वार्षिक प्रतिवेदन ♦ Annual Report

2013-14

राअंअनुके
NRCG

राष्ट्रीय अंगूर अनुसंधान केंद्र, पुणे

National Research Centre for Grapes, Pune

वार्षिक प्रतिवेदन | Annual Report 2013-14

National Research Centre for Grapes

(Indian Council of Agricultural Research)

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Preface

Report on the seventeenth year of National Research Centre of Grapes, Pune is being presented. During these years the grape industry of India has grown considerably. Total area under grapes has grown gradually from 47.5 thousand ha during 2001-02 to 117.8 thousand ha during 2012-13. The total production was 2483.1 thousand MT, which has contributed 1.7, and 3.1 per cent of total area under fruits and total fruit production of the country, respectively. India is now known in the world as table grape growing country. Indian fresh grape export has increased rapidly during last few years. Indian grapes are reaching to more than 100 destinations including countries in EU, Middle East, Africa, Russia and SAARC. From a small beginning of about 1-2 per cent of total production, during 2012-13, the export of fresh grapes had grown up to 6.96 per cent of total production with its value about Rs. 166.65 million.

NRC for Grapes has substantially contributed to the growth in production of quality table grapes and its export through their research in production technology, especially in the field of water and nutrient management, and plant protection. The Centre was also instrumental in implementing national Residue Monitoring Plan in grapes, through APEDA sponsored National Referral Laboratory. Constant interactions of scientists with grape growers to understand their problems, participation in extension programs organized by growers associations, conducting training programs for advance technologies developed at the centre has helped the grape industry for its sustained growth. In fact, both the production and exports would have reached new heights during 2013-14, but for widespread and severe hailstorms in most of the grape growing districts of Maharashtra and northern part of Karnataka during February 2014 which caused tremendous losses to standing crop. Surveys conducted by our scientists immediately after hailstorms have indicated that many vineyards will require replanting due to severe injury to the vines. The grape is a high investment crop and requires assurance to growers to get good returns. Hence, to sustain the growth in area under grapes and production, research on protected grape cultivation needs to be given top priority. The undersigned visited Murcia region of Spain, where mostly table grapes are grown. Murcia also suffers from vagaries of weather. It was interesting to see that cent percent vineyards in that region are protected under plastics. The structure supporting vines and plastic uses only GI pipes and wires. Unlike in India very less steel in used. Adoption of such a technology could be very useful to mitigate problems posed by hailstorms, untimely rains, and cold waves during fruiting.

The Centre has active grape germplasm repository. Efforts are on to add germplasm with known desired traits. Naturally loose bunches, bold berries, long shelf-life, and resistance to downy mildew and powdery mildew are some of the desired traits. During the year attempts were made to list out germplasm accessions with these characters so that focused breeding programs for developing varieties with such characters can be taken up. Black seeded varieties

suitable for raisin making are being demanded by the grape growers who are interested in raisin making. Attempts are being made to evaluate germplasm with such traits for raisin quality.

Since last few years table grape varieties such as Crimson Seedless, Fantasy, Autumn Royal, etc were introduced. Development of package of practices suitable for conditions of tropical viticulture and their demonstrations in major grape growing areas will help in adoption of these varieties for commercial cultivation. Similarly, Medika, a hybrid developed at the Centre was shown to have nutraceutical properties and has potential as good variety for juice. This variety was specially showcased in fruiting and its juice was evaluated on organoleptic ratings for acceptance during the field day organized at the centre. This work was initiated on recommendation of RAC, and guidance and special encouragement from Dr. S. Ayyappan, Secretary, DARE and Director General, ICAR; Dr. N. K. Krishna Kumar, Dy. Director General, Horticultural Sciences, ICAR, to promote grape juice during their visits to the centre.

Availability of skilled labor has been major constraint for sustained growth in area under grapes cultivation. Thus, more attention is required to consider mechanization in vineyards. A brainstorming session on this topic was conducted at the Centre inviting all stake holders such as, progressive growers, scientists, agriculture engineers, tractor and implement manufacturers etc. Spraying machines with advance technology to replace manual applications of growth regulators, implements for pruning, tying canes on training system, weeding within two vines in a row, application of FYM, recycling pruned waste, were some of the priority items which emerged out of discussions based on need and feasibility. A powerful compact orchard tractor with about 35 to 45 HP was needed to use these implements. The centre has already procured the 45 HP orchard tractor and advance spraying system, and will procure most of the other listed implements within next financial year to start adoptive trials at our research farm.

Indian grape processing industry especially in the fields of raisin making and wines is poised to take a prominent place in national and international markets. More than 25% of the grapes produced in the country are processed for raisins, and these raisins are also being exported to EU countries. Browning in raisins is a major problem in recovery of higher percentage of quality raisins. Research on these aspects is in progress at the Centre. Even though wine industry is not growing with desired pace many wineries in the country have shown capabilities of producing good quality wines. To support their efforts, Indian wine standards need to be developed in tune with international standards. Such standards not only facilitate export of Indian wine but also lead to acceptance of Indian wine by international tourists in India.. Based on analysis of numerous wine samples collected from Indian wineries, the Centre has submitted the proposal on developing Indian wine standards to Ministry for food processing industries, Govt. of India and Food Safety and Standards Authority of India (FSSAI). Research on use of byproducts of wine industry such as wine lees for value added foods such as ice-cream, yoghurt etc. is being carried out at the centre. New area developed

under grapes in NEH region, especially in Champai district in Mizoram is on wine grapes. This Centre has taken up development of grapes in these areas under NEH and TSP programs.

The small team of scientists at this Centre is dedicatedly carrying out research on different aspects of viticulture. Identifying different biological methods for disease and pest management, and other safer options is underway to minimize pesticide use. Further, basic research to fill knowledge gaps is also ongoing. The guidance given by QRT under the chairmanship of Dr. G. L. Kaul has greatly helped to prioritize our research programs. While, past and present RAC under the chairmanship of Dr. S. D. Shikhamany and Dr. B. M. C. Reddy respectively have constantly encouraged us to improve the quality of research. Our bonding with grower associations in Maharashtra and Karnataka has made our research programs more meaningful and due to their support transfer of technology has become much easy and effective.

But to keep pace with global developments in viticulture and for sustained growth in quality grape production much more work is to be done. Thus guidance and encouragement given by Dr. S. Ayyappan, Secretary DARE, and Director General, ICAR and Dr. N. K. Krishna Kumar, Deputy Director General, Horticultural Sciences, ICAR are highly appreciated and constantly needed.

Pune
Date: 30th June, 2014

(S. D. Sawant)
Director

कार्यकारी सारांश

राष्ट्रीय अंगूर अनुसंधान केंद्र, पुणे की स्थापना जनवरी 1997 को भारत में अंगूर उत्पादन और प्रसंस्करण की बाधाओं को मिशन उन्मुख अनुसंधान द्वारा संबोधित करने के लिए हुई। भारतीय कृषि अनुसंधान परिषद, आरएसी, क्यूआरटी और आईआरसी के मार्गदर्शन में चार व्यापक क्षेत्रों, आनुवंशिक संसाधन और सुधार, उत्पादन तकनीक, पादप स्वास्थ्य प्रबंधन एवं तुड़ाई उपरांत प्रौद्योगिकी, में संस्थागत और बाह्य वित्त पोषित परियोजनाओं के तहत अनुसंधान किया जा रहा है। केंद्र में अधिदेश के तहत परामर्श सेवा एवं अनुबंधात्मक शोध भी किया जाता है। वर्ष 2013-14 की शोध उपलब्धियों को निम्नवत संक्षेप में प्रस्तुत किया जा रहा है।

आनुवंशिक संसाधन और सुधार

इस वर्ष 13 प्रविष्टियां जर्मप्लाज्म में सम्मिलित की गईं। जर्मप्लाज्म का ढीला गुच्छा और बोल्ड मणि, मणि दरार प्रतिरोध, पाउडरी मिल्ड्यू प्रतिरोध, किशमिश और रस बनाने आदि के लिए मूल्यांकन किया गया। 18-20 मिमी की मणि व्यास वाली सात प्रविष्टियों की पहचान की गई। आठ रस-किस्मों को ओर्गनोलेप्टिक स्कोर के आधार पर आंका गया। अर्का श्याम और मेडिका रस के लिए सर्वाधिक स्वीकार्य किस्में थीं। क्लोनल चयन कार्यक्रम में, उत्पादक क्षेत्र से थॉम्पसन सीडलैस लताओं के दो उत्परिवर्तियों की पहचान की गई और मातृ-लताओं की तुलना में बोल्ड मणि के लिए चयनित किया गया।

डाऊनी मिल्ड्यू प्रतिरोध के लिए प्रजनन कार्यक्रम को मजबूत किया गया तथा सेवे विल्लार्ड × थॉम्पसन सीडलैस और कैरोलिना ब्लैक रोज × थॉम्पसन सीडलैस के क्रॉस से 3720 बीज प्राप्त हुए। कैरोलिना ब्लैक रोज × थॉम्पसन सीडलैस की 70 सन्ततियों की क्षेत्र और *इन विट्रो* जांच में 19 संततियों में डाऊनी मिल्ड्यू सहिष्णुता के लिए उपोव द्वारा सुझाई 1 रेटिंग पाई गई। क्यूटीएल *आरपीवी3* से संबन्धित अंगूर जीनोमिक क्षेत्र का विश्लेषण किया गया और इस क्षेत्र में 10 नए माइक्रोसेटेलाइट मार्करों की पहचान की गई। डाऊनी मिल्ड्यू के प्रतिरोधी तथा अतिसंवेदनशील जीनोटाइप में बहुरूपता के लिए इन मार्करों की जांच की गई। बहुरूपी मार्करों का उपयोग अंकुरण स्तर पर ही प्रतिरोधी संततियों के चयन के लिए किया जाएगा।

आरएनए अनुक्रम आधारित ट्रांसक्रिप्टोम विश्लेषण से 110 आर मूलवृंत पर कलमित थॉम्पसन सीडलैस लताओं की पत्तियों में लवणता तनाव के विभिन्न चरणों पर बड़ी संख्या में ऊपर और नीचे विनियमित जीन की पहचान की गई। लवणता तनाव देने के छह घंटे बाद ही अनेक जीनों का उतार चढ़ाव नियमन देखा गया। कलमित तथा स्वमूल लताओं में रूपात्मक, शारीरिक और पोषण संबंधी मापदंडों के लिए अंतर प्रतिक्रिया दिखाई दी। सभी मापदंडों के लिए स्वमूलित लताओं में प्रतिक्रिया जल्दी देखी गई। जीन अभिव्यक्ति के गहन विश्लेषण के परिणामस्वरूप प्रमुख जीनों तथा लवणता तनाव के प्रक्रिया की पहचान होगी।

थॉम्पसन सीडलैस की कलमित तथा स्वमूलित लताओं की पत्तियों में लवणता तनाव के विभिन्न चरणों पर पाँच जीनों, जिनका चयन *इन सिलिको* विश्लेषण के आधार पर किया गया था, में अंतर अभिव्यक्ति देखी गई। कलमित लताओं में, एपिटेला और एफ़ बॉक्स प्रतिलेखन कारक की अभिव्यक्ति में 15 दिनों में कई गुना वृद्धि हुई जबकि स्वमूलित लताओं में अभिव्यक्ति अपरिवर्तित रही या प्रारंभिक चरण में अत्यल्प बढ़ाव हुआ। पांच जीनोटाइपों में चयनित जीनों के तुलनात्मक जीनोमिक्स विश्लेषण से कोडिंग क्षेत्रों में कई एसएनपी की पहचान की गई। इन परिणामों का उपयोग लवणता तनाव के लिए कार्यात्मक मार्कर विकसित करने के लिए किया जाएगा।

आरएनए अनुक्रमण आधारित ट्रांसक्रिप्टोम विश्लेषण का उपयोग कर थॉम्पसन सीडलैस में पुष्पक्रम और मणि बढ़ाव चरणों में जीए अनुक्रिया का विश्लेषण किया गया। संदर्भ जीनोम अनुक्रम आधारित विश्लेषण से पुष्पक्रम चरण पर जीए प्रयोग के छह घंटे के भीतर ही भिन्नरूपेण अभिव्यक्त बड़ी संख्या में ऊपर और नीचे विनियमित जीन की पहचान की गई। इसी प्रकार गुच्छ विरलन और मणि बढ़ाव अवस्था पर अनेक जीन विनियमित पाई गई। रूपात्मक लक्षण जैसे पुष्पक्रम लंबाई, अंत:संधि संख्या, मणि वजन और व्यास इत्यादि और मेटाबोलाइट्स जैसे कि ग्लूकोज, फ्रक्टोज, सुक्रोज, जीए-3, ए.बी.ए., टार्टरिक अम्ल, मैलिक अम्ल आदि में उपचारित एवं नियंत्रित के बीच सार्थक अंतर देखा गया।

