (14.4).

$CaCl_2$ 1.5% (8 Days after storage at ambient condition)

$CaCl_2$ 1% (8 Days after storage at ambient condition)

Control (8 Days after storage at ambient condition)

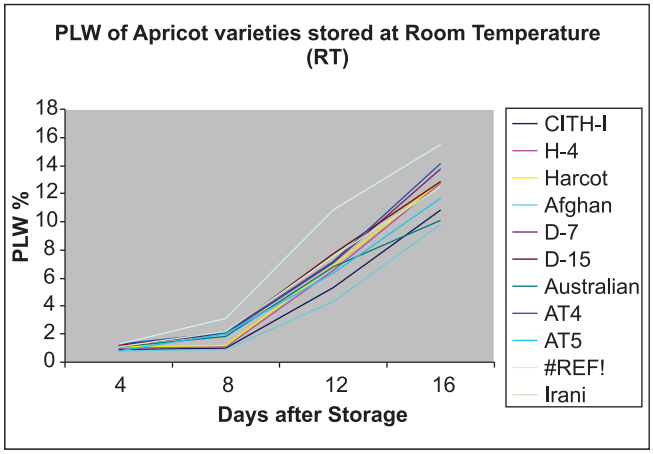
## Varietal evaluation of peach for storage

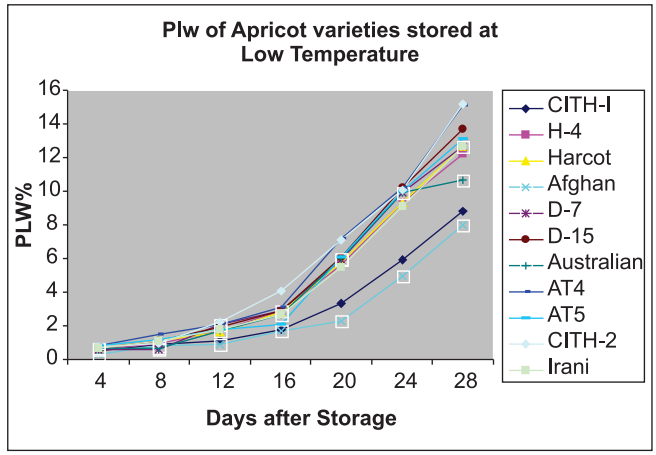
Two commercial varieties of peach i.e. Red Globe and Glow Heaven were evaluated for quality characteristics and shelf life and storage. Fruits of these two varieties were harvested at proper maturity, washed and evaluated for quality parameters. Fruits of variety Red Globe were found to contain maximum TSS 8.54 °Brix where as it was 8.0° Brix in Glow heaven Maximum firmness of fruits was also recorded in the fruits of variety Red Globe (52.9) compared to 37.6 in case of Glow heaven. Storage study revealed that fruits of variety Red Globe and Glow Heaven 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.

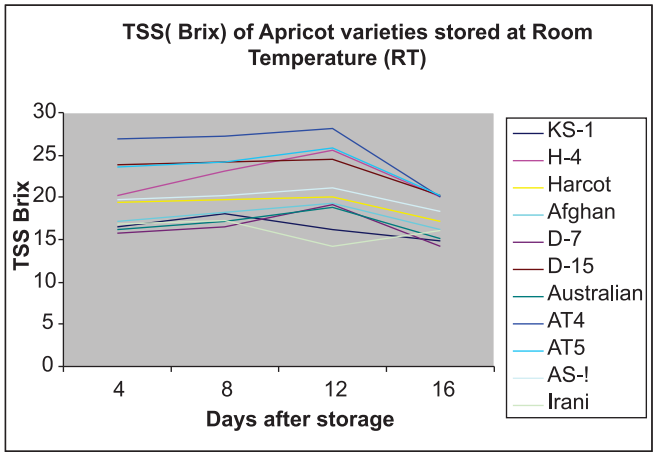
At low temperature the fruits of Red Globe can be stored up to 30-32 days and Glow Heaven for 27-28 days with minimum PLW, maximum retention of firmness, appeal and nutrients.

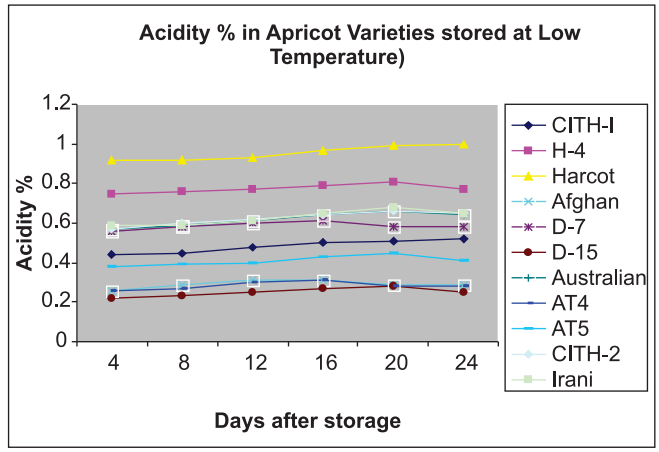
## Shelf life studies in apricot

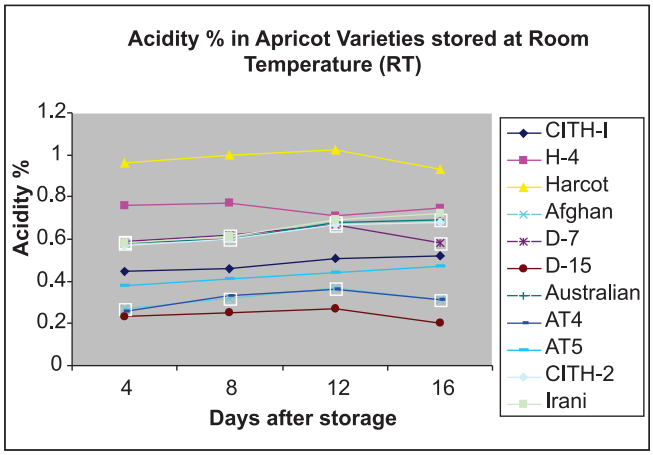
The shelf life of apricot varieties was recorded up to 16 days when stored at room temperature (RT) and 30 days in low temperature (LT). However, minimum PLW was recorded in Afghani (8.0%) and maximum in A T-4 (15.1%). TSS and acidity were retained when varieties are stored at LT. However, maximum TSS and desirable acidity was recorded in CITH Apricot- 1, Afghani and CITH Apricot-2 and shelf life was retained up to 30 days when compare to fruits stored at room temperature (16 days).

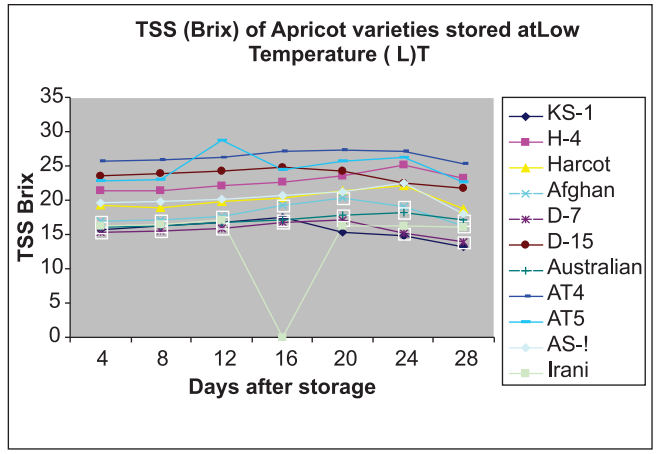



## Development of process technology for making apricot fruit bar

A technology was developed for the preparation of quality Apricot fruit bar. The final product i.e. **Apricot Fruit Bar** is having excellent texture, colour, aroma, taste chewing quality, no sticking character and has acceptable microbial load, least browning and spoilage which can be stored up to 9 months without loss in quality, nutrition and appeal. Technology developed in the form of flow diagram is given in Fig.1

## Standardization of pre- and post-harvest practices for extending shelf life of apple fruits

In apple, among the different treatments (pre and post-harvest), pre-harvest sprays of $GA_3$ + salicylic acid thrice at an interval of 10 days, beginning from one

month before harvest was found to be suitable in respect of increased fruit firmness, TSS, ascorbic acid, total carotenoids, total phenolics, flavonoids, antioxidant activity, reducing and total sugars and decreased fruit infection and physiological loss in weight (PLW). Likewise, among the post-harvest treatments, Salicylic acid dip of apple was found to be the best. The treatment comprising pre harvest spray of $GA_3$+ Ca EDTA+ post-harvest Salicylic acid dip was noticed to be superior to all other combinations for the afore mentioned quality parameters.

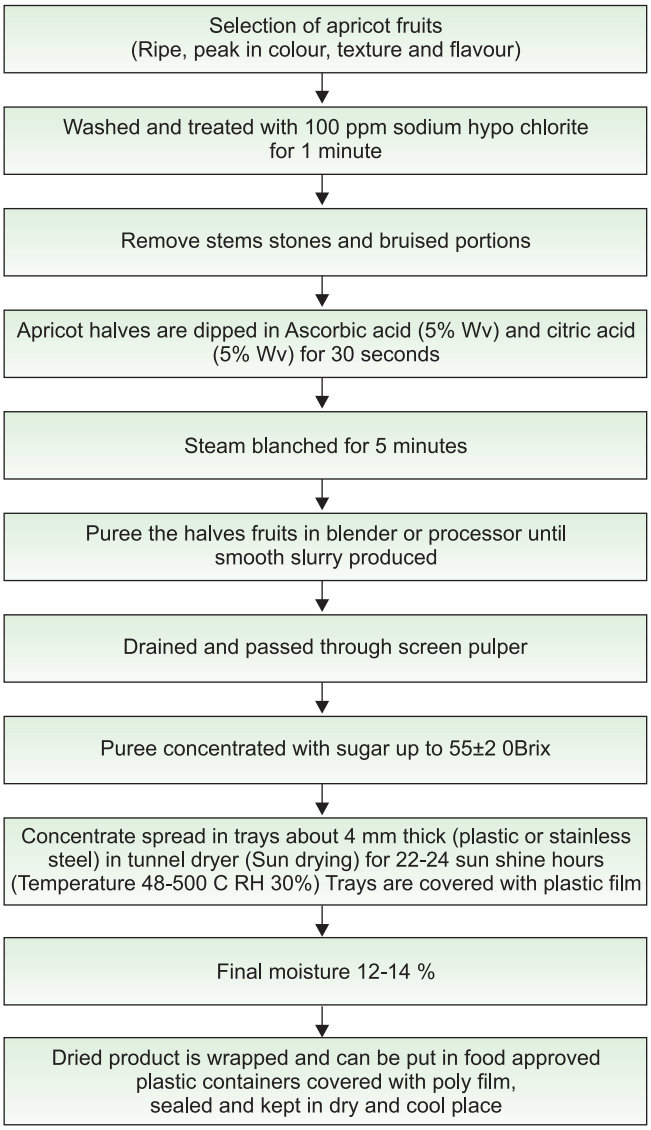
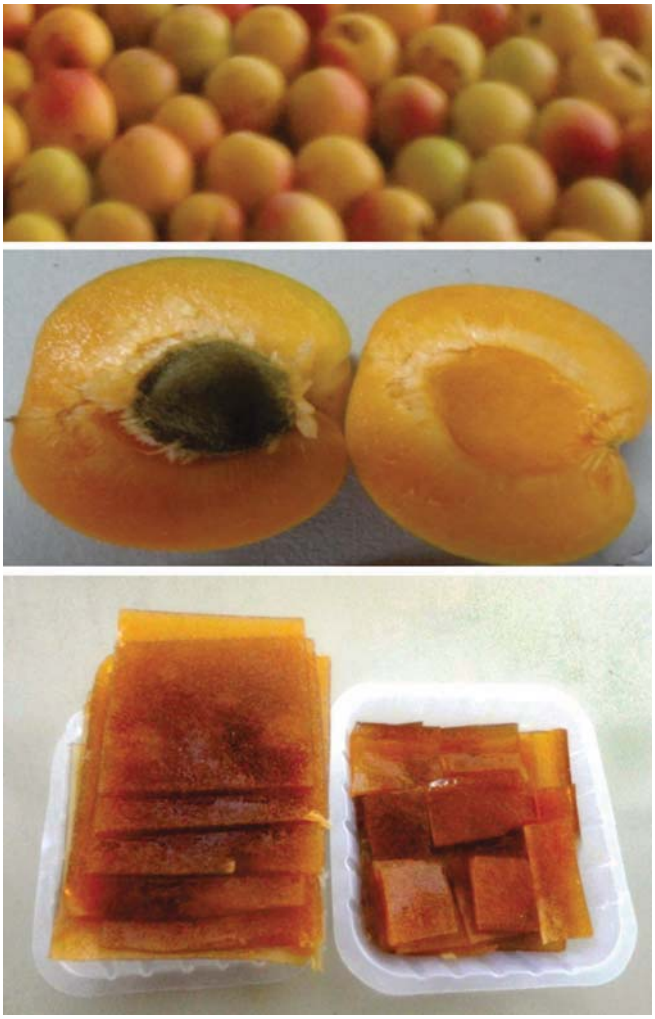