उत्पादन प्रौद्योगिकी

नमी और तापमान तनाव के लिए निर्णय समर्थन प्रणाली (डीएसएस) के विकास हेतु, मौजूदा आंकड़ा संग्रह संवर्धित किया गया और सर्वेक्षणों के माध्यम से विभिन्न तापमान/नमी तनाव के लक्षणों को प्रलेखित किया गया। 1 अप्रैल और 22 मई के बीच छँटाई किए गए अंगूर-बागों के आंकड़ों से ज्ञात होता है कि कलिका विभेदन की अवस्था पर अगेती मानसून के कारण अतिरिक्त मृदा-नमी तथा मेघाच्छादित मौसम होने की वजह से अंगूर बागों में फलित-केन प्रति लता में कमी आई। तापमान एवं अंगूर लता की फलोद्गमिकी के मध्य संबंध स्थापित करने तथा अंगूरलता उत्पादकता पर इसके प्रभाव के अध्ययन के लिए लताओं को विभिन्न समयों पर छांटा गया। अप्रैल (आधारीय छंटाई) और अक्टूबर (फल छंटाई) में छंटाई की लताओं में पछेती छंटाई (क्रमश: मई तथा अक्तूबर) की तुलना में काफी अधिक उपज दी। विभिन्न छंटाई उपचारों के तहत ग्रौइंग डिग्री डेज़ 1450.6 से 1464.4 तक दर्ज़ किए गए। विभिन्न विकास चरणों पर नमी तनाव से पता चला कि छंटाई पश्चात 30 दिनों तक संस्तुति सिंचाई के 50% स्तर और 30-60 दिनों के बीच बिना सिंचित लताओं की उपज में 9.7% का ह्रास था। इसके अलावा, संस्तुति सिंचाई की तुलना में फलन से तुड़ाई तक बिना सिंचाई पर उपज में 8.90% कम हुई।

फ़ेंटासी सीडलैस में, वर्षा (509 मिमी) के साथ उप-सतह सिंचाई द्वारा 227 मिमी सिंचाई से अधिकतम उपज और 103 किग्रा/मिमी की जल उपयोग दक्षता प्राप्त हुई जोकि उच्चतम सिंचाई उपचार के बराबर थी। आंशिक जड़ शुष्कन उपचार से भी जल उपयोग दक्षता (113.98 किग्रा/मिमी सिंचाई) में वृद्धि हुई जो सिंचाई जल उपलब्धता अवरोध परिस्थितियों में इसके महत्व को दिखाती है।

प्रोटिओमिक द्वारा विभिन्न मूलवृंतों का थॉम्पसन सीडलैस में विभिन्न फलाद्गमिकी चरणों पर पड़ने वाले प्रभाव को समझने के लिए अध्ययन के अंतर्गत, फल कलिका विभेदन अवस्था पर युवा पर्ण में पादप हार्मोन विश्लेषण से पता चला कि बढ़े हुए कलिका विभेदन के लिए आईएए तथा सैलिसिक अम्ल वृद्धि और जीए$_3$ एवं एबीए सांद्रता में ह्रास उत्तरदायी कारक हैं। डोगरिज पर कलमित लताओं की अपेक्षा स्वमूलित एवं 110 आर पर कलमित लताओं में अधिक फलीय केन दर्ज किए गए। मणि विकास के विभिन्न चरणों में एकत्र नमूनों की प्रोटीन विश्लेषण, प्रोटीन सांद्रता और 2-डी जैल पर प्रोटीन स्पॉट संख्या में सार्थक अंतर पाया गया। मेटाबोलाइट्स जैसे कि टार्टरिक अम्ल, मैलिक अम्ल, ग्लूकोज, फ्रक्टोज, कुल फिनोल आदि की सांद्रता में भिन्नता मूलवृंतों से सार्थक रूप से प्रभावित होती है। एलसी-एमएस/एमएस पर पूर्ण प्रोटीओमिक विश्लेषण हो चुका है और मूलवृंतों का आणविक स्तर पर विभिन्न भौतिक-

जैवरासायनिक परिवर्तन को प्रभावित करने वाले तंत्र पर प्रभाव तथा विभिन्न फलाद्गमिकी चरणों में उनकी संभावित भूमिका के निष्कर्ष तक पहुँचने के लिए आंकड़ों का विश्लेषण प्रगति पर है।

सात मूलवृंतों का कैबरने सॉविनॉन की वृद्धि, उपज, फल संरचना तथा वाइन गुणवत्ता पर प्रभाव के अध्ययन के लिए दीर्घ अवधि का मूल्यांकन जारी है। रोपण के बाद पांचवें वर्ष के परिणाम उपज मापदंडों, उपज प्रति लता, फल एवं मस्ट संरचना पर मूलवृंतों के सार्थक प्रभाव को दर्शाते हैं। 110 आर मूलवृंत पर कलमित लताओं में अधिकतम गुच्छ संख्या, गुच्छ वजन तथा उपज प्रति लता दर्ज की गई जबकि 101-14 एमजीटी पर निम्नतम उपज दर्ज की गई। मस्ट के विश्लेषित मापदण्डों में ग्रैवसक पर अधिकतम टीएसएस जबकि फरकाल तथा 140 आरयू पर उच्चतम अम्लता दर्ज की गई। फरकाल में मस्ट पीएच कम पाया गया।

एक प्रयोग के अंतर्गत फल छंटाई के समय का सिरा अंगूरों की उपज एवं फल संरचना पर प्रभाव के अध्ययन में अगेती छंटाई (सितम्बर) की तुलना में पछेती छंटाई (अक्टूबर) की गई लताओं से अधिकतम फल-गुच्छ वजन एवं रस प्राप्ति दर्ज की गई। लेकिन अन्य गुणवत्ता मापदंड जैसे कि शर्करा तथा कुल अम्लता जो कि अच्छी गुणीय वाइन के प्रमुख कारक हैं, अगेती छंटाई की गई लताओं में अधिक पाये गए। दो प्रशिक्षण पद्धति में कैबरने सॉविनॉन के निष्पादन के अध्ययन में वीएसपी प्रशिक्षित लताओं में अधिक फल-गुच्छ वजन तथा उपज प्रति लता जबकि वाई ट्रैलिस से अधिक रस प्राप्ति पाई गई।

भारतीय परिस्थितियों में उपयुक्तता को देखने के लिए पांच वर्षीय सफ़ेद और लाल वाइन किस्मों का कायिक वृद्धि, उपज और फल संरचना मापदंडों के लिए मूल्यांकन किया गया। सफेद किस्मों में, सबसे अधिक उपज/लता वार्मिंटिनो (4.68 किग्रा) में तत्पश्चात चेनिन ब्लाँ (4.57 किग्रा) और कोलंबार्ड (4 किग्रा) में दर्ज़ की गई। उच्चतम रस प्राप्ति चेनिन ब्लाँ (73.2%) में तथा तत्पश्चात मस्कट व्हाइट (69.8%) और वार्मिंटिनो (69.4%) में थी। विभिन्न किस्मों में वाञ्छित शर्करा स्तर को प्राप्त करने के लिए आवश्यक डिग्री डेज में सार्थक भिन्नता थी और 1557 -1849 के बीच दर्ज़ किए गए। लाल किस्मों में, सबसे अधिक उपज टेंपरनिलो (3.93 किग्रा) में दर्ज हुई जिसका अनुसरण सिरा (93.89 किग्रा) और निलुसिओ (3.45 किग्रा) ने किया। अधिकतम रस प्राप्ति ग्रीनेच (72.3%) और तत्पश्चात निलुसिओ (69.6%) और कैबरने सॉविनॉन (69.5%) में थी। लाल किस्मों में वांछित शर्करा के स्तर को प्राप्त करने के लिए आवश्यक डिग्री डेज 1833-1984 थे।

कैबरने सॉविनॉन लताओं में पोटेशियम की प्रत्यक्ष और अवशिष्ट प्रभाव के अध्ययन में, खाद और/या पोटेशियम उर्वरक के पांच वर्षों तक उपयोग के परिणामस्वरूप मूल क्षेत्र में उपलब्ध पोटेशियम की मात्रा में वृद्धि हुई जोकि निर्धारित क्रांतिक सीमा से अधिक थी। अत: पोटेशियम उपयोग से, नियंत्रण उपचार के मुक़ाबले उपज में सार्थक अंतर नहीं था। सस्ते एवं वैकल्पिक कार्बनिक स्रोतों जैसे प्रैस मड कम्पोस्ट, हरी खाद तथा छंटित जैवद्रव्यमान के बीच उपज एवं उपज संबंधी मापदंडों में असार्थक अंतर देखा गया, यद्यपि उच्चतम उपज (19.07 टन/हे.) प्रेस मड कम्पोस्ट से प्राप्त हुई। परिणामत: प्रेस मड कम्पोस्ट को एक सस्ते कार्बनिक पदार्थ के स्रोत तथा पोषक तत्वों के रूप में भी प्रयोग किया जा सकता है। 110 आर मूलवृंत पर कलमित कैबरने सॉविनॉन के लिए पर्णवृन्त पोषक मार्गदर्शिका विकसित करने के दौरान, फल कलिका विभेदन एवं पूर्ण पुष्पन चरण पर अनुमानत: नत्र के क्रांतिक स्तर क्रमश: 0.65% और 0.75% थे। फल कलिका विभेदन स्तर पर फास्फोरस का क्रांतिक स्तर 0.30% जबकि पूर्ण पुष्पन अवस्था पर 0.35% पाया गया।

पादप स्वास्थ्य प्रबंधन

महाराष्ट्र के सांगली क्षेत्र से संकलित *प्लाज्मोपेरा विटीकोला* के क्षेत्र आइसोलेट के आण्विक विश्लेषण ने अंगूर बागों में क्यूओआइ फफुंदीनाशक द्वारा डाऊनी मिल्ड्यू नियंत्रण की विफलता का कारण सीवाईटी बी जीन के कोडोन 143 (जी143ए) में पॉइंट उत्परिवर्तन की पुष्टि की। पाउडरी मिल्ड्यू रोगज़नक़ के आण्विक विश्लेषण से केवल एक मेटिंग टाइप इडिओमोर्फ (एमएटी1-2) की उपस्थिति देखी गई जो दर्शाता है कि विपरीत मेटिंग टाइप की कमी के कारण इन क्षेत्रों में *ई. निकेटर* में लैंगिक प्रजनन का अभाव है और इसी कारण अंगूर बागों में क्लीस्टोथीसिआ नहीं देखे जाते।

ट्राइकोडर्मा और *बेसिलस* प्रत्येक के दो उपभेदों ने क्षेत्र में उगी लताओं में पाउडरी मिल्ड्यू तथा एंथ्रैक्नोज पर अच्छा नियंत्रण दिखाया, रोग प्रगति वक्र में 50% से अधिक कमी हुई तथा इन रोगों के जैविक नियंत्रण के लिए उपयोगी हो सकते हैं। पॉट अध्ययन के माध्यम से पांच *ट्राइकोडर्मा* और नौ जीवाणु उपभेदों, जो कि कवक रोगों के प्रति प्रतिरोधकता प्रेरित करते हैं, की पहचान की गई। सभी आठ *बेसिलस* उपजाति जोकि अंगूर रोगों के जैविक नियंत्रण के लिए पहचानी गईं, को *इन विट्रो* में तापमान की व्यापक सीमा (25-45 ^{0}से) और पीएच (5-8) में उगाया जा सकता है। *बी सबटिलिस* की सबसे कुशल तीन जैव नियंत्रण उपभेदों के प्रति सर्वाधिक प्रयोग में आने वाले फफुंदीनाशकों के प्रति संवेदनशीलता बताती है कि सल्फर, तांबा, कार्बण्डाजिम और टेट्राकोनाज़ोल की निम्न सांद्रता आइसोलेट्स की *इन विट्रो* वृद्धि को बढ़ाती है जबकि अजोक्सिस्ट्रोबिन थोड़ी सी अधिक सांद्रता पर भी वृद्धि को बढ़ाता है। *बी. सबटिलिस* के चार आइसोलेट्स, जिन्होने पूर्व में प्रोफिनोफोस के अवक्रमन की क्षमता दिखाई थी, अंगूर मणियों पर कार्बन्डाजिम, टेट्राकोनाज़ोल तथा माइकोब्यूटानिल को भी अवक्रमित कर सकते हैं।

एन्थ्रेकनोज रोग की भविष्यवाणी के लिए एक तार्किक मॉडल विकसित किया गया तथा रोग की भविष्यवाणी में काफी सटीक पाया गया। कार्बन्डाजिम के प्रतिरोधी कोलेटोट्राइकम के आइसोलेट्स की पहचान के लिए एक एससीएआर मार्कर विकसित तथा प्रमाणित किया गया।

12 गणों के 61 वंशों से 66 कीट प्रजातियों को अंगूर-बागों से संकलन करके प्रलेखित किया गया। *एस. बर्बेटम* के जीवन चक्र का पता लगाया गया। अंगूर-बागों में *कोक्सिडोक्सिनोइड्स परमिनटस, एनाग्रस डेक्टिलोपी* और *लेप्टोमेस्टिक्स डेक्टिलोपी* को मिलीबग के ऊपर परजीवी के रूप में पाया गया। *इन विट्रो* परिस्थितियों में *एस. रानी* की अपरिपक्व एवं प्रौढ़ अवस्थाओं के प्रबंधन हेतु शहद और पराग आधारित कृत्रिम आहार विकसित किया गया। एंटोमोपेथोजीनिक निमेटोड (ईपीएन) *हिटेरोहेब्डिटिस इंडिका* के 25 संक्रामक किशोर/ मिली के उपयोग से *एस. बार्बेटम* के लार्वा मे 85.65% मृत्यु दर थी। तीन आर्द्रक की क्रांतिक मिसेल सांद्रताओं (सीएमसी) का अनुमान लगाया गया। लता वृद्धि चरण और मौसम मापदंड के आधार पर छह कीटों के लिए 'कीट और घुन जोखिम मूल्यांकन और सलाहकार प्रणाली' को विकसित किया गया।

अंगूर-बागों में मिलीबग की तीन प्रजातियों को आश्रय देने वाले नौ वैकल्पिक पोषक पौधे पाए गए। इमिडाक्लोप्रिड 70 डब्ल्यूजी, क्लोथियानिडिन 50 डब्ल्यूडीजी और स्पाइरोटेट्रामेट 150 ओडी को मिलीबग के प्रबंधन में प्रभावी पाया गया। लता पर सीलर कम हीलर का प्रयोग *स्ट्रोमेटियम बार्बेटम* के संक्रमण को कम करने में प्रभावी पाया गया। *इन विट्रो* प्रयोग में *एच. इंडिका* और उसके सहजीवी जीवाणु से *एस बार्बेटम* के कीटडिंभ और *एम. हिर्सुटस* के मादा

वयस्कों में 100 प्रति शत मृत्यु दर थी अत: उनकी रोगजनकता साबित हुई। *एस. बार्बेटम* के पछेती इन्स्टार कीटडिंभ पर दस कीटनाशकों के स्थानिक प्रयोग जैवपरख में छिड़काव मात्रा से 100 गुना अधिक उपयोग से भी महत्वपूर्ण मृत्युदर नहीं मिली।

किशमिश बनाने की प्रक्रिया के दौरान क्रेसोक्सिम मिथाइल, सायमोक्सेनिल, फेमोक्सडोन, प्यराक्लोस्ट्रोबिन और मेटिरम अवशेषों के लिए पूर्व फसल अंतराल (पीएचआई) और प्रसंस्करण फैक्टर (पीएफ) का आंकलन किया गया। अंगूर और किशमिश के बाजार नमूनों में परिकलित आहार जोखिम यूरोपीय संघ के एमआरअल से नीचे थे और आहार जोखिम से संबंधित तीव्र विषाक्तता के किसी भी जोखिम से रहित थे। अंगूर में हेक्ज़िथाइजोक्स, स्यंतरानिलिपरोल, स्पाइरोटेट्रामेट और मेंकोजेब अवशेषों के लिए पूर्व फसल अंतराल (पीएचआई) निर्धारित किया गया। अंगूर में डाइथिओकार्बमेट फफुंदीनाशक के एक संवेदनशील और बीहड़ सीएस2 अवशेष विश्लेषण विधि का मानकी कारण किया गया। इसी प्रकार, किशमिश मैट्रिक्स के लिए 270 यौगिकों के आंकलन के लिए एथिल एसीटेट आधारित बहु कीटनाशक अवशेष विधि विकसित की गई और उसका मानकी कारण किया गया।

कुल 84 वाइन नमूनों, जिनकी 300 से अधिक कीटनाशकों के लिए जांच की गई थी, में अवशिष्ट नहीं पाये गए। बाजार नमूना विश्लेषण के आधार पर, प्रस्तावित वाइन मानकों के लिए विस्तृत मापदंडों, उनकी अधिकतम सीमा इत्यादी जानकारी तैयार की और भारतीय अंगूर प्रसंस्करण बोर्ड को भारतीय वाइन के लिए मानक निर्धारित करने हेतु प्रस्तुत की गयी। अंगूर में अवशिष्ट निगरानी योजना के अनुबंध 9 के अनुसार किशमिश के 78 बाजार नमूनों की कृषि रसायन अवशिष्ट के लिए जांच की गई और सभी नमूनों में कीटनाशी अवशिष्ट की मात्रा पीएफए एमआरएल से कम थी। डाइफेनोकोनाजोल, हेक्ज़ाकोनाजोल और फ्लुसिलाजोल का, अंगूर उत्पादन में सुरक्षित उपयोग आंकलन के लिए, चार विभिन्न मृदा प्रकारों में अवक्रमण गति का अध्ययन किया गया। क्रिसोक्ज़िम मिथाइल का विभिन्न प्रयोग मृदाओं में एसिड फॉस्फेटेज़, अल्कलाइन फॉस्फेटेज़, बीटा–ग्लुकोसिडेज और डीहाइड्रोजिनेज़ एन्जाइम की कार्यशीलता पर कोई विपरीत प्रभाव नहीं पाया गया, अतः यह पदार्थ मृदा सूक्ष्म जीवों के लिए हानिकारक नहीं है।

तुडाई उपरान्त प्रौद्योगिकी

सुखाने से पूर्व अंगूर गुच्छों को 15 मिली ईथाइल ओलिएट और 45 ग्रा पोटैशियम कार्बोनेट के मिश्रण में डुबोने से किशमिश में न्यूनतम भूरापन हुआ। शिराज में 30 गुच्छे/बेल का फसल भार रखने पर अधिकतम एल्कोहोल मात्रा और अधिकतम रंग तीव्रता वाली वाइन बनी। शीघ्र छंटाई (14 सितंबर) और 30 गुच्छे/बेल फसल भार वाले अंगूर से प्राप्त वाइन का पीएच कम और स्वीकार्य सीमा में था। डिंडोरी परिस्थितियों में केबरनेट सॉविनॉन की 11 अक्तूबर को छंटाई और 20 गुच्छे/बेल फसल भार अंगूरों की वाइन में उच्च एल्कोहोल मात्रा (10.6%) दर्ज की गई।

सूचना प्रौद्योगिकी

अंगूर के महत्वपूर्ण कीटों और बीमारियों के निदान और प्रबंधन के लिए एक कम्प्यूटर आधारित विशेषज्ञ प्रणाली का विकास किया गया।

उत्तर पूर्व पर्वतीय एवं जनजातीय उप योजना

मिजोरम में अंगूर उपयोग में उत्पादन संबंधित बाधाओं की पहचान के लिए सर्वेक्षण किया गया। देरी और असमान अंकुरण महत्वपूर्ण बाधाएं पाई गयी और निवारक उपायों का सुझाव दिया गया। बागवानी विभाग (मिजोरम) के अधिकारियों के लिए गुणवत्ता वाइन उत्पादन के लिए विटिकल्चर तकनीकी पर अनुकूलन कार्यक्रम और किसानों के लिए गुणवत्ता रोपण सामग्री के उत्पादन के लिए नर्सरी की स्थापना पर प्रशिक्षण कार्यक्रम आयोजित किए गए। मिजोरम में अंगूर उद्योग के विकास के लिए एक कार्यनीति तैयार की गई और सहमति पत्र पर संस्थान और बागवानी विभाग, मिजोरम राज्य द्वारा हस्ताक्षर किए गए।

तकनीकी स्थानांतरण

केंद्र में विकसित प्रौद्योगिकों को प्रदर्शित करने के लिए क्षेत्र दिवस का आयोजन किया गया, जिस दौरान फलन अवस्था पर खाने योग्य, किशमिश और जूस के लिए आशाजनक किस्मों का प्रदर्शन किया गया। केंद्र में विकसित संकर मेडिका के जूस को सभी प्रतिभागियों को परोसा गया जिन्होंने इसके रंग, स्वाद और अन्य गुणों की सराहना की। बागवानों द्वारा रिपोर्ट की गई अनेक समस्याओं के समाधान के लिए अनेक प्रक्षेत्र दौरे किए गए। केंद्र ने बारामती, दिल्ली, नागपुर और पुणे में आयोजित पांच कृषि प्रदर्शनियों में भाग लिया। अंगूर उत्पादन और तुडाई उपरान्त प्रौद्यागिकी के विभिन्न पहलूओं पर सूचना अंगूर उद्योग के हितधारकों को विभिन्न माध्यमों जैसे प्रशिक्षण कार्यक्रम, प्रक्षेत्र दौरा, बागवानों/एसोसिएशन के सेमिनार, वेब परामर्शी, रेडियो वार्ता, केंद्र में पारस्पारिक बातचीत और केंद्र की वेबसाइट आदि द्वारा उपलब्ध कराई गई। वर्ष के दौरान करीब 1580 किसानों ने अंगूर उत्पाद और केंद्र में विकसित प्रौद्योगिकी की जानकारी पाने के लिए केंद्र का दौरा किया।

मानव संसाधन

निदेशक ने महाराष्ट्र राज्य द्राक्ष बागाईतदार संघ के प्रतिनिधि मंडल के साथ 31 जुलाई – 4 अगस्त 2013 में स्पेन और इटली और 5–9 फरवरी 2013 में बर्लिन, जर्मनी में आयोजित फल लॉजिस्टिका प्रदर्शनी का दौरा किया।

एक वैज्ञानिक ने, 25–28 अगस्त 2013 को शिकागो में आयोजित 127 वी एओएसी अन्तर्राष्ट्रीय की वार्षिक बैठक और प्रदर्शनी में हिस्सा लिया और तकनीकी पोस्टर प्रस्तुत किए।

पांच वैज्ञानिक, एक तकनीकी और एक प्रशासनिक स्टाफ को उनके विशेषज्ञता क्षेत्र में ज्ञान वृद्धि के लिए विभिन्न राष्ट्रीय संस्थाओं में प्रशिक्षित किया गया।

राजस्व आय

प्रशिक्षण, परामर्श, अनुबंध अनुसंधान एवं सेवाएं, रोपण सामग्री और फार्म उत्पाद की विक्री द्वारा रु. 46.86945 लाख का राजस्व अर्जित हुआ।

Executive Summary

National Research Centre for Grapes, Pune was established in January 1997 to undertake mission oriented research to address the constraints in grape production and processing in India. Under the guidance of ICAR, RAC, QRT and IRC, research is being carried out under four broad areas of genetic resources and improvement, production technology, plant health management and postharvest technology under institutional and externally funded projects. The Centre has also undertaken consultancy services and contractual researches related to its mandate. The research achievements made during 2013-14 are briefly summarized below:

Genetic Resources and Improvement

Thirteen accessions were added to the germplasm. Germplasm was evaluated for loose bunch and bold berries, berry cracking, resistance to powdery mildew, raisin making and juice making. Seven accessions with berry diameter of 18-20 mm were identified. Eight juice varieties were ranked based on organoleptic score. Arka Shyam and Medika were the most acceptable varieties for juice. In clonal selection program, two mutant vines of Thompson Seedless were identified in grower's field and were selected for bold berries as compared to their mother vines.

Breeding program for downy mildew resistance was strengthened and 3720 seeds were obtained from crosses of Seyve Villard x Thompson Seedless and Carolina Black Rose x Thompson Seedless. Field and *in vitro* screening of 70 field planted progenies of Carolina Black Rose x Thompson Seedless identified 19 progenies with a UPOV rating of 1 suggesting their tolerance to downy mildew. Grape genomic region corresponding to QTL *Rpv3* was analysed and 10 new microsatellite markers in this region were identified. These markers were screened for polymorphism using downy mildew resistant and susceptible genotypes. The polymorphic markers will be used for selection of resistant progenies at seedling stage itself.

RNA sequence based transcriptome analysis of salinity stress response in leaves of Thompson Seedless vines grafted on 110 R rootstock identified large number of up-regulated and down-regulated genes at different stages of salinity stress. Up- and down-regulation of several genes was observed as early as six hours after salinity stress imposition. Morphological, physiological and nutritional parameters showed differential response of own rooted and grafted vines and early response was observed in own rooted vines for all the parameters. In-depth analysis of gene expression will result in the identification of important genes and pathways for salinity stress.

Differential expression of five genes, which were selected based on *in silico* analysis, was observed in leaves of grafted and own rooted vines of Thompson Seedless at different stages of salinity stress. In grafted vines, expression of APETALLA and FBOX transcription factor increased several folds at 15 days, while in own rooted vines, expression either remained unchanged or changed marginally at early stage. Comparative genomics analysis of selected genes in five genotypes identified several SNPs in coding regions. These results will be used to develop functional markers for salinity stress.

GA response at rachis and berry elongation stages in Thompson Seedless was analysed using RNA sequencing based transcriptome analysis. Reference genome sequence based analysis identified large number of differentially expressed both up-regulated and down-regulated genes within six hours of GA application at rachis stage. Similarly large numbers of genes were regulated at cluster thinning and berry elongation stages. Morphological traits like rachis length, number of internodes, berry weight and diameter etc. as well as metabolites such as glucose, fructose, sucrose, GA_3, ABA, tartaric acid, malic acid etc. showed significant variation between treated and control samples.

Production Technology

For developing decision support system (DSS) for moisture and temperature stress, the existing data library was augmented and symptoms of different temperature /moisture stresses were documented through surveys. Data from vineyards pruned between 1st April and 22nd May revealed that, excess soil moisture and cloudy weather conditions due to early onset of monsoon during bud differentiation stage reduced the number of fruitful canes/vine drastically in late pruned vineyards. To establish relationship between temperature and phenology of grapevine and its impact on grapevine productivity, vines were pruned at different times. Vines pruned during April (foundation pruning) and October (fruit pruning) produced significantly higher yield compared to late pruned vines (May and November respectively). The growing degree days (°C) ranged from 1450.6 to 1464.4 under different pruning treatments. Moisture stress at different growth stages showed that, highest yield reduction of 9.7% in vines irrigated at 50% of the recommended level up to 30 days after pruning followed by no irrigation between 30 to 60 days after foundation pruning. Further, moisture stress after fruit set till harvest reduced the yield by 8.90% compared to recommended irrigation.

In Fantasy Seedless, sub surface irrigation with 227 mm of applied irrigation water along with rainfall (509 mm) produced highest yield with WUE of 103 kg/mm of irrigation water which was on par with the treatments which provided higher quantity of irrigation. The partial root drying treatment also increased the water use efficiency (113.98 kg/mm of irrigation applied) indicating its importance under conditions where availability of irrigation water is a major constraint.