Fig. 1 Flow diagram for preparation of Apricot Fruit Bar

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

Among the different treatment compositions comprising Malta juice and ginger, the squash prepared from Malta (20%) and ginger (5%) was found to be the best at the time of preparation till three months of storage (Fig. ). The acidity, ascorbic acid and reducing sugars were found to reduce whereas the TSS and total sugars increased during storage of the products (Table-58). Further, products prepared by blending major and minor temperate fruit juices viz., rhododendron, *kaphal*, *kilmora*, *galgal* and ginger in different ratios revealed that the best squash

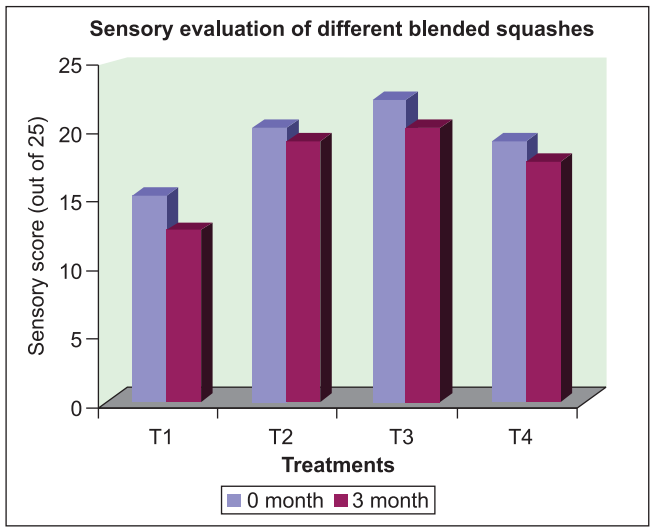


Apricot Fruit Bar–Product of CITH

**Table 58: Physico-chemical and sensory quality characters of different squashes**

| S. No. | | Treatment | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | T1 | | T2 | | T3 | | T4 | |
| | | 0 | 3 | 0 | 3 | 0 | 3 | 0 | 3 |
| 1. | TSS (°B) | 46.6 | 47.2 | 46.0 | 46.5 | 46.4 | 46.8 | 46.4 | 46.6 |
| 2. | Acidity (%) | 0.650 | 0.636 | 0.623 | 0.603 | 0.620 | 0.603 | 0.616 | 0.603 |
| 3. | Ascorbic acid (mg/100g) | 27.27 | 26.36 | 25.45 | 24.54 | 23.64 | 22.73 | 21.82 | 20.91 |
| 4. | Reducing sugars (%) | 6.67 | 6.25 | 6.25 | 5.88 | 5.88 | 5.55 | 5.56 | 5.26 |
| 5. | Total sugars (%) | 40.00 | 41.67 | 39.21 | 40.00 | 40.00 | 40.82 | 40.00 | 40.82 |

obtained 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.



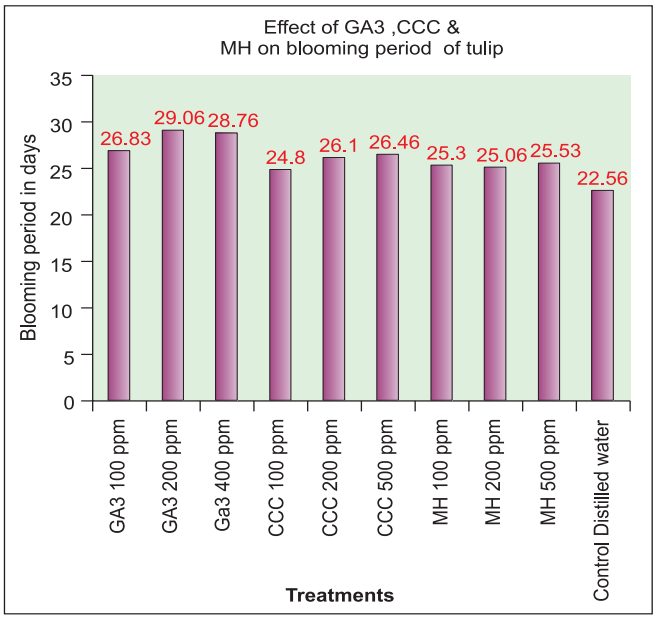

## Enhancement of shelf life of different temperate fruits through post harvest chemical interventions

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 period as compared to control. Further, Red June cultivar of peach collected 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 (Table-59).

The storage study of three cultivars of apple viz., Fenny, Golden Delicious, Vance Delicious after treating with salicylic acid (200 ppm) 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 to be the best. 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 that Sand Pear is best for storage followed by Gola and Kakria. The plum cultivar Santa Rosa was also treated with 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.

## Enhancing blooming period of tulip involving plant growth regulators and different storage period of bulb

Among all the PGRs (GA3, CCC, MH) , GA3 at 400 ppm caused early sprouting (79.72 days) and increased plant height (38.36 cm), no. of leaves (4.24) and bulb (4.24) per plant as compare to control. It also induced early flowering (142.20 days) with improved flowering duration (28.76 days), flower size (6.97 cm) and stalk diameter (6.93 cm). CCC and MH delayed sprouting, reduced plant height, but improved no. of leaves and bulb per plant. Further, CCC and MH induced late flowering, increased flowering duration, but reduced flower size and flower stalk diameter with their



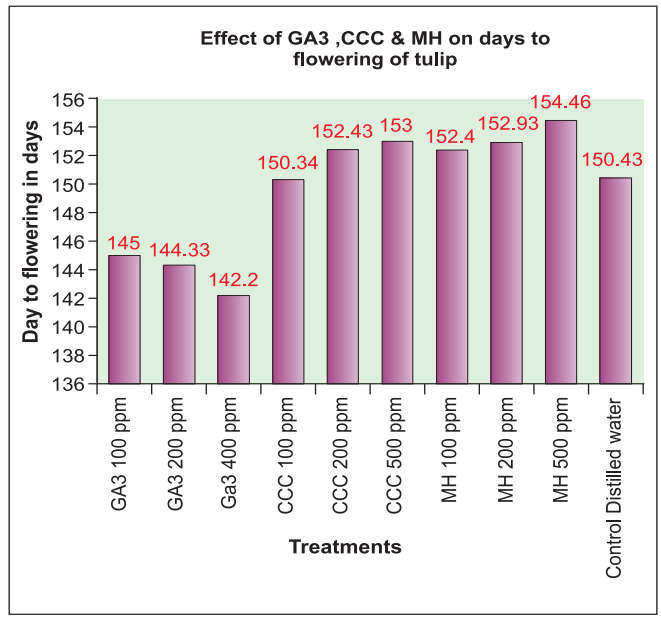




**Table 59: Physico-chemical characters of peach cultivar Red June from different locations**

| S.No. | Character | Location | | | |
|---|---|---|---|---|---|
| | | Talla Ramarh | Darim | Sargakhet | Mukteshwar |
| 1. | Pressure (kg/cm$^2$) | 1.009 | 2.911 | 1.561 | 1.550 |
| 2. | Weight (gm) | 87.49 | 74.20 | 105.08 | 156.25 |
| 3. | Length (mm) | 58.50 | 58.60 | 61.77 | 67.44 |
| 4. | Breadth (mm) | 58.18 | 51.00 | 59.17 | 67.84 |
| 5. | Destoned halves (%) | 94.30 | 94.17 | 95.62 | 96.45 |
| 6. | Stone (%) | 5.70 | 5.83 | 4.38 | 3.55 |
| 7. | TSS (ob) | 12.0 | 11.0 | 9.6 | 11.0 |
| 8. | Acidity (%) | 0.502 | 0.570 | 0.502 | 0.838 |
| 9. | Ascorbic acid (mg/100g) | 9.09 | 10.90 | 10.00 | 10.90 |
| 10. | Reducing sugars (%) | 2.94 | 3.85 | 2.63 | 2.63 |
| 11. | Total sugars (%) | 8.34 | 9.52 | 8.00 | 9.52 |
| 12. | Total carotenoids (µg/100g) | 393.41 | 398.04 | 854.71 | 1109.27 |
| 13. | TSS acid ratiom | 23.90 | 19.30 | 19.12 | 13.13 |

**Table 60: Effect of $GA_3$, CCC & MH on vegetative attributes of tulip**

| Sr. No. | Treatments | Days to sprouting of bulb | Plant Height (cm) | No. of leaves/ plant | Days to drying of foliage | No. of bulb /plant |
|---|---|---|---|---|---|---|
| 1 | T1 | 82.44 | 33.02 | 3.66 | 179.0 | 3.65 |
| 2 | T2 | 81.27 | 34.76 | 4.11 | 182.6 | 4.18 |
| 3 | T3 | 79.72 | 38.36 | 4.24 | 185.0 | 4.24 |
| 4 | T4 | 84.29 | 34.61 | 3.77 | 182.0 | 3.62 |
| 5 | T5 | 86.32 | 33.06 | 4.79 | 183.6 | 3.91 |
| 6 | T6 | 87.09 | 32.32 | 4.69 | 186.3 | 4.17 |
| 7 | T7 | 85.41 | 35.28 | 3.70 | 181.0 | 3.65 |
| 8 | T8 | 85.87 | 34.63 | 3.80 | 181.6 | 3.84 |
| 9 | T9 | 87.26 | 32.91 | 4.12 | 183.0 | 3.53 |
| 10 | T10 | 84.40 | 33.39 | 3.63 | 179.0 | 3.23 |
| CD 5 % | | 1.671 | 2.110 | 0.304 | 1.734 | 0.284 |