In the studies to understand the influence of rootstocks on Thompson Seedless vines at different phenological stages through proteomic approach, analysis of plant hormones in young leaves during fruit bud differentiation stage revealed increased IAA and salicylic acid and reduced GA_3 and ABA concentration as responsible factors for increased fruit bud differentiation. Own rooted vines and vines grafted on 110R recorded more fruitful canes compared to vines grafted on Dogridge. Protein analysis of samples collected at different stages of berry development revealed significant differences in protein concentration and subsequently number of protein spots on 2D gels. Rootstocks significantly influenced the variation in concentration of metabolites such as tartaric acid, malic acid, glucose, fructose,

total phenols etc. Whole proteome analysis on LC-MS/MS has been completed, while data analysis is in progress to derive conclusions on mecahnism of rootstocks influencing several physio-biochemical changes at molecular level and their possible role at various phenological stages.

Long term evaluation is in progress to study the influence of seven rootstocks on growth, yield, fruit composition and wine quality of Cabernet Sauvignon grapes. The results during fifth year after planting indicated significant influence of rootstocks on yield parameters, fruit and must composition. Vines grafted on 110 R rootstock recorded highest number of clusters, cluster weight and yield per vine while lowest yield was recorded on 101-14 Mgt. Among must parameters, highest TSS was recorded on Gravesac while highest acidity was recorded on 140 Ru and Fercal. Fercal was found to reduce must pH.

In an experiment to study the influence of time of fruit pruning on yield and fruit composition of Syrah grapes, highest bunch weight and juice recovery was recorded on late pruned (October) vines as compared to early pruned (September) vines. But other quality parameters such as sugar and total acidity which are contributing factors for good quality wine were better on early pruned vines. In the studies on performance of Cabernet Sauvignon on two training systems, VSP trained vines recorded highest bunch weight and yield per vine while juice recovery was highest on Y trellises.

Five year old white and red wine varieties were evaluated for vegetative growth, yield and fruit composition parameters to see their suitability for growing under Indian conditions. Among white varieties, highest yield/vine was recorded in Vermentino (4.68 kg) followed by Chenin Blanc (4.57 kg) and Colombard (4 kg). The highest juice recovery was recorded in Chenin Blanc (73.2%) followed by Muscat White (69.8%) and Vermentino (69.4%). The degree days (°C) required to achieve the desired sugar level varied significantly among the different varieties and ranged between 1557 to 1849. Among red varieties, highest yield was recorded on Tempranillo (3.93 kg) followed by Syrah 93.89 kg) and Niellucio (3.45 kg). Juice recovery was highest in Grenach (72.3%) followed by Niellucio (69.6%) and Cabernet Sauvignon (69.5%). The degree (°C) days required to achieve the desired sugar level in red variety ranged from 1833 to 1984.

In a study on direct and residual effects of applied potassium in Cabernet Sauvignon vines, application of manure (FYM) and/or potassium fertilizer over five years resulted in increase in available potassium in the root zone which was above its established critical limit. Hence, no significant response was observed to applied potassium in terms of yield over control treatments. Among cheaper and alternate sources of organic matter viz. press mud compost, green manure and pruned biomass, no significant difference was recorded for yield and yield related parameters though highest yield (19.07 ton/ha) was recorded with press mud compost. Results indicated that press mud compost can be used as a cheaper source of organic matter as well as nutrients. In developing petiole nutrient guide for Cabernet Sauvignon grapes grafted on 110R rootstock, critical level for N at fruit bud differentiation stage and full bloom

stage was estimated to be 0.65% and 0.75% respectively. Critical level for P at bud differentiation stage was found to be 0.30% whereas at full bloom stage it was 0.35%.

Plant Health Management

Molecular analysis of field isolates of *Plasmopara vitiola*, collected from Sangli region of Maharashtra showed point mutation at codon 143 (G143A) in cyt b gene confirming resistance to QoI fungicides as the reason for failure of control of downy mildew in vineyards. Molecular analysis of powdery mildew pathogen showed presence of only one mating type idiomorph i.e. MAT1-2 indicating that *E. necator* is not sexually reproducing in these areas due to lack of opposite mating type and explains the non-sighting of cleistothecia in vineyards.

Two strains each of *Trichoderma* and *Bacillus* showed good control of powdery mildew and anthracnose on field grown vines, providing more than 50% reduction in area under disease progress curve and can be useful for biological control of these diseases. Five *Trichoderma* and nine bacterial strains which induced resistance to grapevine fungal disease were identified through pot studies. All the eight *Bacillus* spp. which were identified as promising for biological control of grape diseases, could grow at wide range of temperature (25-45 °C) and pH (5 to 8) *in vitro*. Sensitivity to commonly used fungicides against the three most efficient bio-control strains of *B. subtilis* revealed that at low concentrations sulphur, copper, carbendazim and tetraconazole enhanced the *in vitro* growth of the isolates, while azoxystrobin enhanced the growth at slightly higher concentrations, too. Four *B. subtilis* isolates which had earlier shown ability to degrade profenofos, could also degrade carbendazim, tetraconazole and myclobutanil on grape berries.

A logical model for prediction of anthracnose disease was developed and found reasonably accurate in predicting disease. A SCAR marker for the identification of carbendazim resistant isolates of *Colletotrichum* was developed and validated.

Sixty six insect species from 12 orders and 61 families have been collected from vineyard and documented so far. Life cycle of *S. barbatum* was worked out. *Coccidoxenoides perminutus*, *Anagyrus dactylopii* and *Leptomastix dactylopii* were found parasitizing mealybugs in vineyards. Honey and pollen based artificial diet was developed to maintain immature and adult stages of *S. rani* under *in vitro* conditions. Entomopathogenic nematode (EPN), *Heterorhabditis indica* @ 25 infective juveniles/ml resulted in 85.65% mortality of larvae of *S. barbatum*. Critical Micelle Concentrations (CMC) of three surfactants was estimated. An 'Insect and mite pest risk assessment and advisory system' based on vine growth stage and weather parameter was developed for six pests.

Nine alternate host plants were found harbouring three species of mealybugs in vineyards. Imidacloprid 70 WG, clothianidin 50 WDG and spirotetramate 150 OD were found effective for management of mealybugs. Sealer cum healer was found to reduce *Stromatium barbatum* infestation on treated vine parts. *H. indica* and its symbiotic bacteria resulted in 100

per cent mortality of *S. barbatum* grubs and adult females of *M. hirsutus in vitro* and their pathogenicity was proved. Topical application bioassays of ten insecticides on *S. barbatum* late instar grubs, up to 100 times of spraying doses, did not result in significant mortality.

Pre-harvest interval (PHI) and processing factor (PF) were evaluated for kresoxim methyl, cymoxanil, famoxadone, pyraclostrobin and metiram residues during raisin making process. The dietary exposure calculated in market samples of grapes and raisins were well below the EU-MRL and were devoid of any risk of acute toxicity related to dietary exposure. Pre harvest intervals (PHI) were determined for hexythiazox, cyantraniliprole, spirotetramate and mancozeb residues in grapes. A sensitive and rugged CS_2 residue analysis method was validated for the estimation of dithiocarbamate fungicides in grapes. An ethyl acetate based multi-pesticide residue method for about 270 compounds was developed and validated for raisin matrix.

Eighty four wine samples were screened for >300 pesticides and were found devoid of any pesticide residues. Based on the market sample analysis, the details on proposed wine standards including parameters, their maximum limits in Indian wines were submitted to Indian Grape Processing Board (IGPB) for setting standards for the Indian wines. 78 market samples of raisin were screened for agrochemical residues as per Annexure 9 on RMP in grapes and all the samples contained pesticide residues below PFA MRLs. The rates of degradation of difenoconazole, hexaconazole and flusilazole were studied in 4 different soils of India to assess their safe use in viticulture. Kresoxim methyl was found to have no effects on acid phosphatase, alkaline phosphatase, β-glucosidase and dehydrogenase activity of the various test soils studied suggesting that this molecule does not have deleterious effect on soil micro-flora.

Post-harvest Technology

Dipping of bunches before drying in a solution of 15 ml ethyl oleate and 45 g potassium carbonate resulted in minimum browning in raisins. In Shiraz, crop level of 30 bunches/vine produced wine having maximum alcohol and maximum colour intensity. The wine produced from early pruned (14th September) and with 30 bunches/vine had low pH in acceptable range. Under Dindori conditions, high alcohol content (10.6%) was recorded in wine of Cabernet Sauvignon from vines pruned on 11th October with a crop load of 20 bunches per vine.

Information Technology

An expert system was developed for the diagnosis and management of important diseases and insect pests of grapes.

NEH and TSP program

Survey was carried out to identify production related constraints facing grape industry in Mizoram. Delayed and uneven sprouting was found to be the important constraints and preventive measures were suggested. Orientation programmes on viticultural techniques for

quality wine production for officials of the Department of Horticulture (Mizoram) and training for the farmers for setting up of Nursery for production of quality planting materials were organised. An action plan for the 'Development of Grape Industry in Mizoram' was prepared and a MoU was signed by the Institute and Department of Horticulture, Mizoram State.

Production of Quality Planting Material

Approximately 41 thousand cuttings of grape rootstocks and commercially popular varieties were sold to grape growers of Maharashtra, Karnataka and other grape growing regions. Among the commercial varieties, demand for Fantasy Seedless (2120 Nos.) and Manjri Naveen (1525 Nos.) was the maximum.

Transfer of Technology

A field day was organized to showcase the technologies developed at the Centre during which promising varieties for table, raisin and juice were shown at fruiting stage. Juice prepared from the NRCG hybrid 'Medika' was served to the participants and was appreciated for colour, taste and other qualities. Several field visits were taken up to address the problems reported by growers. Centre also participated in five agri-exhibitions organized at Baramati, Delhi, Nagpur and Pune. Information on various aspects of grape cultivation including postharvest technology was made available to the several stakeholders of grape industry through various means of dissemination such as organizing training programs, field visit, participating in grape growers/association's seminars, web advisory, radio talks, one-to-one interactions with them at the institutes and also displaying the information on the Institute's website under farmer's corner. During the year about 1580 farmers visited the Centre to know about viticulture and technologies developed at the Centre.

Human Resource Development

The Director visited Spain and Italy during 31st July – 4th August 2013 and Fruit Logistica Exhibition at Berlin, Germany during 5-9th February 2014 with the delegation of Maharashtra Rajya Draksha Bagaitdar Sangh (MRDBS).

One Scientist participated in 127th AOAC International 2013 Annual Meeting and Exposition in Chicago, during 25-28th August 2013 and presented technical posters. Five scientists, one technical and one administrative staff were trained in different national organizations to acquire the knowledge in their respective field of specialization.

Revenue Generation

Revenue of Rs. 46.86995 lakhs was generated through training, consultancy, contract research and services, sale of planting material and farm produce.

Introduction

In the seventeen years of its establishment, the National Research Centre for Grapes has acquired the technical expertise and state of art equipments to undertake mission oriented research to resolve the problems faced by the grape growers of the country. The small team of 15 scientists is involved in research on all aspects of viticulture and enology. A grape gene bank in field comprising 426 collections from India and few from abroad has been established. The germplasm has been characterized based on phenotypic and molecular characters and a catalogue of germplasm was prepared. The germplasm has also been evaluated for many desirable traits for direct commercial use or for improvement of existing cultivars. Breeding activities on a small scale have given a cross between Flame Seedless and Pusa Navrang which is named as 'Medika' with excellent juice colour and qualities. The hybrid was well accepted by consumers and will be promoted for its potential health benefits. Another important ongoing breeding program is to introgress downy mildew resistance in Thompson Seedless and molecular markers are being developed for identifying downy mildew resistant progenies. Breeding to develop naturally loose bunches with bold berries is also initiated.

Long term evaluation of rootstocks for table grapes has shown that Dogridge is suitable for drought conditions but is unable to restrict uptake of sodium in conditions where soil and irrigation water have high sodium content. 110 R was found to be more suitable for Thompson Seedless under such conditions due to its higher Na exclusion capabilities. Identifying rootstocks for other commercial table grapes such as Red Globe and Fantasy Seedless and wine grapes viz. Cabernet Sauvignon and Sauvignon Blanc are ongoing. The vine growth stage wise nutrient and water requirements for Thompson Seedless and Cabernet Sauvignon grapes were worked out. These technologies can result in considerable saving of nutrients and water and enhance nutrient and water use efficiency in vineyards. Identification of nutrient deficiency symptoms in farmer's field and suggesting appropriate nutrient applications has overcome many problems in cultivation. Similarly, many trials on bioregulators have helped to generate appropriate schedules for Thompson Seedless, Tas-A-Ganesh and Sharad Seedless for enhanced productivity, quality and shelf life.

Understanding the disease progress under varying weather conditions has helped to develop logical models for disease management based on location specific real time forecasted weather and vine growth stages. This has resulted in better disease management with less number of fungicide applications. Demonstration of this technology to farmers in their own vineyards has boosted their confidence in weather information based disease management and has been one of the success stories of this Centre. The Ongoing research has shown the possibility of disease management using microorganisms. A number of efficient *Bacillus* and *Trichoderma* isolates with potential for multiple disease control have been identified and will be taken forward for large scale field trials. These bio-control agents have also shown potential for management of fungicide resistance in pathogens and pesticide residues on berries.

A multi-target insecticide strategy for management of insect pest complex was developed which can help farmers for proper selection of insecticide based on insect pest complex present in the vineyard and avoiding different sprays for separate insect pests. Various potential

biological agents such as *Anagyrus dactylopii* and *Scymnus coccivora* against pink mealybug, *Stethorus rani* against red spider mite and *Heterorhabditis indica* against stem borer were identified.

Trials on evaluating 19 wine varieties for yield, quality of fruits and quality of wine and 11 rootstocks for growing Cabernet Sauvignon have been initiated. A fermentation room with small fermentors was set up for making wines from grapes harvested these research trials.

One of the success stories of this Centre has been the successful implementation of the Residue Monitoring Plan (RMP). This was the 10th year of the RMP, initiated by APEDA, Ministry of Commerce, Government of India in 2003-04 in collaboration through the National Referral Laboratory (NRL) setup under this institute. More than 23000 farms have registered for export. This institute updated the package of practice related to the list of recommended pesticides and also the list of chemicals for monitoring which minimized non-compliance to the EU-MRLs to a large extent. An overall improvement in quality was recorded with most of the residue detections being restricted to selected insecticides. NRL also established sampling and analysis protocols for okra and curry leaf, which were implemented for residue monitoring across the country.

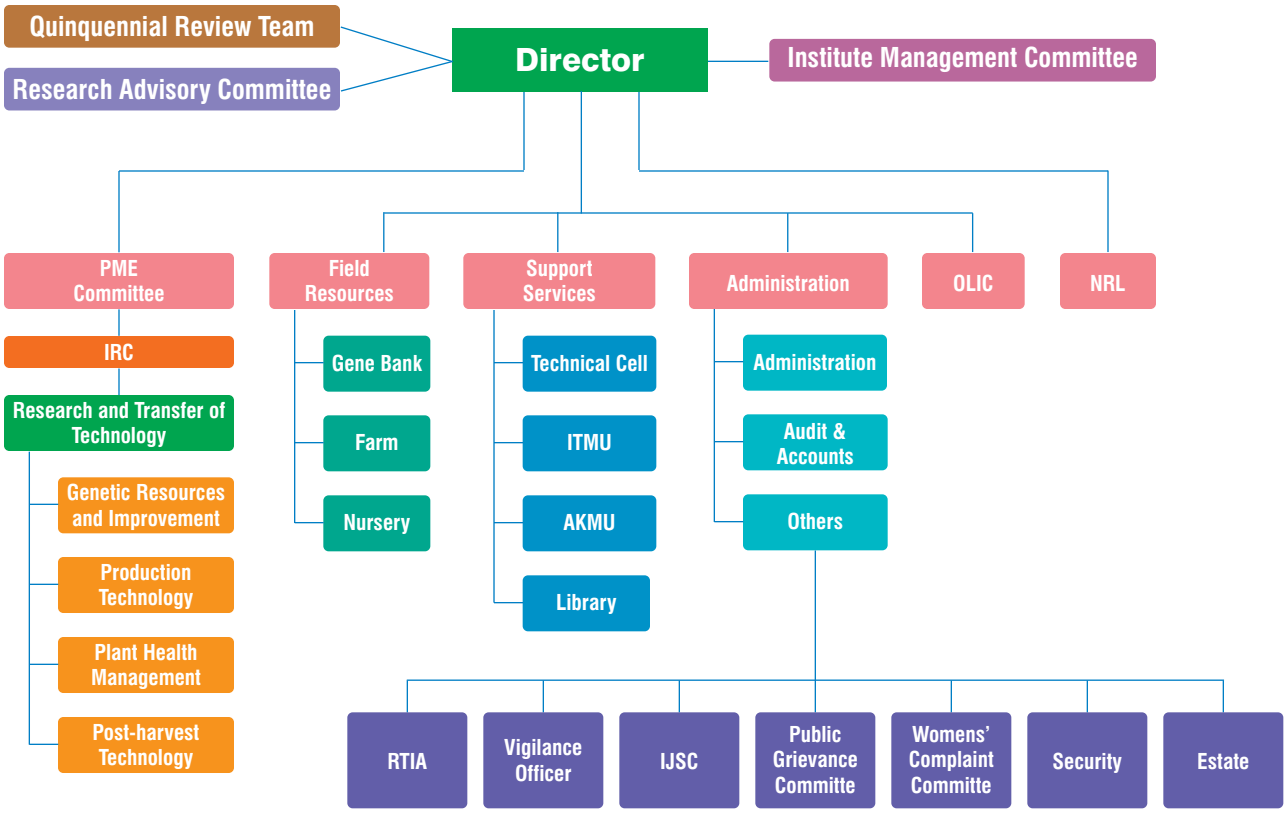
The scientists have been actively visiting vineyards in all parts of India and have over the years developed excellent personal contacts with the growers, the state agriculture department officers and other stake holders. This has resulted in in-depth understanding of the problems being faced by the farmers and the industry and in resolving many of the problems based on short and long term experimentation. Collaboration with scientists from other research institutes and Universities has helped in generating additional supporting research data.

The research programs are formulated after assessing the needs of grape industry in India. The recommendation of Quinquennial Review Team (QRT), Research Advisory Committee (RAC), and inputs from other grape industry stake-holders are deliberated by Priority Setting, Monitoring and Evaluation (PME) cell for identifying the research priority areas. Presently research is conducted under broad areas of Genetic Resources and Improvement, Production Technology, Plant Health Management and Pre and Postharvest technology. Besides 15 institutional research programmes, six externally funded projects, two ICAR ORP projects are in progress. The Centre also undertakes consulting and mandate related contractual research projects.

Mandate

To undertake mission oriented programme involving basic and strategic research for resolving the major biotic and abiotic constraints affecting the grapes production, productivity and utilization.

Organizational set-up



Staff position

Sl. No.	Post	Number of posts		
		Sanctioned	Filled	Vacant
1.	Research & Management Personnel	1	1	0
2.	Scientific	16	14	2
3.	Technical	8	7	1
4.	Administrative	13	10	3
5.	Supportive	7	7	0
	Total	**45**	**39**	**6**

Financial statement

(₹ in Lakhs)

Sl. No.	Heads	R.E. 2013-14		Expenditure 2013-14		Final Grant		Revenue Generated
		Plan	Non-Plan	Plan	Non-Plan	Plan	Non-Plan	
1.	Estt. Charges	0.00	330.00	0.00	293.82001	0.00	330.00	
2.	O.T.A.	0.00	0.00	0.00	0.00	0.00	0.00	
3.	T.A.	10.00	1.50	10.00	1.50	10.00	1.5	
4.	Equipment	60.00	4.00	51.98358	3.92719	60.00	4.00	
5.	Library books	0.114	0.00	0.1139	0.00	0.114	0.00	
6.	Other charges	237.00	80.00	236.2447	79.99386	237.00	80.00	
7.	Works	35.386	10.00	33.28425	10.00	35.386	10.00	
8.	Furniture	37.50	1.00	37.49703	1.00	37.50	1.00	
9.	Pension	0.00	0.00	0.00	0.00	0.00	30.00	
	Total	**380.00**	**456.50**	**369.12346**	**390.24106**	**380.00**	**456.50**	**46.86995***

* Revenue of ₹ 46.86995 Lakhs was generated against the target of ₹ 44.50 Lakhs through training, consultancy, contract research and services, sale of planting material and farm produce.

Genetic Resources and Improvement

Collection, characterization and evaluation of grape germplasm for tolerance to biotic/abiotic stress factors

Germplasm collection and maintenance

Thirteen accessions were collected and planted in the nursery for multiplication and will be grafted on Dogridge rootstock in field. In addition 2 clones were identified in the farmer's field and were grafted on Dogridge rootstock in field for further observations.

Classification of accessions

At present, germplasm has 451 accessions which include 344 for table/juice/raisin, 17 wine, 25 rootstocks and 65 repeat entries. Among table/raisin accessions, 275 accessions are seeded while 69 accessions are seedless with 68 duplicates thus totalling 426 accessions in the germplasm repository. Among the seeded accessions, 121 are white and 154 are coloured accessions. Among seedless, number of white and coloured accessions is 42 and 27 respectively.

Evaluation of germplasm for loose bunch and bold berries

Two important parameters which determine quality of table grapes are loose bunches and bold berries. To achieve these characters, practice of chemical and/or manual thinning of berries is followed which adds to the cost of cultivation. Hence, evaluation of germplasm for commercially important traits such as naturally loose bunches and bolder berries is highly essential. Considering this, main focus during the year was to evaluate the available germplasm accessions for these characters, without using any spray of growth regulators. The accessions were characterized based on bunch compactness and berry size. Seven accessions viz. Arka Majestic, Kali Sahebi, Anab-e-Shahi, F-26-8, Labrusca, A18-2, Rizamat, Black Champa x Thompson Seedless were fulfilling criteria of the berry diameter of 18-20 mm with loose bunch.

Evaluation of germplasm for raisin making

Twenty-six accessions including commercial varieties were evaluated for raisin recovery and quality. The grapevines under experiment were not treated with any growth regulator. Average bunch weight ranged from 64.80 g in Kishmish Bailey to 347.0 g in Athens. Raisin prepared from medium berries is generally preferred by the consumers. Berry diameter differed significantly among the different accessions. Maximum accessions were with 12 to 14 mm berry diameter. Total soluble solids (TSS) ranged from 20 °B to 22.60 °B whereas the juice pH ranged from 3.3 to 3.8. The raisin recovery ranged from 23% in EC 552117 to 30.4% in Ribier.

Evaluation of germplasm for juice making

Grape juice is becoming popular among the consumers. The research carried out on breeding grape varieties suitable for juice making during the last five years resulted in

identifying a hybrid between Flame Seedless × Pusa Navrang named as 'Medika'. This hybrid was evaluated in comparison to seven other promising hybrids and cultivars including its parents. Fruit pruning of all the varieties were done on a single day and uniform cultural practices were followed to maintain healthy vines during the season. Average bunch weight of Medika was more (318.6 g) than Flame Seedless (245.3 g) and Pusa Navrang (220.0 g). However, the berry diameter of Medika was less (15.1 mm) than Flame Seedless (16.4 mm) and the number of seeds were less (02) than its parents Pusa Navrang (03). Juice colour of Medika was reddish pink than Pusa Navrang (pinkish) and Flame Seedless (reddish). Higher juice recovery of 68% was recorded in Medika than Pusa Navrang (64%) and Flame Seedless (52%). Based on organoleptic test, juice from Arka Shyam had highest overall acceptance followed by Medika (Fig. 1). However, a major important phenolic compound resveratrol, considered of medicinal value was higher in Medika (2.4 ppm) than both the parents Flame Seedless (1.27 ppm) and Pusa Navrang (0.17 ppm).

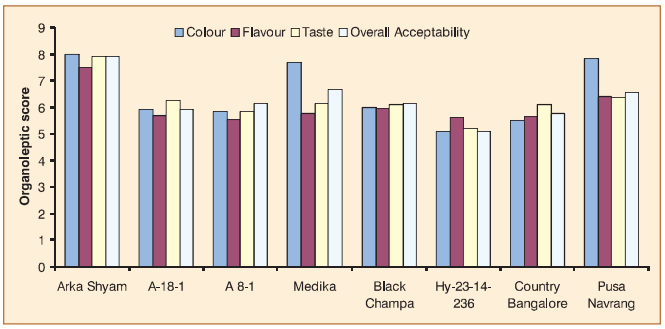


Fig. 1. Organoleptic scores for different juice varieties

Evaluation of germplasm against reaction to powdery mildew

Under Indian conditions, powdery mildew is the major disease during fruiting season. The available germplasm was screened in field against reaction to powdery mildew incidence. Bunches were scored depending on the level of incidence and the accessions were categorized into susceptible, tolerant and resistant. Nineteen accessions recorded PDI<10 indicating their tolerance to powdery mildew, 27 accessions had PDI 20-25%, 15 accessions with PDI 26-50% and remaining accessions had PDI>50.

Evaluation of germplasm for ripening period

The duration in terms of degree days required to achieve 18 °B was recorded among the different accessions. Based on the time taken for maturity, 59 accessions were found to be early ripening with a ripening period of 121-130 days whereas 14 accessions were late ripening having a ripening period of 141-150 days. In seeded grapes, the degree days varied from 1434 to 1558 in early ripening varieties (121-130 days), 1355 to 1565 in mid ripening (131-140 days) while the degree days ranged from 1460 to 1664 in long duration accessions (141-150 days). Among seedless grapes, the degree days ranged from 1422 to 1425 in early ripening accessions (110-120 days), 1434 to 1451 in medium ripening accessions of (121-130 days), and 1455 to 1465 (131-140 days) respectively, whereas in late ripening accessions (141-150 days) the degree days ranged from 1464 to 1491.

Breeding for development of marker assisted selection technique for downy mildew resistance in seedless grape varieties

Seventy progenies of Carolina Black Rose (CBR) x Thompson Seedless (TS) were rated according to the UPOV rating scale (1-9) for their response to downy mildew in field and *in vitro* screening (Fig. 2). Nineteen progenies had a rating of 1 and 5 progenies were rated as 3, indicating resistance to the pathogen. Remaining progenies had a rating of 5 or more than 5.

During last fruiting season (Oct 2013 – Feb. 2014), large scale crossing was carried out between CBR x TS, Seyve Villard 12-375 x TS and Seyve Villard 12-309 x TS. A total of 3720 seeds were obtained which will be germinated according to the standardized protocol and progeny generated will be screened for downy mildew resistance. The grape genome sequence corresponding to *RPV3* QTL was analysed to find the microsatellite repeats. A total of 497 repeat sequences were obtained. Ten repeat regions were selected in closest proximity to the QTL region and primers in their conserved flanking regions were designed and synthesized. These primers were screened for polymorphism using DNA from 10 genotypes including resistant and susceptible. DNA was isolated from 70 progenies of CBR x TS. Analysis of known markers and new markers in *RPV3* region is in progress.