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

| Sr. No. | Treatments | Days to sprouting of bulb | Plant Height | No. of leaves/ plant | Days to drying of foliage | No. of bulb /plant |
|---|---|---|---|---|---|---|
| 1 | T1 | 84.94 | 32.09 | 3.30 | 176.00 | 2.66 |
| 2 | T2 | 84.18 | 32.35 | 4.07 | 175.33 | 2.81 |
| 3 | T3 | 83.65 | 34.03 | 4.60 | 176.33 | 3.77 |
| 4 | T4 | 81.50 | 36.25 | 4.51 | 181.00 | 3.89 |
| 5 | T5 | 79.64 | 38.11 | 5.28 | 184.00 | 4.06 |
| 6 | T6 | 79.52 | 37.98 | 5.12 | 182.33 | 3.38 |
| CD 5 % | | 0.734 | 1.097 | 0.293 | 2.759 | 0.144 |

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

| Sr. No. | Treatments | Days to bud formation | Day to flowering | Flowering duration | Flower diameter (cm) | Flower stalk diameter (mm) |
|---|---|---|---|---|---|---|
| 1 | T1 | 141.63 | 151.76 | 20.34 | 6.24 | 4.56 |
| 2 | T2 | 140.46 | 150.43 | 23.76 | 6.71 | 4.66 |
| 3 | T3 | 137.70 | 148.94 | 24.14 | 6.64 | 4.76 |
| 4 | T4 | 134.55 | 147.84 | 26.56 | 7.83 | 5.21 |
| 5 | T5 | 132.76 | 145.16 | 28.27 | 8.21 | 5.20 |
| 6 | T6 | 132.56 | 145.10 | 27.54 | 7.33 | 5.10 |
| CD 5 % | | 1.585 | 1.316 | 0.795 | 0.45 | 0.241 |

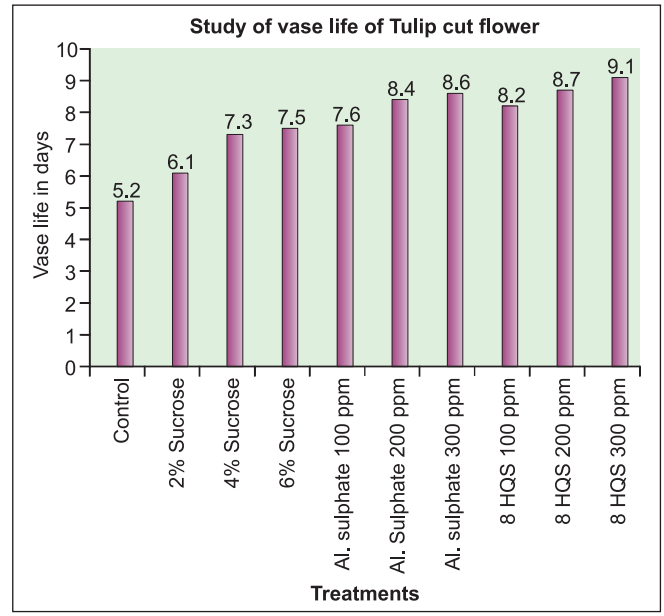
increasing concentration in comparison to control (Table-60).

## Effect of cold storage periods of bulb on blooming period of tulip

Among all the treatments of cold storage, treatment T5 (12 week storage at $5^0$ C ) causes early sprouting (79.64 days) with improved plant height (38.11 cm), no. of leaves (5.28) and bulb (4.06) per plant as compare to control (Table-60). It also induced early flowering (145.16 days) with improved flowering duration (28.27 days), flower size (8.21cm) and stalk diameter (5.20cm). 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-62).

## Study of vase life of tulip cut flower

Among the different treatments, longest vase life (9.1 days) was recorded in treatment 8-HQS 300 ppm followed by treatment 8-HQS 200 ppm (8.7 days) and treatment Alumunium sulphate 300 ppm (8.6 days) as compare to control (5.2 days). Maximum water uptake was recorded in treatment treatment 8-HQS 300 ppm (116.7 gm/spike) followed by 8 HQS 200 ppm (110.8 gm/spike) as compare to control (76.3 gm/spike). The minimum water loss/uptake ratio was found in treatment 8-HQS 300 ppm (1.01) and maximum in control (1.24) and there was negative correlation between vase life and loss/uptake ratio.



Vase life and quality of tulip cut flowers

## Network project on outreach of technologies for temperate fruit crops

For Multilocation testing and dissemination of new varieties and technologies, a network project on out reach of technologies was initiated during 2008-09 involving 8 centres spread over different agro-climatic conditions of North Western Himalayas, North Eastern States and high altitude areas of Tamil Nadu having temperate climate with the following objective and six project activities.

### Major objectives

1. Introduction of new promising varieties and clonal rootstocks and their evaluation under different agro-climatic conditions.

**A view of plant architecture in apple for energy harvest at CITH, Srinagar**


Espalier system | Cordon system | Vertical axis

Walnut, apricot and almond at Ranichauri centre, Uttarakhand

2. Production of quality planting material of promising varieties and clonal rootstocks and their utilization.
3. Demonstration of proven production & protection technologies and their further refinement and popularization in the area.
4. Imparting training to stakeholders for technology out reach.
5. Human Resource Development for acquiring modern technological know how in advanced centre of excellence within country and abroad.

**Technical programme along with brief progress**

| S.No. | Title of Sub project | Name of the implementing Centres | Progress of the project |
|---|---|---|---|
| 1. | Productivity enhancement of elite apple cultivars through high density planting and efficient water and pollination management | Srinagar, Bhaderwah, Mukteswar, Ranichauri, Solan, Bajaura, Pasighat and Ooty | Planting has been done plant stand and growth performance is satisfactory |
| 2. | Medium density orcharding for higher almond productivity | Srinagar, Bhaderwah, Mukteswar, Solan, Ooty and Ranichauri | Planting has been done and performance is satisfactory |
| 3. | Plant architectural engineering for higher energy harvest vis-à-vis productivity in apple | Srinagar, Bhaderwah, Mukteswar, Ranichauri, Solan, Bajaura, Pasighat and Ooty | Planting has been done in Srinagar while in rest of the centre it will be initiated in 2010-11 |
| 4. | Multi-location testing of elite walnut genotypes under medium density | Srinagar, Bhaderwah, Mukteswar, Ranichauri, Solan, Bajaura, Pasighat and Ooty | Planting has been done and performance is highly satisfactory |
| 5. | Multi-location testing of elite apricot genotypes under medium density | Srinagar, Bhaderwah, Mukteswar, Ranichauri, Solan,Bajaura, Pasighat and Ooty | Planting has been done and performance is satisfactory |
| 6. | Survey and mapping of major pest and disease of temperate fruits | Srinagar, Bhaderwah, Mukteswar, Ranichauri, Solan, Bajaura, Pasighat and Ooty | Major pests and diseases have been recorded periodically and are being assessed with weather parameters. |

# Meetings and Events

## 1st Annual Group Meeting of AINRP on Onion and Garlic

1st Annual Group Meeting of All India Network Research Project on Onion and Garlic research was organized by Directorate of Onion and Garlic Research, Pune and Central Institute of Temperate Horticulture, Rangreth, Srinagar from 10-11th May, 2010. Dr. Umesh Srivastava, Assistant Director General (Horticulture-II), ICAR and Director, DOGR, Pune was the Chief Guest. Director Research SKUAST(K), Shalimar; Director, CITH, Srinagar; Director, IIHR, Banglore; Director, IIVR, Varansi and Director NHRDF, Nasik was chaired various Technical Sessions. In two days mega event more than 100 scientists and Directors from different Institutes of Indian Council of Agriculture Research, State Agricultural Universities, Private Sectors and Officers from Development Departments et.' participated. The main focus of the workshop was on the various research and developmental activities for increasing the production and productivity of onion and garlic for benefiting the farmers, consumers and processors in the country.


## Hindi Week

Hindi week was organized from 14 to 20th September at CITH, Srinagar and RS, Mukteshwar to promote and implement National language Hindi in the Institution. During the week long programme, number of events were conducted like debates, essay writing, poster making etc and prizes were distributed among the winners of different competitions.

## ICAR Zonal Sports Meet

Nine participants from CITH including Chief De-Mission, Mr Javid Iqbal Mir, Scientist, participated in Zonal Sports Meet which was held at IIPR, Kanpur, from 6th to 9th April, 2010. All the participants took part in different games and showed very good discipline and performance.

## IRC

Institute Research Council Meeting was held on 05-08-2010. 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. Nazeer Ahmed, Director, who is also the Chairman of IRC, gave critical inputs on experimentation for obtaining realistic and reproducible results. New Institute projects were proposed, which were also approved by the house.

## 8th Research Advisory Committee Meeting

The 8th RAC meeting was held on 26th and 27th October, 2010 at main campus, Srinagar under the Chairmanship of Dr. D. S. Rathore, Former Vice Chancellor, CSKHPKV, New Delhi. The other members of RAC who attended the meeting were Dr. K.K. Jindal, Former Director of Research, Dr. YSPUHF, Solan; Dr. I.D. Tyagi, Former Head, Vegetable Research Station, Kanpur; Dr. R. P. Kaushal, Prof. Plant Pathology, CSK Himachal Pradesh Agril. University, Palampur; Prof. M.A. Masoodi, Registrar, Islamic University, Srinagar; Dr. B. N. Choudhary, Former ADG (Extension) New Delhi; Dr S. Rajan , ADG (Hort. I), ICAR, KAB-II, Pusa New Delhi; Shri Thakur Randhir Singh, Former Minister (J &K) Jammu; Shri Abdul Aziz Bazaz, Progressive orchardist, Srinagar; Prof. Nazeer Ahmed, Director, CITH, Srinagar and Dr. R.K. Verma, Pr. Scientist, Plant Pathalogy, and Member Secretary RAC, CITH. The committee visited the experimental farm and had detailed discussion and interactions with the scientists and suggested recommendations after reviewing all the ongoing projects.