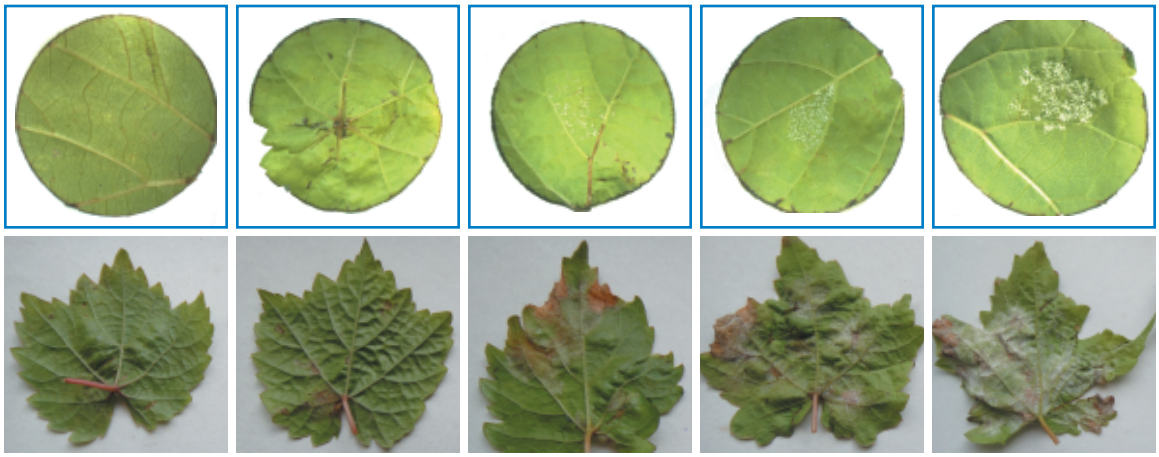


Fig. 2. *In vitro* (top) and field (bottom) screening against *Plasmopara viticola*

Clonal section in grapes

Vines raised from two spontaneous bud mutants of Sonaka from Indapur and Sangli region of Maharashtra (Fig. 3) were observed for berry and bunch characters and compared to those of mother vines (Table 1). Both the mutants were having higher bunch and berry weight, longer berries as compared to the mother vine.

Mutant from Indapur

Mutant from Sangli

Fig. 3. Two mutants of Sonaka

Table 1. Comparison of bunch and berry characters of mutants with mother vines

Sr. No.	Parameters	Indapur		Sangli	
		Mutant	Mother	Mutant	Mother
1	Bunch weight (gm)	500	380	450	350
2	10 berry weight (gm)	43	34	55	40
3	Berry diameter (mm)	16	15	16	15
4	Berry length (mm)	40	32	30	20
5	Pedicle thickness (mm)	2.35	2.30	3.5	2.4
6	TSS (°Brix)	23	24	19	18
7	Acidity (%)	0.30	0.28	0.13	0.13

Observations were recorded for the nine mutants from different regions of Maharashtra. Pooled data (2011-2013) of these mutants is presented in table 2. Most of the mutants were obtained from the variety Sonaka followed by Sharad Seedless. Mutants from Sharad Seedless particularly from Boramani area and mutant of Sonaka (Akkalkot area) were recorded with higher bunch weight, 10 berry weight, berry diameter and berry length as compared to the mother vine. In case of Walwa area, berry of mutant was more elongated. At Tuljapur, mutant was found to be superior with respect to the bunch weight. At Bhose and Jaysinghpur, Sonaka was cultivated mainly for raisin purpose without treatment of growth hormones. In both the cases mutants were found to be higher in range in terms of bunch weight, 10 berry weight, berry diameter and berry length

Table 2. Pool data on bunch and berry characters of the mutants and their mother vines

Place of identification	Boramani (Mother vine: Sharad Seedless)		Akkalkot (Mother vine: Sonaka)		Tuljapur (Mother vine: Super Sonaka)		Jaysinghpur (Mother vine: Sonaka)				Mhaisal (Mother vine: Sharad Seedless)		Walwa (Mother vine: Sharad Seedless)		Bori (Mother vine: Sonaka)		Bhose (Mother vine: Sonaka)	
Parameters	Mother	Mutant	Mother	Mutant	Mother	Mutant	Mother	Mutant 1	Mother	Mutant 2	Mother	Mutant	Mother	Mutant	Mother	Mutant	Mother	Mutant
Bunch weight (g)	489.1	543.3	276.38	473.5	259.3	460.2	259.58	448.86	288.52	384.85	414.23	477.13	450.2	440.6	449.21	492.31	179.65	197.7.8
10 berry weight (g)	75.36	102.96	25.02	34.90	41.22	36.04	18.52	23.26	18.77	22.03	34.62	38.87	66.41	63.18	36.54	40.21	17.46	23.02
Berry diameter (mm)	19.56	22.12	12.56	13.38	13.26	13.21	13.22	14.79	12.24	13.76	17.22	19.54	17.65	16.02	15.21	16.71	10.83	13.53
Berry length (mm)	26.53	30.25	20.27	24.19	33.98	25.69	14.25	16.77	14.45	16.43	24.79	26.22	28.21	38.11	19.33	21.32	16.02	16.84
Pedicle thickness (mm)	2.88	2.98	2.55	2.90	2.83	2.59	2.33	2.72	2.08	2.07	2.03	2.02	3.15	3.44	1.91	1.93	0.46	0.89
TSS (°Brix)	20.73	21.78	22.50	21.33	19.33	19.56	24.62	23.95	20.40	21.79	18.69	19.12	21.53	20.51	19.01	18.32	24.99	22.54
Acidity (%)	4.15	4.58	4.05	3.49	5.02	5.15	5.07	5.31	4.55	4.46	4.72	4.78	5.53	5.10	5.11	4.93	2.82	2.71

Functional analysis of salinity stress response in grapevine

This project is undertaken to identify the important genes and proteins involved in response to salinity stress in grapevine and to study the effect of rootstocks on expression of salinity stress responsive genes. Thompson Seedless vines raised on their own roots and grafted on rootstock were grown in pots and subjected to salinity stress. Morphological and physiological parameters were measured at every 4th day. Significant differences were observed among control and treated vines of grafted as well as own rooted vines for parameters viz. plant height and total shoot length and inter-nodal distance. Stress response was early in own rooted vines (Fig. 4). Number of leaves was found to be significantly different after 23rd days. Other parameters did not vary among control and treated vines. Effect of salinity stress on physiological parameters was observed after 13th day of treatment when significant reduction in physiological parameters viz. assimilation rate, transpiration rate and water use efficiency was observed.

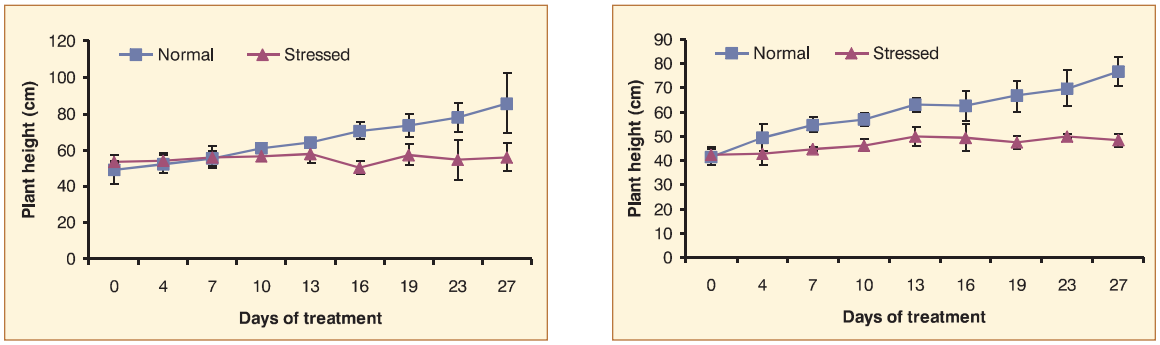


Fig. 4. Effect of salt stress on plant height of grafted (left) and own rooted (right) grapevines

RNA was extracted from young leaf of control and treated vines sampled at three different time points. RNA was sequenced using Illumina HiSeq 2000 platform. The quality of raw sequence data was ascertained and more than 90% of the sequences had Phred value of 30, indicating unambiguous and high quality of sequence data which is essential for further analysis. The RNA sequence data was subjected to reference genome based alignment and more than 90% of the sequences were aligned to the reference genome. The data was subjected to differential expression analysis to identify the genes whose expression was changed in salt treated vines. This analysis identified large number of up-regulated (increased gene expression) and down-regulated (decreased gene expression) genes at different stages of salinity stress. Detailed gene expression analysis to identify the most significant genes and their role in salinity stress is in progress.

The leaf samples of control and treated grafted and own rooted vines were analysed for accumulation of Na at different time intervals (Fig. 5). The Na content of treated vines of own root was significantly higher at all the time points. In case of 110R grafted vines, Na

accumulation in treated vines did not vary significantly up to 15 days, however, at 30 days Na content in treated vines was significantly higher than the control vines. Similarly chloride accumulation was higher in treated own rooted vines as compared to grafted vines.

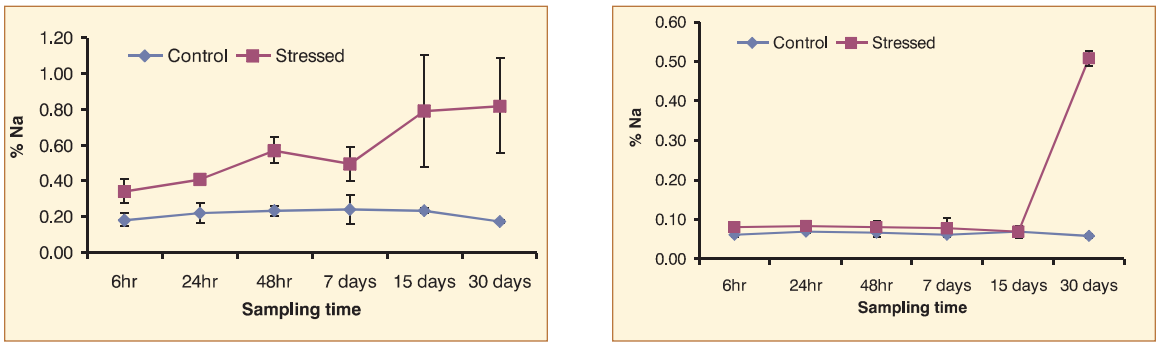


Fig. 5. Effect of salt stress on Na accumulation in own rooted (L) and grafted (R) grapevines

Methods for estimation of organic acid, sugar and sugar alcohols were standardized on Agilent HPLC system 1200 Infinity. Leaf sap of control and treated samples was used to estimate four organic acids, sugar and sugar alcohols. No specific trend of accumulation of organic acids was observed in grafted as well as own rooted vines.

In silico identification of abiotic stress (salinity) responsive transcription factors and their cis-regulatory elements in grape

Based on *in silico* analysis of different databases, five genes, four transcription factors (TF) and one synthetic gene were selected for further analysis. The sequence of these genes were analysed in five genotypes viz. Thompson Seedless, Cabernet Sauvignon, 110 R, Dogridge and Salt Creek. Several SNPs and indel mutations were detected in coding regions of these genes. Expression of these genes was analysed in leaves of grafted and own rooted vines of Thompson Seedless at different stages of salinity stress. Differential expression of these genes was observed. In grafted vines expression of APETALLA transcription factor increased 7 folds i.e. up-regulated at 15 days whereas it remained unchanged in own rooted vines. Expression of FBOX TF was increased in grafted vines at 7 days onwards and its expression increased 12 folds at 15 days (Fig. 6), whereas in own rooted vines expression of this TF was increased as early as at 24 hr of salinity stress. The expression level of bZIP TF was decreased i.e. down regulated in grafted vines at 24 hr whereas in own rooted vines this TF was up-regulated at 7 days. In grafted vines, expression of WRKY TF was up-regulated at 15 days of salinity stress whereas it remained unaffected in own rooted vines. Expression of synthetic gene Inositol 3 Phosphate Synthase (I3PS) was up-regulated in own rooted vines at 7 and 15 days whereas in grafted vines its expression was down-regulated at 48 hr and then remained unchanged at later stages of salt stress.

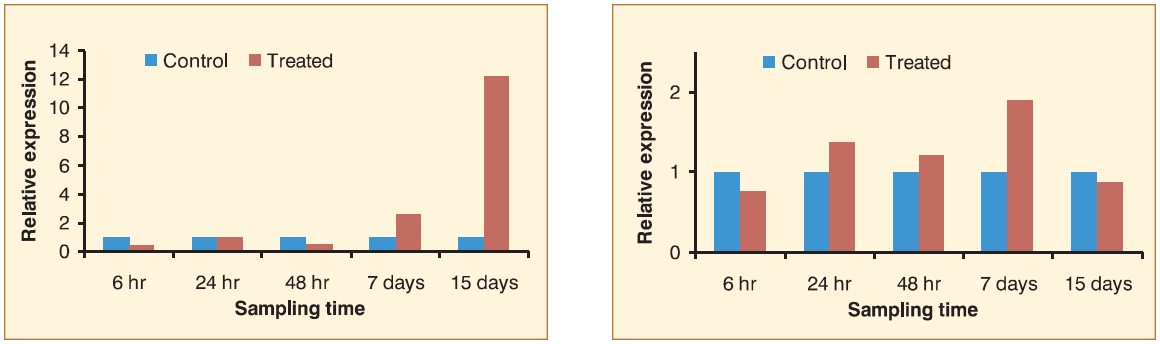


Fig. 6. Expression of FBox TF in (L) grafted and (R) own rooted vines in response to salt stress

Understanding the rachis and berry elongation in response to GA_3 application in Thompson Seedless grapes using functional genomics approach

This project was initiated during April 2013 with the financial assistance from Department of Biotechnology, New Delhi. Uniformly grown vines of grape cultivar Thompson Seedless grafted on Dogridge rootstock were selected for the study. About sixty vines were selected and divided into five groups of twelve vines to impose five different treatments. In each treatment, three biological replications of four vines were made. GA_3 was sprayed either at cluster emergence (treatment 1), full bloom stage (treatment 2) and 3-4 mm berry size (treatment 3) or at all stages combined (treatment 4) at recommended doses. Control vines were sprayed with water.