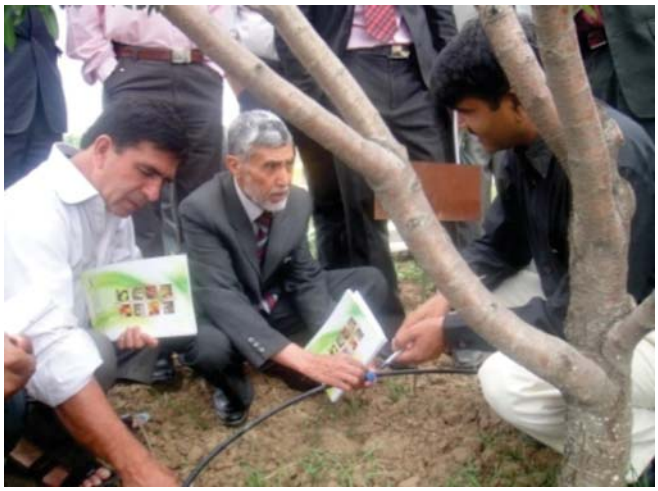
## Vigilance awareness week

Vigilance awareness week was observed from 3rd November to 7th November, 2010. The vigilance awareness week commenced with the pledge for "continuos striving to bring about integrity and transparency in all spheres of activities" on 3rd November at 11:00 AM by all staff members of CITH.

# Extension and Trainings

## International Training on Advanced Cultivation Techniques of Temperate Horticultural Crops

Two weeks International Training Programme on "Advance Cultivation Techniques of Temperate Horticultural Crops" organized by Central Institute of Temperate Horticulture, Srinagar and sponsored by IHITC, Jaipur on 17th to 28th May, 2010, under the leadership of Prof. Nazeer Ahmed, Director CITH as Course Director and Dr. D. B. Singh as Course Co-ordinator and participants came from Afghanistan, IHITC, Jaipur and one representative from PTC Holland. In the training, more emphasis was given on advances in crop improvement, crop production, crop protection, hybrid seed production, nursery techniques, water harvesting, high value vegetable and saffron production, value addition, post harvesting management, minimal processing etc. Jenab Javed Ahmad Dar, Hon'ble Minister of State for Agriculture, Horticulture, Health and R&B; J&K, Govt was the Chief Guest and Jenab Hasmat Ullah Khan, Former Vice Chancellor, SKUAST (J) and Dr. Gulam Hassan Shah, Director Horticulture, Kashmir, were the Guest of Honour of valedictory function. A final compendium covering various topics was also compiled, released and distributed alongwith certificates by the Chief Guest.



## Apricot Day

An apricot day was organized on 29th June, 2010 at Central Institute of Temperate Horticulture, Srinagar. Dr. G. H. Shah, Director Horticulture, Kashmir was the Chief Guest on the occasion. A large number of fruit growers from different districts of Kashmir participated in the event. The Director, Prof. Nazeer Ahmed, and Resource Scientists of the Institute took the participants around the farm, high tech laboratories and poly green houses and demonstrated advance production technologies and the varieties. Water harvesting and moisture conservation

techniques in karewas, role of pollinizers and pollinators, drip and sprinkler irrigation for higher water use efficiency, intercropping of legumes, vegetables and oil seeds for improving soil fertility and pollination, protected cultivation of vegetables, efficient propagation techniques in field and green houses, medium and high density 3-4 year old grafted fruit bearing walnut plantations and large number of exotic high yielding varieties in apple, almond, apricot, walnut and vegetables etc were the main attractions. Besides field visit, an interaction meeting was also held where various problems pertaining to production of apricot and other fruit crops and post harvest problems were discussed and effective scientific solutions were suggested to the farmers. The farmers were impressed and showed very keen interest in adoption of technologies and the new varieties developed at the Institute and have put up large demand for planting material of elite varieties.

## National Training Programme on Canopy Management of Temperate Fruits

An eight days National Training Programme on "Canopy management for enhancing yield and quality of temperate fruit crops" organized by Central Institute of Temperate Horticulture, Srinagar and Sponsored by National Horticulture Board, Gurgoan on 13th to 20th January 2011. Dr. Dinesh Kumar, Pr. Scientist, Horticulture was the Course Diretor ad Mr. Shiv Lal was the Course Co-ordinator. In this national training programme, progressive farmers from Tamil Nadu, Arunachal Pradesh and Jammu and Kashmir participated. During the training both practical and theoretical knowledge was imparted to the participants and the latest technologies about the role of canopy management in temperate fruit crops for obtaining high productivity and role of sun light in quality fruit production. Prof. G.M.Wani, Former Director Extension Education of SKUAST (K) was the Chief Guest and Dr. G. H. Shah, Director Horticulture, Kashmir Division was the Guest of Honour, Prof Nazeer Ahmed, Director CITH, Srinagar presided over the valedictory function. Training manual and a horticultural kit was also distributed along with certificates to the trainee participants.


## Training programme on Technique for rejuvenation of old and senile almond plantations in Kashmir valley

Short course on "Technique for rejuvenation of old and senile almond plantations in Kashmir valley" from 22-01-2011 to 24-01-2011 with the financial support from National Horticulture Board, Ministry of India, Govt of India, Gurgoan. Dr. K. K. Srivastava was the course Director, Dr. S. R. Singh was the Course Co-ordinator and Shri Ramesh was the Course Facilitator. 31 progressive farmers from almond growing areas were participated; practical training on rejuvenation was imparted to farmers and farmers were also taken to the rejuvenated orchard. Dr. A. R. Trag, Former Director Research, SKUAST (K) was the Chief Guest. At the end a technical bulletin on rejuvenation, and a compendium containing all the lectures delivered during Release of extension bulletin on rejuvenation of almond the training course was also released and distributed among the trainee participants along with a horticultural kit and certificate.

Three awareness camps of progressive farmers were conducted on the farmers field on 29-03-2011, 31-03-2011 and 02-04-2011 at three sites where the rejuvenation has laid out i.e. Chadoora ( Budgam), Awantipura of Pulewama, and Gogo of Budgam district.Total of 173 farmers were participated. All farmers practiced rejuvenation themselves. All the farmers were provided extension booklets on rejuvenation.

## Short Course on Training and Pruning of Apple and Apricot

Short course on "Training and Pruning of Apple and Apricot" from 4-5th Feb.; 7-8th Feb.; 10-11th Feb.; 25-26th Feb.; 28th Feb.-1st March, 2011 with the financial support from National Horticulture Board, Ministry of India, Govt of India, Gurgoan. Prof. Nazeer Ahmed, Director, CITH was the Course Director;Dr. Desh Beer Singh and Dr. S. R. Singh were the Course Co-ordinator ; Shri Shiv Lal, Shri J.I.Mir and Dr. G. Mahandiran were the Course Facilitator. Many progressive farmers from apple and apricot growing areas were participated. In the training, more emphasis was given on training and pruning of apple and apricot and farmers were also taken to the apple and apricot orchards. Gh. Hassan Mir, Agriculture Minister, J&K Govt was the Chief Guest; Dr. Tej Pratap Singh, Vice Chancellor, SKUAST-K and Dr. Gulam Hassan Shah, Director Horticulture, Kashmir, were the Guest of Honour. At the end a compendium containing all the lectures delivered during the training course was also released and distributed among the trainee participants along with a horticultural kit and certificate.


## Participation in Kisan Melas and Agricultual Fairs

### CITH, Srinagar, participated in 3 days Kisan Mela at SKUAST-J from 23-25th March 2011

Mr. Khandey Chief Secretary, Agricultural Production Deptt. J&K, visited the CITH Stall

Sh. N. N. Vohra , Governor of J&K visited the CITH Stall and interacted with Scientists and discussed about the technologies developed at the Institute.

## CITH at State Level Agriculture Fair held at Hamirpur (H.P.) organized by Dr. YSPUHF, Solan, H.P. on 23-25th Feb. 2011

Sh. I. D. Dhiman, Hon'ble. Minister of Agric. H.P. visitedthe stall and interacted with scientists and discussed about technologies developed at CITH, Srinagar, J & K. Mr. Khandey Chief Secretary, Agricultural Production Deptt. J & K, visited the CITH Stall

Scientists of CITH interacting with farmers of H.P

# Awards & Recognitions

## Prof. Nazeer Ahmed, Director, CITH

- Awarded Dr. Kirti Singh Gold Medal for the year 2010 by Horticultural Society of India, New Delhi on the occasion of 4th Indian Horticulture Congress held at NPL, Pusa, New Delhi on Nov. 2010.


- Awarded best research paper award (poster) entitled "Standardization of efficient propagation techniques in walnut for production of quality planting material" at 4th Indian Horticulture Congress on Nov. 2010, New Delhi.
- Awarded 1st prize for poster presentation entitled "Micro-propagation of strawberry" in the theme area "Biotechnological interventions to overcome abiotic stress" at National Seminar on Impact of climate change on fruit crops on Oct, 2010, PAU, Ludhiana.
- Awarded Best Oral presentation entitled "*In vitro* micro-corm production in Saffron (*Crocus Sativus* L.)" in the National Seminar on "Technological Innovations in Saffron" organized by SKUAST (K), in collaboration with NHB, GOI, November 25-26, 2010, Srinagar.
- Honoured as Patron, Research J. of Agril. Sciences, Awantipora, J&K, India.
- Member, Programme Planning and Policy Committee of the PPV and FRA, New Delhi.
- Member, Board of Management, CSHPKV, Palampur, (HP).
- Chairman, Technical session-I on crop improvement of first annual group meeting of AINRP on onion and garlic May 2010, CITH, Srinagar.
- Organizing Secretary, 1st Annual meeting of AINRP on onion and garlic, 2010 CITH, Srinagar.
- Acted as Co-Chairman, Technical session-II on collection evaluation and conservation of germplasm, 29th AICRP meeting, Jan 2011, JAU, Junagadh.

## Dr. Dinesh Kumar, Pr. Scientist

- Acted as Co-Chairman for the session National Resource Management and way to overcome abiotic stresses, National Seminar on Impact of climate change on fruit crops, PAU, Ludhiana from 6-8 October, 2010.

## Dr. B.L. Attri, Pr. Scientist

- Acted as Chairman for assessment of staff at DRWA, Bhubaneswar under modified assured career progressive scheme (MACPS) on 29 Oct., 2010.
- Acted as Chief Guest for inauguration of training programme on 11th Jan.2011 organized by Humana People to People India (NGO) for Master Farmers w.e.f. 11-17 March, 2011.

## Dr. Hare Krishna, Pr. Scientist

- Acted as reviewer of a research article of international journal i.e. *Journal of Plant Breeding and Crop Science,* African J. of Agricultural Reaserch and *Scientia Horticulturae.*

## Dr. J. K. Ranjan, Pr. Scientist

- Acted as reviewer for African Journal of Food Sciences (AFJS), an International Journal.

# List of Publications

## A. Research Publications (International/ National)


Attri, B.L. and Singh, A. (2010). Effect of different salt concentrations on drying and non-enzymatic browning of mango slices. *Indian J. Hort.*, 67 (Special issue): 485-487.

Chattoo, M. A., Ahmed, N., Khan, S.H., Sidique, S.H. and Hussain, K. (2010) Residual effect of organic manures and inorganic fertilizers on succeeding crop pea (Pisum sativum L.) cv. Bonnevilla *The Asian J. Hort.,* 4(2): 299-304

Chattoo, M. A., Ahmed, N., Khan, S. H., Narayan, S., Jabeen N. and Wani, K. P. (2009) Effect of organic manures and inorganic fertilizers on seed yield and seed quality of Okra (Abelmoschus esculentus L. Moench.). *Journal of eco-friendly Agric.,* 4(1):134-137.