Samples were taken at different stages of cluster development at different time points (6 hr, 24 hr and 48 hr after treatment) from each treatment replication wise for RNA extraction.

Morphological observations

Significant differences were recorded for all the parameters studied. Among different treatments, treatment 4 (recommended dose of GA_3) recorded highest value for all the parameters such as total rachis length (18.82 cm), number of internodes on rachis (14), total length of first five branches on rachis (21.38 cm), rachis weight (7.93 g), 100 berry weight (333.92 g), berry diameter (17.81 mm) and berry length (13.14 mm). The control vines recorded least value for all the parameters studied. The vines which received treatment 1 recorded highest length of rachis (18.22 mm) compared to T2 and T3.

RNA extraction and sequencing

Three different protocols were tried for extraction of RNA from different tissues such as panicles, full bloom clusters and young berries (3-4 mm size). The best protocol was standardized which was found suitable for extraction from all the tissues and could give fairly higher yield of RNA. The RNA samples extracted from panicles, full bloom clusters and young

green berries collected at 6 hr and 24 hr after application of GA_3 (commercial practice) and water spray (control) were utilized for sequencing on Illumina HiSeq 2000 platform.

Read quality check was performed and sequence reads were trimmed to retain only high quality sequence. The pre-processed reads were aligned to the reference *Vitis vinifera* genome. The aligned reads were used for estimating expression of the genes and transcripts and differential expression analysis. A large number of up and down regulated genes were obtained which varied among and between treatments and at different time points. The detailed analysis of differentially expressed genes for their functional categorisation is in progress.

Analysis of metabolites such as glucose, fructose, sucrose, GA_3, ABA, tartaric acid, malic acid etc. showed significant variation between treated and control samples.

Production Technology

Evaluation of rootstocks for growth, yield, fruit composition and wine quality of Cabernet Sauvignon grapes grown in Pune region of India

Five year old Cabernet Sauvignon vines grafted on seven different rootstocks (110 R, 1103 P, 140 Ru, Gravesac, Fercal, SO4 and 101-14 Mgt) were evaluated for growth, yield and fruit composition and must parameters.

After foundation pruning, significant variation was recorded for most of the vegetative parameters in vines grafted on different rootstocks. Maximum pruning weight was recorded on 110 R and 140 Ru rootstock while it was least on Fercal rootstock. Highest cane dry matter content was recorded on 1103 P rootstock and least was on Fercal rootstock. Rootstocks significantly influenced the petiole nutrient content at fruit bud differentiation stage for most of the major and micro nutrients. Maximum nitrogen and phosphorus content of 0.894% and 0.34% respectively was recorded on 110 R, while potassium content was highest on Gravesac (1.68%) and least, on 1103 P (0.54%).

After forward pruning, sprouting percent on 10^{th} day after pruning was highest on 110 R (35%), while least was on 101-14 Mgt (23.4%). The activity of enzyme peroxidase responsible for release of dormancy or increasing bud break was highest on SO4 and 140 Ru followed by those on 110 R and 1103 P. Least activity was on 101-14 Mgt. Highest number of flower clusters emerged was on 140 Ru and 110 R (81) rootstocks, while it was least on 101-1 Mgt (39). At full bloom stage, significant influence of rootstocks was recorded on petiole nutrient content of Cabernet Sauvignon vines. Maximum and minimum nitrogen content was recorded on 101-14 Mgt (0.93%), and 110 R (0.59%) respectively, highest P content was recorded on 1103 P (0.55%) followed by 110 R (0.49%). Highest K content was recorded in vines grafted on 1103 P.

Significant variation was recorded for yield and its parameters and must composition among rootstocks. The maximum number of clusters was recorded in vines grafted on 110 R

(62) while it was least on Gravesac (40). Average cluster weight was highest on 110 R (105g) while it was least on Gravesac (72g). Maximum yield per acre was recorded in vines grafted on 110 R (9.37 MT) followed by Fercal (7.06 MT), while lowest yield was recorded on 101-14 Mgt (3.32 MT). Similarly, significant variation was recorded for must parameters such as TSS, acidity and must pH. Highest TSS was recorded on Gravesac (26 °B), while it was least on 140 Ru (21.2 °B); highest acidity was on 140 Ru and Fercal (7.78 g/l) while it was least on 1103 P (5.6 g/l). Lowest must pH was recorded on Fercal (3.4), while it was highest on 1103 P (3.95).

Effect of rootstocks on physical and chemical changes in Cabernet Sauvignon grapes during berry development stages

After fruit set, at every 15 days interval representative samples were collected till harvest (1st: fruit set, 2nd: 3-4 mm, 3rd: 8-10 mm, 4th: pre-veraison, 5th: veraison, 6th: post veraison, 7th: harvest) to study the effect of rootstocks on berry weight, sugars, acids, phenols and protein content. Significant influence of rootstocks on the parameters studied was observed (Fig. 7). At harvest, maximum berry weight was on 110 R rootstock. The berry growth pattern followed typical double sigmoid curve. The increase in TSS content was highest after veraison and Gravesac recorded highest TSS which also recorded least acids. Though phenols and protein concentration showed decreased trend from fruit set to harvest, there was sudden increase in protein content after veraison on all the rootstocks. Rapid reduction in malic acid concentration was observed till harvest season, while tartaric acid concentration maintained steady phase after veraison till harvest.

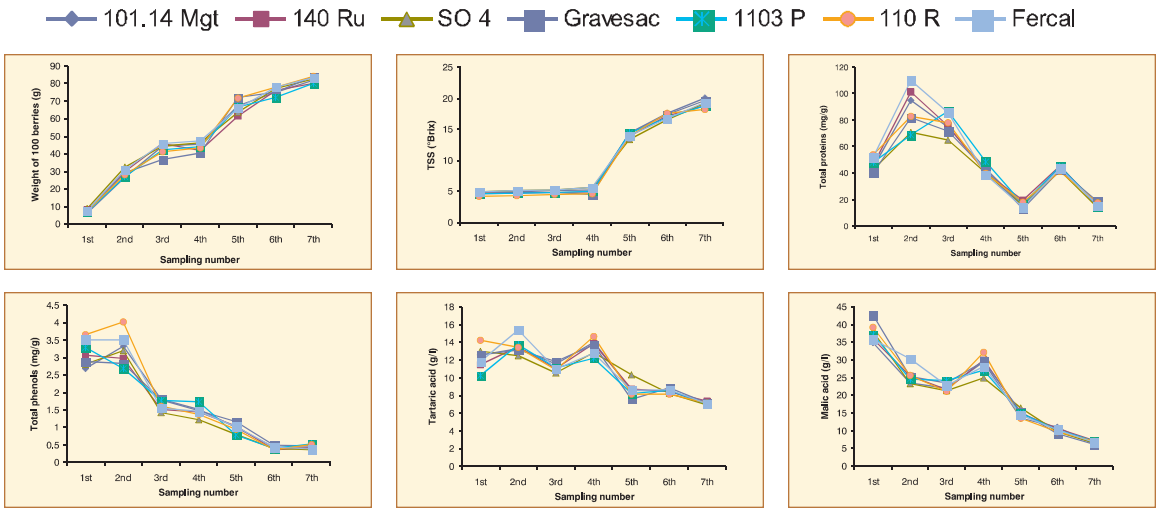


Fig. 7. Effect of rootstocks on berry parameters in Cabernet Sauvignon

Proteomic analysis of Thompson Seedless grapes grafted on different rootstocks at different phenological stages of growth and development

Fruit bud differentiation stage: At fruit bud differentiation stage, leaf samples were collected to analyze various biochemical constituents and hormones to study the influence of rootstocks on fruit bud differentiation in Thompson Seedless. Among plant hormones analyzed, maximum concentration of salicylic acid and IAA were recorded on own rooted and 110 R rootstock respectively. Maximum GA_3 and ABA concentration was recorded in the vines grafted on Dogridge rootstock. Highest uracil concentration was recorded in own rooted vines. Glucose concentration was highest on 110 R grafted vines, while fructose concentration was highest on own rooted vines.

Maximum concentration of phosphorus was recorded on own rooted vines, while it was least on Dogridge. Highest concentration of protein was recorded on own rooted vines followed by those on Dogridge. Percent fruitful canes were maximum on own rooted and vines grafted on 110 R (32%) while it was least on Dogridge (19%). These results suggested that the high concentration of proteins, phenols and sugars in addition to higher concentration of Uracil, Salicylic acid (responsible for fruitfulness) improves fruit bud differentiation, which is evident from increased fruitful canes on own rooted vines and vines grafted on 110 R. Highest concentration of GA_3, ABA and reduced Uracil in leaves of vines grafted on Dogridge rootstock during fruit bud differentiation might have reduced its fruitfulness.

Berry development stages: Protein analysis of samples collected at different stages of berry development in Thompson Seedless grafted on different rootstocks along with own rooted vines, revealed significant differences in protein concentration and subsequently number of protein spots on 2D gels. Maximum concentration of proteins was recorded in Dogridge at 3-4 mm (6.078 mg/g) and 8-10 mm stage (1.3 mg/g) followed by those on own rooted vines. However during veraison and harvest stage the protein concentration was highest on 110 R grafted vines with the concentration of 6.12 mg/g and 6.18 mg/g respectively. In proportion to the protein concentration, number of protein spots also varied among rootstocks. At 3-4 and 8-10 mm stage, maximum protein sports was recorded on Dogridge (1624 and 487 respectively) rootstock followed by own rooted vines (817 and 394 respectively). But, during veraison and harvest stage, maximum spots were detected in vines grafted on 110 R rootstock (893 and 409 respectively). The proteins spots on 2D gel in grape berries of Thompson Seedless grafted on Dogridge rootstocks are shown in figure 8. The same protein samples after in-sol trypsin digestion have been sent to M/s AbSciex Laboratory, Gurgaon for protein characterization.

The same berry samples were used for detection of several metabolites such as organic acids, sugars, phenolic compounds etc on HPLC. Rootstocks significantly influenced the variation in concentration of metabolites analyzed at different stages of berry development. The proteins responsible for synthesizing metabolites will be identified after analysis of whole proteome on MS-MS.

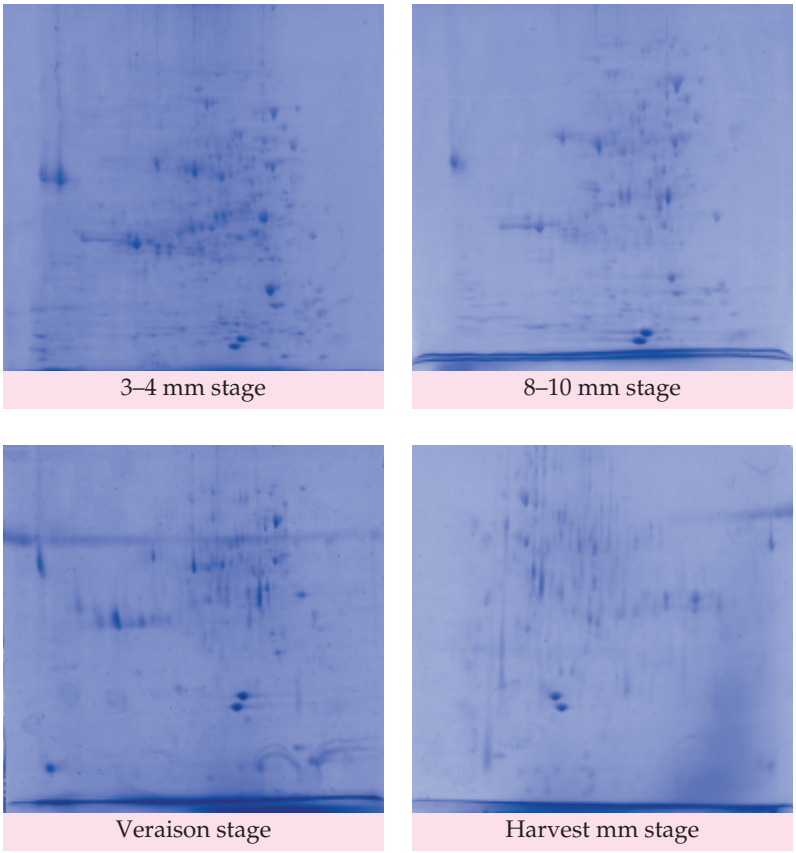


Fig. 8. Protein spots of Thompson Seedless grapes grafted on Dogridge rootstock during different stages of berry development

Standardization of cultural practices to increase quality wine

Effect of different pruning dates on bunch yield and fruit composition of Syrah wine grapes

The experiment was conducted at farmer's field in Nashik. The vines were fruit pruned on three different dates (20.09.2013, 29.09.2013 and 10.10.2013). All the recommended cultural practices were followed for maintaining health of vines. The grapes were harvested when they attained sugar level which is desirable for wine making. Significant differences were recorded for bunch and berry characters. The average bunch weight was the highest (125.0 g) in the late pruned vines (10.10.2013) and the lowest (99.05 g) in early pruned vines (20.09.2013). The same trend was also recorded for the 100-berry weight. The juice recovery was more in late pruned vines than in the early pruned vines. However, the TSS was more (22.70 °B) in the vines pruned on 29.09.2013 as compared to the late pruned vines (10.10.2013).