Dar, H.A. , Singh, S.R. Sundouri, A.S., Sharma, M.K. and Srivastava, K.K. (2010). Regeneration of sour charry (P. Cerasus) through in vitro propagation. *Indian J. Physio.,*15 (2), 144- 149.

Dar, H.A., Singh, S.R. Sundouri, A.S., Sharma, M.K. and Srivastava, K.K (2010).Micro - propagation of sour cherry root stocks by employing forced and unforced explants . *Indian J. Hort.,* 67 (Special issue): 9-14.

Das, B., Ahmad, N., Sharma, N. N. and Singh, M. P. (2011). Bioefficacy and phytotoxicity evaluation of acaricide against European red mite, Penonychus ulmi (Koch) on apple. *Pestology*. 35(2): 37-42.

Das, B., Krishna, H., Ahmed, N., Ranjan, J.K. and Pragya (2011). Foraging behaviour of different major pollinators during blooming period in high altitude apple (Malus X domestica) orchards. *Indian J. Agric. Sci.,* 81 (1): 89-91.

Dolma, T. and Gupta, A.J., Ahmed, N. and Feza, M. (2010). Screening and identification of lettuce genotypes for leaf yield and its quality attributed in Kashmir valley. *Indian J. Hort.,* 67 (Special Issue): 479-484.

Dolma, T., Gupta A.J. Ahmed, N and Mujahid, M. (2010). Variability, heritability and genetic advance in lettuce. *Indian J. Hort.,* 67 (Special issue): 193-196.

Gupta A. J., Ahmed, N. and Bhat F. N. (2009). Enhancement of yield and its attributes of sprouting broccoli through drip irrigation and fertigation. *Veg. Sci.,* 36(2):179-183.

Gupta, A. J., Ahmed, N. and Singh, L. (2010) Response of lettuce to drip irrigation and fertigation. *Indian J. Ferti.,* 6(5):12-16

Gupta, A.J., Ahmed, N., Bhat, F. N. and Chattoo, M. A. (2010). Production of hybrid tomato for higher income under drip irrigation and fertigation in Kashmir valley. *Indian J. Hort.,* 67(1): 127-131.

Hedau, N.K., Ranjan, J.K., Das, B., Pragya, Verma, R.K. and Sofi, A.A. (2010). Effect of bio-fertilization and mulch treatments on yield attributes and fruit quality of tomato under hill conditions of Uttarakhand. *Indian J. Hort.,* 67: 259-262.

Hedau, N.K., Verma, R.K. and Sofi, A.A. (2010) . Role of biofertilizers and mulching on quality fruit production of capsicum under North-West Himalayas. *Prog. Hort.,* 42(2): 224-228.

Khan, S. H., Ahmed, N., Jabeen, N., Chattoo, M.A. and Hussain, K. (2010) Biodiversity of Kale (*Brassica oleracea* var. *acephala L.*) in Kashmir valley. *The Asian J. Hort.,* 5(1): 208-210.

Krishna, H. Das, B., Attri, B.L., Grover, M. and Ahmed, N. (2010). Suppression of Botryospheria canker of apple by arbuscular mycorrhizal fungi. *Crop Protection,* 29: 1049-1054.

Krishna, H., Singh, S.K., Sairam, R.K. and Verma, S. (2010). Effect of different factors on in vitro shoot tip culture establishment in mango. *Indian J. Hort.* 67(3): 293-300.

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Kumar, R., Ram M. and Gaur G.S. (2010). Effect of GA3 and ethrel on growth and flowering of African marigold cv. Pusa Narangi Gainda. *Indian J. Hort.* 67 (Special Issue): 362-366.

Mir, J.I., Ahmed, N., Shabir H. Wani, Rizwan Rashid, Hidayatullah Mir and Muneer A. Sheikh (2010). In-vitro development of microcorms and stigma like structures in saffron (*Crocus sativus* L.). *Physiol Mol Biol Plants,* 16 (4):369-73.

Mir, J.I., Ahmed, N., Verma, M.K., Ahmed Muneer and Lal Shiv 2010. In-vitro multiplication of cherry rootstocks. *Indian J. Hort.* 67 (Special issue)

Narayan, S., Ahmed, N., Mufti Shahnaz, Afroza Baseerat, Roohi Seema and Hussain, K. (2009) Effect of fruit load on quality and seed yield in okra (Abelmoschus esculentus L. Moench.) under temperate conditions of Kashmir Valley. *The Asian J. Hort.,* 4(1): 57-58.

Narsaiah, Jha, S.N., Devatkal, S.K., Borah, A., Singh D.. B. and Sahoo, J. (2010). Tenderizing effect of blade tenderizer and pomegranate fruit products in goat meat. *J. Food Science Technol.* 48 (1):61-68.

Noorani, M.S., Awasthi, P., Singh, R. M., Ram Raja, Sharma, M.P., Singh, S.R., Ahmed, N., Hallan, V. and Zaidi, A.A. (2010) Complete nucleotide sequence of cherry virus A (CVA) infecting sweet cherry in India. *Archives in Virology* (Accepted).

Pragya, Bhat, K.V., Misra, R.L. and Ranjan, J. K. (2010). Analysis of diversity and relationship among gladiolus cultivars using morphological and RAPD markers. *Indian J. of Agric., Sci.,* 80 (9) : 766-72.

Pragya, Ranjan, J.K., Attri, B.L., Das, B., Krishna, H. and Ahmed, N. (2010). Performance of gladiolus genotypes for cut flower and corm production under high altitude of Uttarakhand. *Indian J. Hort.,* 67 (Special issue): 386-390.

Ranjan J.K., Ahmed, N. Das, B., Pragya and Krishna Hare (2010). Effect of bio-fertilizers in combination with reduced dose of fertilizers on growth and yield of garlic at high altitude of North-West Himlayas. *Indian J. Hort.,* 67: 263-267.

Ranjan Pragya, Bhat, K.V., Misra, R.L., Singh, S. K. and Ranjan, J. K. (2010). Genetic relationship of gladiolus cultivars inferred from fluorescence based AFLP markers. *Scientia Horticulture,* 123: 562-67.

Ranjan, J. K., Chakrabarti, A. K., Singh, S.K. and Pragya. (2010). Micro-propagation of chilli (*Capsicum annuum* L.) plants through shoot tip culture. Vege. Sci., 37 (1): 30-34

Ranjan, J. K., Singh, S. K., Chakrabarti A. K. and Pragya. (2010). In vitro shoot regeneration from cotyledonary leaf explants in chilli (*Capsicum annuum* L.) and bio-hardening of plantlets. I*ndian J. Hort.,* 67 (1):43-49.

Ranjan, J. K., Singh, S.K., Chakrabarti, A. K. and Pragya. (2010). Studies on in vitro germination of chilli (Capsicum annuum L.) seed. *Indian J. Hort.* 67 (Special issue): 453-455.

Saha, R., Nath, V. and Kumar Dinesh (2010). Effect of farm yard manure on soil organic carbon stock, the pattern of fertility buildup and plant growth in Mallika mango (*Mangifera indica* L). *Journal of Hort. Sci. and Biotech.,* 85 (6): 539-543.

Shah, D. A., Narayan R., Ahmed N., Narayan S. and Wani K.P. (2010) Influence of boron and zinc on growth, yield and quality of knoll khol cv. Early White Veinna. *Indian J. Hort.,* 67: 323-328.

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Srivastava, K. K., Zargar, K. A. and Singh, S. R. (2010). Genetic Divergence among Corylus colurna genotypes based on morphological characters of hazel nut. *Biodiversity Research & Conservation*. 17: 13 - 17.

Srivastava, K.K, Zargar, K.A., Singh, S.R. and Shagoo, P A. (2010).Influence of different physiological stages of cuttings and plant bio-regulators on rooting potential of hazelnut. *Indian J. Hort.,* 67 (Special issue), 439 -442.

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the seedling trees of pecan (*Carya illinoensis Koch.*) *J. Plant Genet. Resources.* 63.

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## B. Extension folders/Bulletins/Popular Articles

Ahmed, N., Srivastava, K.K., Lal S., Kumar Dinesh, Singh S.R., and Kumar R. (2011).Global warming carved niche for quality apple production. *Indian Hort.* 56(1): 9-10.

Attri, B.L. (2010). Kendriya Sheetoshan Bagvani Sansthan, Kshetriya Kendra, Mukteshwar. *Amar Ujala,* 09.03.2011 pp. 11.

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Attri, B.L. and Krishna, H. (2010). Mrida Sudhar Mein Mycorrhiza Sukshamjiv Kargar. *Dainik Jagran,* 23.11.2010 pp 05.

Attri, B.L. and Krishna, H. (2010). Sankat Mein Seb Ki Sehat. *Hindustan,* 29.05.2010 pp.02.

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Krishna, H., Attri, B.L. and Ahmed, N. (2010). Health beverages from Rhododendron -promising technologies. *ICAR News,* Oct. - Dec., 2010 pp 3-4.

Kumar, D., Ahmed, N., Verma, R.K., Singh, D.B., Dar, G.M., Dar, T.A. and Shagoo, P.A. (2011). Badam Ki Amdan Bakhash Paidawar Scienci Tarikai Se. (Urdu). Published by Central Institute of Temperate Horticulture, Srinagar. J & K.pp.04

Kumar, D., Ahmed, N., Verma, R.K., Singh, D.B., Dar, G.M. and Dar, T.A. (2011).Khubani: Ek Intihahi Amdan Bakhash Fasal. (Urdu). Published by Central Institute of Temperate Horticulture, Srinagar. J & K.pp.04

Lal S., Ahmed N., Singh S.R., Singh D.B., Mir J.I. and Kumar R. (2010). Kiwi fruit: Miracle berry. Science Reporter, July, 2010. P.52-54.

Singh D. B. (2011). Value added pomegranate products to enrich farmers. *Indian Hort.,* 56(1):15-18.

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## C. Book chapters

Ahmed, N., Lal S, Das B. and Mir, J.I. (2011) Impact of climate change on temperate fruit crops In: Impact of Climate Change on Fruit Crops, Narendra Publishing House, Delhi. Pp.141-150.

Ahmed, N., Mir, J.I., Verma, M.K. and Krishna Hare (2011) Apple In: Advances in horticulture biotechnology- Regeneration systems- Fruit crops, plantation crops and spices-Vol. I. Ed. H.P. Singh, V.A. Parthsarthy and K. Nirmal Babu, Westville Publishing House, New Delhi. Pp 191-202

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Ahmed, N., Mir, J.I., Reshi, T. A., Verma, M. K. and Krishna Hare (2011) Plum In: Advances in

horticulture biotechnology- Regeneration systems-Fruit crops, plantation crops and spices-Vol. I. Ed. H.P. Singh, V.A. Parthsarthy and K. Nirmal Babu, Westville Publishing House, New Delhi. Pp 223-232.

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Ahmed, N., Mir, J.I., Verma, M.K., Sheikh, M.A. and Krishna Hare (2011) Pear In: Advances in horticulture biotechnology- Molecular markers and marker assisted selection- fruit crops, plantation crops and spices-Vol. III. Ed. H.P. Singh, V.A. Parthsarthy and K. Nirmal Babu, Westville Publishing House, New Delhi. Pp153-158.

Das, B. and Ahmed, N. (2010). Temperate fruit crops in Uttarakhand: status and technology interventions. In: Advances in Temperate Fruit Production, Ed. F.A. Banday and M. K. Sharma. Kalyani Publisher, New Delhi.

## D. Conferences/symposia/seminars/other papers and Abstracts

Ahmed N., Kumar R., Lal S. and Bhat A. B. (2010) Orchid flora of North-Western Himalaya: need for conservation and sustainable utilization. Souvenir cum Abstracts: National consultation for production and utilization of orchids. 19-21 Feb. 2011. NRC for orchid, Pakyong. P.63.

Ahmed, N., Kumar Ramesh and Lal, S.(2011). Orchid Flora of North Western Himalaya: need for Conservation and Sustainable Utilization. National consultation on production and utilization of orchids from 19-21st Feb. Gangtok, Sikkim.

Ahmed, N., Singh, S.R. Srivastava, K.K. and Shagoo, P.A. (2010). Standardization of efficient propagation technique for production of quality planting material. Poster presented at the 4th Indian Horticulture Congress from Nov. 18 - 21, awarded best poster award.

Ahmed, N., Singh, S.R., Lal S. and Hyat Shazia (2011).'Underutilized Horticultural Crops of Northern Himalayan States: An Overview" in National Seminar Cum Workshop on Developing the Potential of Underutilized Horticultural Crops of Hill Regions held on Feb., 14-16, 2011 Imphal, Manipur.

Ahmed, N., Singh, S.R., Lal, S., Srivastava, K.K. and Mir, J.I. (2010). 'Clonal rootstocks and high density orcharding in apple". Souveniers book of 4th Indian Horticulture Congress-Nov., 18-21, 2010.

Attri, B.L., Krishna, H., Kumar, A. and Ahmed, H. (2010). Utilization of under utilized fruits for antioxidant rich beverages and their storage. Poster presented in "4th Indian Horticulture Congress-2010" from 18-21 Nov., 2010. New Delhi pp. 485.

Attri, B.L., Krishna, H., Pragya and Ahmed, N. (2010). Women in bio-diversity conservation in north-west Himalayan region. Abstract in "National seminar on gender and bio-diversity" at DRWA, Bhubaneswar from 28-29th Dec., 2010. pp 27-29.

Das, B., Ahmad, N., Krishna Hare, Ranjan, J. K. and Pragya. (2010). Integration of high density planting and integrated nutrient management (INM) schedule in apple for quality fruit production. Book of Abstract, 4th Indian Horticulture Congress, New Delhi. No. III-176, pp. 294.

Das, B., Ahmad, N., Ranjan, J. K. and Pragya. (2010). Standardization of year the round top working schedule of pollinizers on trees of apple cultivars for efficient pollination management in apple orchard. Book of Abstract, 4th Indian Horticulture Congress, New Delhi. No. III-175,pp. 293.

Krishna, H., Attri, B.L., Das, B., Ranjan, J.K., Pragya, Kumar, A. and Ahmed, N. (2010). Beverages rich in health promoting bio-active compounds employing under utilized horticultural crops. Paper presented in "5th Uttarakhand State Science & Technology Congress-2010" held at Dehradun w.e.f 10-12th Nov., 2010. Oral-02 pp. 2.

Kumar, D., Ahmed, N. and Dar, G.A.(2010). Evaluation of plum varieties/genotypes under Kashmir

valley condition. Indian Horticulture Congress-2010. National Physical Laboratory, Pusa Campus, New Delhi; November 18-21, 2010.

Kumar, R., Ahmed N., Singh S. R. and Lal S. (2010). Ouality of Pelargonium graveolens L. stem cutting as affected by different rooting substrate and IBA concentrations. Book of Abstract . 4th Indian Horticulture Congress. 18-21 Nov. P.502.

Kumar, R., Ahmed, N., Lal, S. and Bhat, A. B.(2010). Conservation and Sustainable Utilization of Medicinal Plant Diversity of Kashmir Himalaya. Souvenir and Abstract: The national conferenace on Biodiversity of Medicinal and Aromatic Plants: Collection, Characterization and Utilization at MAPAI, Anand. 18-21st Nov., 2010.

Kumar R., Ahmed, N., Singh, S.R. and Lal Shiv (2010). 'Quality of Pelargonium graveolens L. Stem cutting as affected by different rooting substrate and IBA concentration". Book of abstract of 4th Indian Horticulture Congress-Nov., 18-21, 2010.

Kumar, D. and Ahmed,N. (2011). Water management in fruit crops under changing climate Scenario. Workshop on Spring recharge & Rejuvenation of natural spring by artificial recharge & catchment treatment. CGWB, Jammu. March 16, 2011.

Kumar, D., Ahmed, N. Srivastava, K.K. and Dar, T.A. (2010). Effect of planting density on growth, yield and quality of apricot. 4th Indian Horticulture Congress-2010, National Physical Laboratory, Pusa Campus, New Delhi, November 18-21, 2010.

Kumar, D., Ahmed, N., Srivastava, K.K. and Sharma, M.P. (2010). Water management in fruit crops under stress condition. Lead paper, National Seminar on Impact of climate change on fruit crops, PAU, Ludhiana, October 6-8, 2010.

Kumar, R., Ahmed N., Lal S. and Bhat A. B. (2010). Conservation and sustainable utilization of medicinal plant diversity of Kashmir Himalaya. Souvenir & Abstracts: National conference on biodiversity of medicinal and aromatic plants: collection, characterization and utilization. 24-25 Nov. 2010. MAPAI, Anand. P.19-20.

Lal, S., Mir, J.I., Andrabi, K. and Padder, S.A. (2010). 'Assessment of efficiency of apple pollinizers through pollen production, pollen viability, germination and tube growth tests". Book of abstract of 4th Indian Horticulture Congress-Nov., 18-21, 2010.

Mir, J.I., Ahmed, N, Kumar Dinesh, Dar, G.A, Parveen, I, Shah, S., Rizwan Rashid, Shabir, H. and Sheikh, M.A. (2010). Fruit quality analysis in apricot genotypes. National Conference on Horticultural Bio-diversity for livelihood, Economic Development and health care, UHS, Bangalore, May 29-31, 2010.

Mir, J.I., Ahmed, N., Kumar Dinesh and Dar, T.A. (2010). Genetic diversity studies in apricot (Prunus armeniaca L.) using RAPD markers. Swadesh Prem Jagriti Sangosthi-2010. National Conference on horticultural Bio-Diversity for Livelihood, Economic Development and Health care, UHS, Bangalore, May 29-31, 2010.

Singh D. B., Kumar, D. and Ahmed, N. (2010). Evaluation of apricot varieties for table and dehydration. Paper presented during 4th Indian Horticulture Congress 18-21 Nov. 2010, New Delhi.

Singh, D. B., Ahmed, N., Qureshi, S.H. and Lal Shiv (2010). 'Diversification of Temperate Fruits In Western Himalays: An alternate to climate change'. Book of abstract of National seminar on impact of climate change on fruit crops- 6-8 Oct., 2010.

Singh, D.B. Ahmed, N., Qureshi, S. N. and Lal Shiv. (2010).Diversification of temperate fruits in western Himalayas: an alternate to climate change. National Seminar on "Impact of climate change on Fruit crops "6-8th Oct, 2010, PAU, Ludhinana.

Singh, D.B., Ahmed, N. and Kumar Dinesh (2010). Evaluation of apricot variety for drying purpose. Indian Horticulture Congress-2010. National Physical Laboratory, Pusa Campus, New Delhi; November 18-21, 2010.

Singh, S.R., Lal S., Ahmed, N., Srivastava, K.K., Kumar Dinesh, Kumar R. and Jan, N. (2010). 'Evaluation of strawberry varieties under Kashmir conditions under different production system.

Book of abstract of 4th Indian Horticulture Congress-Nov., 18-21, 2010. Delhi Delhi.

Singh, S.R., Srivastava, K.K., Kumar Dinesh, Sagoo, P.A. and Kumar Sunil (2010). Effect of climate change on temperate fruits and strategies for its mitigation in Kashmir Valley. National Seminar on Impact of climate change on fruit crops, PAU, Ludhiana, October 6-8, 2010.

Singh, S.R.,Sundouri, A.S. Sharma, M.K., Srivastava, K.K. and Dar. H.A.(2010). Impact of climate change on fruit crops. National Seminar on climate change from 6 - 8th October at PAU, Ludhiana, pp:128.

Srivastava, K.K, Ahmed, N., Singh, S.R., Singh, D. B., Lal, S., Bhat, S.K., Shagoo P.A. and Rather, J.A. 2010. High Density planting in Cherry for increasing orchard efficiency and productivity. 4th Indian Horticulture Congress from 18-21 Nov. 2010, New Delhi.

Verma, M.K., Ahmed, N., Kumar Dinesh, Lal,S. and Mir, S.A. (2010). Evaluation of almond (Prunus dulcis ) cultivars under medium density orcharding in Karewa conditions of Kashmir valley. Indian Horticulture Congress-2010. New Delhi from November 18-21, 2010.

Verma, M.K., Lal, S. and Sagoo, P.A. (2010). 'Walnut (Juglans regia L) improvement in India". Book of abstract of 4th Indian Horticulture Congress-2010, New Delhi from Nov., 18-21, 2010.

Vishal Nath, Singh, H.S., Pandey, V. and Kumar Dinesh 2010. Growth analysis of insitu raised mango orchard under alphisole of Eastern India. 4th Indian Horticulture Congress, New Delhi from 18-21 November, 2010.

## E. Radio / TV Talks

### Dr. Dinesh Kumar, Pr. Scientist

- TV talk show on water harvesting techniques for rainfed almond production, Door Darshan on 19.06.2010.
- TV show on canopy management in temperate fruit crops, Door Darshan on 20.01.2011.

### Dr B.L. Attri, Pr. Scientist

- Phal sabji tudai uprant nuksan kam karne ke tarike – AIR, Almora on 20th Aug., 2010.
- Bagvani ki nai takneekein avam sambhavnayein – Kumaon vani on 3rd Aug., 2010.
- Urvara shakti avam upyogita - Kumaon vani on 21st Oct., 2010.
- Buransh- ek bahupayogi ped - Kumaon vani on 13th Dec., 2010.
- Aay ka uttam sadhan- phal va sabji utpadan – AIR, Almora on 12th March, 2011.

### Dr Hare Krishna, Scientist

- Farm yard *khad* – Kumaon Vani on 3rd Aug., 2010.
- *Jaivik Kheti* – Kumaon Vani on 3rd Aug., 2010.
- Vermi Composting- Kumaon Vani on 15th Oct., 2010.
- *Seb Mein Sukha Rog* - Kumaon Vani on 15th Oct., 2010.
- *Bagwani Mein Sukshma Jeevon Ka Upyog Avam Katai-Chatain Ka Mahatva* – Kumaon Vani on 6th December, 2010.

# Participation in Workshops/ Conferences/Trainings/Meetings

### Prof. Nazeer Ahmed, Director

- Attended national conference on horticultural biodiversity for livelihood, economic development and health care, at UHS, Bangalore, from 28th May - 1st June, 2010.
- Attended regional committee-1, meeting at SKUAST (J) Jammu, from 8th to 12th June, 2010.
- Attended workshop of NAIP consortium for developing, commissioning, operating and managing an online system for NET/ARS-PRELIM-Examination for ASRB, ICAR.
- Attended meeting on National Mission on saffron in J&K at Krishi Bhawan, New Delhi on 12th July, 2010.
- Attended Director's conference at New Delhi on 15-16th July, 2010.
- Attended Meeting of Vice chancellors of Agricultural Universities and DG's nominees in BOM of SAUs at NASC, Delhi on 3rd and 4th Oct., 2010.
- Attended Interactive meeting with Hon'ble Director General, ICAR on 10th Nov. and Horticulture Industry Meet on 12th Nov. 2010 at IIHR, Bangalore.
- Attended 4th Indian Horticulture Congress at NPL, New Delhi from 17-19 Nov. 2010.
- Attended interface meeting of Crop Science, Horticulture and Natural Resource Management Divisions at NASC Complex, Pusa, New Delhi.
- Attended 98th meeting of Board of Management of CSHPKV, Palampur on 21st Dec. 2010.
- Attended AICRP(VC) group meeting at JAU, Junagarh from 27 to 29th Jan., 2011.
- Attended Director's Conference from 22nd to 24th Feb., 2011, NASC, New Delhi.
- Attended Division wise interaction meeting with the chairs of RAC's on 8th & 9th March 2011, New Delhi.
- Attended National Symposium on Alliums on 13th & 14th March, 2011 at Pune.
- Attended Meeting on use of Biotechnology in Agriculture and got it sanctioned tissue culture project for CITH on 23rd March, 2011, Krishi Bhawan, New Delhi.

### Dr. R. K. Verma, Pr. Scientist

Attended 32nd Annual Confrence & Symposium on "Innovations in Plant Pathology Research and Human Resource Development". November 24-26, 2010. Junagadh Agricultural University, Junagadh.

### Dr. D. B. Singh, Pr. Scientist

Attended "Brain storming for new extension approaches / mechanisms for strengthening the activities of KVK's in XII plan" at CSKHPKV, Palampur on 20-10-2010.

### Dr. Dinesh Kumar, Pr. Scientist

- Attended the workshop on "Spring recharge and rejuvenation of natural springs by artificial recharge and catchment treatment on March 16, 2011, Central Ground Water Board, Srinagar.
- Attended Indian Horticulture Congress-2010 on "Effect of planting density on growth, yield and quality of apricot" at National Physical Laboratory, Pusa Campus, New Delhi; November 18-21, 2010.
- Attended National Seminar on Impact of climate change on fruit crops by water management in fruit crops under stress condition. Lead paper, PAU, Ludhiana, October 6-8, 2010.
- Attended National seminar on advances in micro irrigation at NASC Complex, New Delhi , Feb 15-16, 2011.
- Attended interface meeting on weed management at Directorate of Weed Science Research, Jabalpur on 17-18 May, 2010.
- Attended review meeting of DUS test centre and DUS project on 25.02.2011 at NASC Complex, New Delhi.
- Attended sensitization meeting of Nodal Officer for preparation of Result Framework Document (RFD) from 11-14 March, 2011 at NASC Complex, New Delhi.

### Dr. K. K. Srivastava, Sr. Scientist

- Attended International training on "Research Station Management" from 11th to 16th October, 2010, at ICRISAT, Hyderabad.
- Attended review meeting of DUS test centre and DUS project on 25.02.2011 at NASC Complex, New Delhi.

### Mr. Ramesh Kumar, Scientist

- Attended National conference on "Biodiversity of Medicinal and Aromatic Plants: Collection, Characterization and Utilization." at Anand, Gujarat from 18-21st Nov., 2010.
- Attended National consultation on production and utilization of orchids at Gangtok, Sikkim from 19-21st Feb., 2011

### Mr. Shiv Lal, Scientist

- Attended National seminar cum workshop on developing the potential of underutilized horticultural crops of hill regions from Feb., 14-16, 2011, Imphal, Manipur.
- Attended training programme on "Antioxidant Phyto-Nutrient and Volatile Flavors in Horticultural Crops" from 15th to 24th September, 2010, IIHR, Bangalore.
- Attended and participated in interactive meet on Information and Communication Technology in ICAR during Nov. 3-4, 2010 at NASC Complex, New Delhi.

### Mr. J. I. Mir, Scientist

Attended National Conference on Horticultural Bio-diversity for livelihood, Economic Development and health care, UHS, Bangalore, May 29-31, 2010.

### Dr. G. Mahendiran, Scientist

Attended ICAR sponsored Summer school "Advances in Agricultural Acarology from 8th -28th October, 2010" organized by All India Network Project on Agricultural Acarology and Department of Agricultural Entomology, University of Agricultural Sciences, GKVK, Bangalore.

### Dr. B. L. Attri , Pr. Scientist

Attended 4th Indian Horticultural Congress 2010 at New Delhi, from 18- 21 Nov., 2010.

### Dr. B. Das, Sr. Scientist

- Attended workshop on Horticultural Technology Mission for North East and Himalayan States at VPKAS, Almora on 01.09.10 and 17.03.11.
- Attended the review meeting Chaired by The Hon'ble Horticulture Commissioner, Ministry of Agriculture, Govt. of India, Dehradun from 20-21st January.2011.

### Dr. Hare Krishna, Scientist

Attended a short course on 'Antioxidant phytonutrients and volatile flavours in horticultural crops' at IIHR, Bangalore from 15-24 Sept., 2010.

### Dr. J. K. Ranjan, Scientist

Attended 1st Annual workshop of AINRP onion and Garlic at CITH, Srinagar.

### Sh. Y. S. Dhanik, AAO

Attended training programme on employers perspective on lobour low at NAARM, Hyderabad.

### Mrs. Shahida Rafiq

Attended training course for personal assistants (Refreshers) Course at ISTM, New Delhi from 24-01-2011 to 04-02-2011.

# List of Ongoing Projects

| S.No. | Title of the Project | Project Code | Duration | |
|---|---|---|---|---|
| | | | Date of initiation | Date of complelition |
| **I. Crop improvement and Biotechnology** | | | | |
| 1. | Survey, collection, characterization and documentation of temperate horticultural crops | CITH-01 | 1998 | On going |
| 2. | Studies on improvement and production of saffron | CITH - 06 | 1999 | On going |
| 3. | Breeding for development of superior varieties/hybrids in Solanaceous vegetables | CITH - 07 | 2000 | On going |
| 4. | Evaluation of walnut genotypes in relation to floral biology and yield attributes | CITH-24 | 2008 | 2011 |
| 5. | Development of superior cultivars/hybrids in temperate fruits through conventional and non conventional methods | CITH-40 | 2009 | 2020 |
| 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. | Standardization of efficient propagation techniques for production of quality planting material of temperate fruits and nuts | CITH-02 | 1998 | On- going |
| 2. | Standardization of medium, medium high and high density orcharding in temperate fruits and nuts | CITH -03 | 1999 | On going |
| 3. | Large scale multiplication of quality planting material and seeds of temperate horticultural crops | CITH-04 | 1999 | On going |
| 4. | Standardization of agro techniques for quality cut flower and corm production of gladiolus | CITH-14 | 2006 | 2011 |
| 5. | Integrated nutrient management in high density apple plantation under different mulching | CITH-15 | 2007 | 2011 |

| S.No. | Title of the Project | Project Code | Duration | |
|---|---|---|---|---|
| | | | Date of initiation | Date of completion |
| 6. | Standardization of organic agro techniques for peach under high density planting system | CITH-19 | 2007 | 2012 |
| 7. | Evaluation of promising genotypes of apricot for table and drying purpose | CITH-25 | 2008 | 2011 |
| 8. | Evaluation of gerbera genotypes under protected conditions and refinement of technologies for production and propagation | CITH-28 | 2008 | 2011 |
| 9. | Energy harvest through plant architectural engineering for increasing source and sink relationship in apple and other temperate fruit crops | CITH-31 | 2008 | 2013 |
| 10. | Management of physiological disorders in temperate fruits | CITH-32 | 2008 | 2012 |
| 11. | Effect of integrated nitrogen management on yield and quality of almond and soil properties | CITH-34 | 2008 | 2012 |
| 12. | Evaluation of strawberry varieties under Kashmir conditions in different production systems | CITH-39 | 2009 | 2011 |
| 13. | Development of intensive cropping system involving almond and saffron | CITH-41 | 2009 | 2012 |
| 14. | Enhancing blooming period of tulip using PGRs and different storage period | CITH-42 | 2009 | 2012 |
| 15. | Evaluation and standardization of agro-techniques for quality cut flower production both under poly house and open conditions | CITH-43 | 2009 | 2012 |
| 16. | Characterization of soil and nutritional survey of temperate fruit crop | CITH-44 | 2009 | 2012 |
| 17. | Integrated nutrient management in medium and high density orchards in apple | CITH-45 | 2009 | 2012 |
| 18. | Fertigation studies in almond | CITH-46 | 2009 | 2012 |
| **III. Crop Protection** | | | | |
| 1. | Studies on gummosis of stone fruits and its management | CITH-22 | 2008 | 2012 |
| 2. | Development of forecasting model for important pests and diseases of temperate fruits & nuts | CITH-23 | 2008 | 2012 |

| S.No. | Title of the Project | Project Code | Duration | |
|---|---|---|---|---|
| | | | Date of initiation | Date of completion |
| **IV. Post Harvest Management** | | | | |
| 1. | Standardization of pre and post harvest practices for extending shelf life of apple fruits | CITH-27 | 2009 | 2012 |
| 2. | Minimal processing, packaging and storage study of high value vegetables and fruits for quality maintenance and storage | CITH-30 | 2008 | 2012 |
| 3. | Post harvest management of temperate fruits and nuts for storage and value added products | CITH-37 | 2009 | 2013 |
| 4. | Value addition, storage and sensory quality evaluation of different production from major and minor temperate fruits | CITH-49 | 2009 | 2012 |
| 5. | Enhancement of shelf life of different temperate fruits through post harvest chemical intervals | 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. | Standardization 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 project** | | | | |
| 1. | Net work project on outreach of technologies for temperate fruit crops | Plan Project | 2008 | On going |
| 2. | AICRP on vegetable crops (ICAR)- Voluntary centre (Srinagar/ Mukteshwar) | — | 2007-08 | On going |
| 3. | Net work project on onion and garlic (co-operating centre -PI) | — | 2008 | On going |
| 4. | Intellectual property management and transfer/commercialization of agricultural technology scheme (ICAR) | — | 2008 | On going |

| S.No. | Title of the Project | Project Code | Duration | |
|---|---|---|---|---|
| | | | Date of initiation | Date of completion |
| 5. | Net work project " Assessment of gender issues and identification and refinement of selected women specific technologies in horticultural crops-RS, Mukteshwar | | 2009 | On going |
| 6. | Survey, collection, evaluation and conservation of temperate pomegranate genotypes/ wild species/ varieties under North Western Himalayan region | Inter Institutional Project | 2010 | On going |
| **IX. Validation of DUS International Guideline under Indian condition** | | | | |
| 1. | DUS on apple and pear | | 2008-09 | 2011-12 |
| 2. | DUS on walnut and almond | | 2008-09 | 2011-12 |
| 3. | DUS on apricot and cherry | | 2008-09 | 2011-12 |
| **X.** | Biotechnological interventions for improvement of apple through virus and genetic fidelity certification and production | | 2011-12 | On going |
| **XI.** | Establishment and strengthening of tissue culture facilities | | 2011-12 | 2014-15 |
| **XII.** | Horticulture Technology Mission Projects | | 2005 | On going |
| 1. | Production of nucleus/basic seed and planting meterial (8 activities) | | | |
| 2. | Standardization of production and protection technologies (5 activities) | | | |
| 3. | Refinement of Technologies and training (2 activities) | | | |

# Research, Review and Management Committees

## Research Advisory Committee Members

| | | |
|---|---|---|
| 1. | Dr. Jagmohan Singh Chauhan<br>E-2 Block, II[nd] Floor, Room No. 205<br>Amity University, Noida, U.P. | Chairman |
| 2. | Dr. S. N. Pandey<br>Ex-ADG(Hort.), ICAR, New Delhi<br>139, Sector-41, Noida (U.P.) | Member |
| 3. | Dr. D.P. Singh<br>Farmer ADG (Veg), ICAR, New Delhi | Member |
| 4. | Dr. N. Kumar<br>Dean (Hort.) TNAU, Coimbatore, Tamil Nadu | Member |
| 5. | Dr. J. Kumar<br>Prof. & Head, Division of Plant Pathology<br>G.B. Pant University of Agriculture and Technology<br>Pant Nagar, Nainital, Uttaranchal | Member |
| 6. | Dr. A. K. Dhawan<br>Prof. & Head<br>Division of Entomology, PAU, Ludhiana | Member |
| 7. | Prof. Nazeer Ahmed<br>Director, CITH, Srinagar | Member |
| 8. | ADG (Hort.-1)<br>ICAR, KAB-II, Pusa, New Delhi-110012 | Member |
| 9. | Shri Thakur Randhir Singh<br>Former Minister, 298 EP Flat<br>Wazarat Nagar, Jammu-Tawi | Member |
| 10. | Shri Ab. Aziz Bazaz<br>Progressive Orchardist, Gojwara<br>Shishbagh, Srinagar-190002 | Member |
| 11. | Dr. M. P. Sharma<br>Pr. Scientist (Soil Science)<br>CITH, Srinagar | Member Secretary |

## Institute Management Committee (IMC)

| | | |
|---|---|---|
| 1. | Prof. Nazeer Ahmed<br>Director, CITH, Srinagar | Chairman |
| 2. | Dr. S. Rajan<br>Asstt. Director General (Hort. I)<br>ICAR, KAB-II, Pusa, New Delhi | Member |
| 3. | Director (Horticulture)<br>Govt. of J&K, Rajbagh, Srinagar (J&K) | Member |
| 4. | Director (Horticulture & Food Processing)<br>Department of Horticulture<br>Chaubatia, Ranikhet, Almora (Uttarakhand) | Member |
| 5. | Dr. M. S. Wani<br>Prof. cum Chief Scientist, Fruit Breeding<br>Division of Pomology, SKUAST-K, Srinagar | Member |
| 6. | Shri Thakur Randhir Singh<br>Former Minister, 298 EP Flat<br>Wazarat Nagar, Jammu-Tawi | Member |
| 7. | Shri Ab. Aziz Bazaz<br>Progressive Orchardist, Gojwara<br>Shishbagh, Srinagar-190002 | Member |
| 8. | Finanace and Accounts Officer<br>CPRI, Shimla (H.P.) | Member |
| 9. | Dr. A. K. Singh<br>Head, Fruit and Horticulture Technology<br>IARI, New Delhi-110012 | Member |
| 10. | Dr. A. T. Sadashiva<br>Principal Scientist (VC), IIHR, Bangalore | Member |
| 11. | Dr. M. K. Verma<br>Senior Scientist (H),<br>CITH, Srinagar (J&K) | Member |
| 12. | Shri Javid Iqbal Mir, Scientist<br>CITH, Srinagar | Member |
| 13. | Shri Y. S. Dhanik, Asstt. Admn. Officer<br>CITH, Srinagar | Member Secretary |

# Distinguished Visitors

1. Dr. S. Rajan, ADG (Hort-I), KAB-II, Pusa, New Delhi visited CITH on 15th April, 2010
2. Shri S. K. Roongta, C. M. D., N.S C. Ltd., visited CITH, Srinagar on 23rd April, 2010.
3. Dr. R.C. Gupta, Director NHRDF, Nasik, visited CITH, Sringar on 11th May, 2010
4. Dr. T. A. More, Director, IIVR, Varanasi, U. P. visited CITH, Srinagar on 11th May, 2010
5. Dr. K. E. Lawande, Director, Directorate of Onion and Garlic Research, Pune visited CITH, Srinagar on 11th May, 2010
6. Dr. Umesh Srivastava, ADG (Hort.-II), KAB-II, Pusa, New Delhi visited CITH, Srinagar 11th May, 2010
7. Dr. A.S. Sidhu, Director, IIHR, Bangaloru, visited CITH, Srinagar on 11th -12th May, 2010
8. Dr. A.R. Trag, Director Reseaerch, SKUAST-K, Shalimar visited CITH, Srinagar on 24th May, 2010
9. Shri Hashmat Ullah Khan, Former Vice Chancellor, SKUAST-J visited CITH, Srinagar on 28th May, 2010
10. Dr. Tej Partap Singh, Hon'ble Vice Chancellor, SKUAST-K, Shalimar visited CITH, Srinagar on 28th May, 2010
11. Shri Javed Ahmed Dar, Hon'ble State Minister for Agricutlure, Horticutlure, Health and R&B, J&K visited, CITH, Srinagar on 28th May, 2010
12. Secretary, ASRB, Sh. N.S. Randhawa, New Delhi visited CITH, Regional Station, Mukteshwar on 29 May, 2010
13. DR. K. M. L. Pathak Hon'ble DDG (AS) visited CITH, Regional Station, Mukteshwar on 6th July, 2010
14. Dr. Manzoor Ahmed Nowshari, Scientist Biotchnology from Germany visited CITH, Srinagar on 27th July, 2010
15. Dr. Manjit Singh, Director, DMR, Solan, visited CITH, Srinagar on 10th October, 2010
16. Dr. D.S. Rathore, Former Vice Chancellor, CSHPKV and Chairman RAC, CITH visited CITH, Srinagar on 27th -28th October, 2010
17. Dr. G.H. Shah, Director Horticulture (Kashmir) visited CITH, Srinagar on 20th Jan, 2011
18. Prof. G.M. Wani, Former Director Extension Education, SKUAST-K, Shalimar visited CITH, Srinagar on 20th Jan, 2011
19. Shri Gh. Hassan Mir, Hon'ble Minister for Agriculture, J&K visited CITH, Sringar on 1st March, 2011

20. Shri Anup K. Thakur, Addl., Secy, DAC, MoA, govt. of India visited CITH, Srinagar on 25th March, 2011

# Personnel

## Cith Head Quarter, Srinagar

### RMP

- Prof. Nazeer Ahmed, Director

### Scientific

- DR. R. K. Verma, Principal Scientist, Plant Pathology
- Dr. D. B. Singh, Pr. Scientist, Hort-Vegetable Science
- Dr. Dinesh Kumar, Pr. Scientist, Hort-Fruit Science
- Dr. S. R. Singh, Sr. Scientist, Hort-Vegetable Science
- Dr. K.K. Srivastava, Sr. Scientist, Hort-Fruit Science
- Mr. J. I. Mir, Scientist, Plant Biotechnology
- Mr. Shiv Lal, Scientist, Hort- Fruit Science
- Mr. Ramesh Kumar, Scientist, Floriculture
- Dr. G. Mahendirin, Scientist, Agril. Entomology
- Dr. Om Chand Sharma, Sr. Scientist, Hort-Floriculture

### Director Cell

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

### Technical

- 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. Showkat Ahmad Mir, Assistant
- Sh. Mukhtar Ahmad, UDC
- Sh. Reyaz Ahmad Mir, UDC
- Sh. Tariq Ahmad Mir, Jr. Stenographer
- Sh. Mehraj-ud-din Meer, LDC

### 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. Ishtiyaq Ahmad Sheikh, SSS
- Sh. Zubair Ahmad Swathi, SSS

## CITH (RS), Mukteshwar

### Scientific

- Dr. B.L. Attri, Principal Scientist , Hort- Fruit Science
- Dr. B. Das, Senior Scientist, Hort – Fruit Science
- Dr. J.K. Ranjan, Scientist, Hort- Vegetables
- Dr. Pragya, Scientist, Hort- Floriculture
- Dr. Hare Krishna, Scientist, Hort – Fruit Science
- Sh. Anil Kumar, Scientist, Plant Pathology

### Technical

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

### Adminitrative

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

### Supporting staff

- Sh. Lakshman Singh, S.S.GR. IV
- 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. Mohd. 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 Ganei, SSS

# Appointments/New Joinings

| | | |
|---|---|---|
| 1. | **Dr. Om Chand Sharma,** joined CITH, Srinagar as Sr. Scientist, Hort-Floriculture w.e.f. 16 March, 2011. He was earlier serving as Subject Matter Specialist (Pomology) at KVK, Leh, Ladakh, J&K under SKUAST-K. |  |
| 2. | **Sh. Anil Kumar,** joined CITH, Regional Station, Mukteshwar as Scientist, Plant Pathology w.e.f. 10 January, 2011. |  |
| 3. | **Mr. Tariq Ahmad Mir,** joined CITH, Srinagar as Jr. Stenographer w.e.f. 27 August, 2010. |  |
| 4. | **Ms. Mubeena,** joined CITH, Srinagar as T-1 (Computer/Data Operator) w.e.f. 27 August, 2010. |  |
| 5. | **Sh. Pushpendra Kumar,** joined CITH, Regional Station, Mukteshwar as Junior Clerk w.e.f. 13 September, 2010. |  |

## Transfer (s)

1. Dr. M. P. Sharma, Pr. Scientist, Soil Science relieved from this Institute on 22 Nov., 2010 to join at Project Diercetorate of Farming System Research , Madipuram, Meerut.
2. Dr. Pragya, Scientist, Floriculture relieved from Regional Station, Mukteshwar on 22nd December, 2010 to join as Sr. Scientist at NBPGR, New Delhi.
3. Dr. J. K. Ranjan, Scientist, Horticulture relieved fom Regional Station, Mukteshwar on 22nd December, 2010 to join as Sr. Scientist at National Research Centre on Seed Spices, Ajmer.
4. Dr. Hare Krishna, Scientist, Horticulture relieved from Regional Station, Mukteshwar on 22nd December, 2010 to join as Sr. Scientist at CIAH, Bikaner.

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