Effect of training system on bunch yield and fruit composition of Cabernet Sauvignon

The experiment was conducted on five-year old Cabernet Sauvignon vines grafted on Dogridge rootstock. The vines were trained to mini Y system and vertically shoot positioned (VSP) system. All the recommended cultural practices were followed during the season to maintain health of vines. The grapes were harvested after 160 days of fruit pruning. The grapes harvested from both the training system showed significant differences for growth, yield and yield parameters. The shoot vigour was reduced in VSP trained vines (75 cm) as compared to the mini Y-trained vines (85 cm). The shoot diameter was 7.50 mm in Y-trained vines as compared to 6.65 mm in VSP trained vine. The performance of Cabernet Sauvignon on VSP was found to be better in terms of average bunch weight (103.40 g) and 100-berry weight (116.70 g) than that of Y-trained vines (98.24 g and 81.70 g respectively). However, the juice recovery was more in Y-trained vine.

Performance of wine grape varieties for growth, yield and wine quality under Pune condition

Five year old wine varieties (10 red and 9 white) were evaluated for vegetative, yield, fruit composition and wine quality.

White wine varieties

Vegetative parameters: Significant differences were recorded for vegetative parameters among all the white wine varieties studied. The variety Vermentino was late to sprout (11.30 days) as compared to Gewurztraminer (6.70 days). The shoot vigour among the different varieties varied from 19.49 cm (Muscat White) to 48.30 cm (Vermentino). Shoot diameter also varied significantly among the different white grape varieties. The lowest leaf area (96.25 cm^2) was recorded in Gewurztraminer while the maximum in Vermentino (178.50 cm^2). The data recorded on growth parameters showed no consistency among the varieties.

Yield and fruit composition parameters: Less number of bunches were recorded in Gros Meseng (1.5) while Colombard recorded highest number of bunches per vine (79.4). As the number of bunches per vine increased, the yield per vine was also increased. The highest yield per vine was recorded in Vermentino (4.68 kg) as compared to lowest in Gros Meseng (0.20 kg). Average bunch weight ranged from 27.7 g in Gros Meseng to 110.80 g in Vermentino. The juice recovery ranged from 47.80% to 73.20%. The varieties were harvested at their recommended sugar levels for wine production. The highest TSS was recorded in Muscat White (23.8 °B).

Degree days required for fruit maturity and ripening: Based on the recommended sugar levels, grapes were harvested at different days. The duration in degree days required to achieve the TSS in each variety was calculated. The degree days varied significantly among the different varieties with minimum degree days of 1557 in Sauvignon Blanc, Riesling and Gewurztraminer as compared to the maximum of 1849 in Colombard, Muscat White, and Chenin White respectively (Fig. 9a).

Red wine varieties

Vegetative parameters: Significant differences were recorded for days taken for bud sprouts among the different varieties. The duration ranged from 7.56 days in Tempranillo to 9.58 days in Caladoc. The variation in shoot vigour was observed among the different varieties with higher leaf area in Niellucio while lowest in Cabernet Sauvignon.

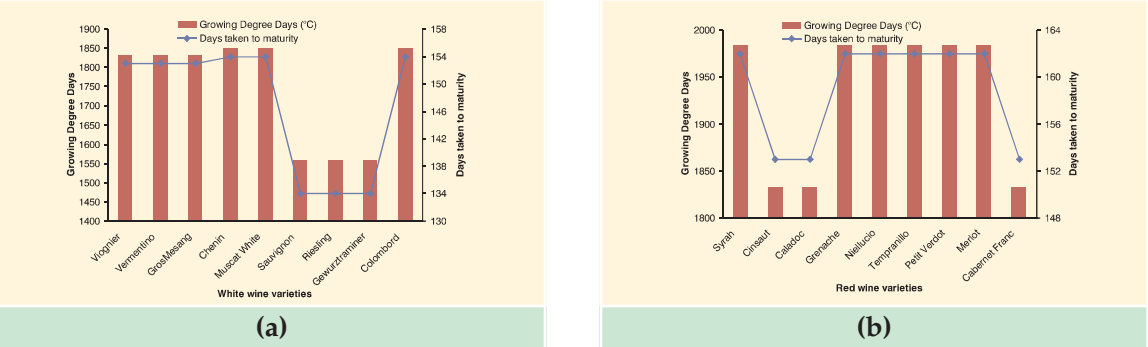


Fig. 9. Growing degree days requirement of (a) white and (b) red wine varieties

Yield and fruit composition parameters: Highest number of bunches per vine were recorded in Syrah (44.5) and the lowest was in Merlot (11.80). The increase in bunches per vine resulted in increase in yield per vine in these varieties. Highest yield of 3.93 kg was recorded in Tempranillo and the lowest in Merlot (0.55 kg). Average bunch weight was maximum (136.80 g) in Cinsaut and the lowest in Cabernet Sauvignon (43.40 g). The juice recovery also varied significantly among the different varieties.

Degree days required for fruit maturity and ripening: The degree day requirement differed significantly among the different red wine varieties. The degree day required to achieve the appropriate TSS in each variety ranged from 1833 to 1984 (Fig 9b).

Standardising irrigation schedule for Fantasy Seedless vines raised on 110 R rootstock

The experiment on standardizing irrigation schedule for Fantasy Seedless vines raised on 110 R rootstock was initiated in 2013-14. Five treatments (irrigation schedule based on crop growth stage and recorded open pan evaporation) as shown in table 3 were imposed on vines raised under uniform management conditions. Treatments T1, T2 and T3 were applied through surface drip irrigation technique, treatment T4 was applied through subsurface irrigation technique (SS) using PVC pipes and microtubes to directly deliver water at 9" depth. Treatment T5 comprised of Partial root zone drying (PRD) technique which involved alternate wetting and drying of one half of the root zone whereas the other is left dry at any given time. Total pan evaporation and rainfall recorded during the period was 1403 mm and 509.1 mm respectively. The vines were not irrigated for 158 days during the experiment period due to frequent rains.

Table 3. Irrigation schedule treatments of Fantasy Seedless vines raised on 110 R rootstock

Growth Stage	Expected duration (days after pruning)	Treatments *				
		T1	T2	T3	T4 (With subsurface irrigation)	T5 PRD
Foundation Pruning / Back Pruning						
Shoot growth	1 - 40	40	30	20	20	20
Fruit bud differentiation	41 - 60	15	15	15	15	15
Cane maturity and Fruit bud development*	61 - 120	15	15	15	15	15
121 days - fruit pruning *	121 -	15	15	0	0	0
Fruit Pruning / Forward Pruning						
Shoot growth	1 - 40	40	30	20	20	20
Bloom to Shatter	41 - 55	15	15	15	15	15
Berry growth and development	56 - 105	40	30	30	20	30
Ripening to Harvest	106 - harvest	40	30	20	0	20
Rest period	Harvest to Foundation pruning	–	–	–	–	–

*= % replenishment based on open pan evaporimeter

Treatment with 227 mm of applied irrigation (T2) along with rainfall (509 mm) produced yield (23.41 MT/ha) which was on par with the highest treatment (296.9 mm) with WUE of 103 kg/mm of irrigation water (Table 4). The treatment T2 was significantly superior over treatments with lower irrigation water application except T4 (SS) but had significantly higher TSS over T4 treatment. Between treatments T4 (SS) and T5 (PRD), no significant difference in yield was observed. Treatment T4 (SS) utilized least irrigation water of 131.4 mm with highest WUE of 162.47 kg/mm of irrigation water followed by T5 (PRD) thereby, signifying the importance of this technique under low availability of irrigation water. Treatment T3 produced lowest yield with lowest TSS and showed non uniform ripening of berries on the bunch. The total irrigation water utilized was 166.7 mm which was comparable to T5 (PRD) and higher than T4 (SS).

The photosynthetic rate did not differ significantly among treatments up to 90 days after pruning due to frequent spells of rains and the treatments could not be imposed properly. Similar trends were observed in case of transpiration. Leaf water potential also did not differ among the treatments up to 90 days (-9 to -10.8 bars). However, at harvest, vines under T4 (SS) treatment had lowest leaf water potential of -12.16 bars implying that the vines were slightly stressed as compared to other treatments as they had not been irrigated after ripening

stage. The leaf water potential at harvest was highest in T1 treatment and followed trend similar to the quantity of irrigation water applied (Table 3). The petiole nutrient content of the vines at both stages viz. the fruit bud differentiation and full bloom did not differ significantly among the treatments as the vines were maintained under uniform management conditions.

Table 4. Effect of irrigation treatments on yield and yield parameters of Fantasy Seedless vines

Treatments	Yield (t/ha)	Bunch weight (g)	Bunch no.	TSS (°B)	Acidity (%)	Irrigation applied (mm)	WUE (kg /mm of irrigation applied)
T1	24.02	256.78	52.15	17.10	0.56	296.9	80.89
T2	23.41	243.56	53.65	17.25	0.57	227.1	103.07
T3	18.90	202.74	52.00	15.85	0.56	166.7	113.42
T4	21.34	233.73	51.03	16.05	0.54	131.4	162.47
T5	20.47	222.92	51.15	16.68	0.55	179.6	113.98
SEm±	1.03	9.62	1.52	0.31	0.02		
CD (p=0.05)	2.24	20.96	NS	0.67	NS		

Direct and residual effects of applied potassium in Cabernet Sauvignon vines

The experiment was initiated in 2012 to study the direct and residual effects of potassium in Cabernet Sauvignon raised on 110R rootstock vines which were fertilised for three successive years with graded doses of potassium during 2009-2012. The modified treatment details are given in table 5. Application of manure (FYM) and/or potassium fertilizer over the years resulted in increase in soil available potassium (ammonium acetate extractable potassium) in the root zone which was above its established critical limit (375 ppm). Further, petiole K content under different treatments at bud differentiation (0.98 to 1.18%) and full bloom stage (2.60 to 3.06%) was above the critical levels of potassium. Hence, no significant response was observed to applied potassium in terms of yield over control treatments. Sodium content in petioles was within safe limits at all the stages of sampling. Other nutrient content in the petiole at both the stages of sampling were in sufficient range.

To compare different sources of organic matter in grapevines including pruned biomass

Use of farm yard manure (FYM) is most common in vineyards but during the recent years its cost has increased due to short availability in the grape growing regions. An experiment was initiated during the 2013 foundation pruning with an objective to replace FYM either partly or fully by cheaper sources of organic matter such as press mud compost, green manure and pruned biomass. The different treatment combinations are given in table 6. There was no

Table 5. Effect of direct and residual potassium application in Cabernet Sauvignon vines on yield, soil available K and petiole nutrient content

Treatments	Yield (t/ha)	TSS (°B)	Acidity (%)	Soil Available K (ppm) – Year 2013	K content (%) in petiole at Full bloom stage	K content (%) in petiole at Bud differentiation stage
T1 (0 K_2O/ha)	13.51	22.90	0.61	548.33	2.60	0.98
T2 (50 kg K_2O/ha)	13.34	22.80	0.64	625.00	2.65	1.01
T3 (100 kg K_2O/ha)	13.50	22.70	0.65	911.33	2.67	1.04
T4 (200 kg K_2O/ha)	13.46	22.90	0.63	1436.67	2.92	1.09
T5 (100 kg K_2O/ha)	13.32	22.80	0.63	1630.33	2.87	1.18
T6 (200 kg K_2O/ha)	13.06	22.80	0.65	1981.67	3.06	1.13
T7 (0 kg K_2O/ha)	13.51	22.90	0.64	2373.33	2.91	1.17
T8 (0 kg K_2O/ha)	13.10	22.70	0.62	2848.67	2.92	1.14
SEm±	0.29	0.016	0.03	51	0.064	0.048
CD (p=0.05)	NS	0.034	NS	110	0.14	0.102

significant difference among different treatments in terms of yield and yield related parameters though highest yield was recorded in treatment T3 (press mud compost). Treatments involving above sources of organic matter increased the nitrogen and potassium concentration significantly at full bloom stage (Table 7). Initial results indicated that press mud compost can be used as a cheaper source of organic matter as well as nutrients. The experiment is being continued.

Table 6. Treatment details

Treatment	Description
T1	Control (no organic matter)
T2	T1 + FYM@ 15 ton/ha on dry weight basis
T3	T1 + Press mud compost @ 15 ton/ha on dry weight basis
T4	T1+ FYM (@ 7.5 ton/ha) + Press mud (@ 7.5 ton/ha)
T5	T1+ Pruned biomass @ 4 ton/ha + GM @ 2.5 ton/ha + press mud compost @ 8.5 ton/ha on dry weight basis

Table 7. Effect of treatments on petiole nutrient content at Full bloom stage

Treatments	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Na (%)
T1	1.07	0.45	2.15	1.38	0.59	0.37
T2	1.20	0.44	2.28	1.39	0.59	0.36
T3	1.24	0.44	2.43	1.40	0.61	0.34
T4	1.24	0.45	2.37	1.39	0.63	0.38
T5	1.26	0.45	2.32	1.39	0.63	0.38
SEm+	0.05	0.01	0.046	0.039	0.025	0.022
CD (p=0.05)	0.10	NS	0.099	NS	NS	NS

Nutrient imbalance in Sharad Seedless

Samples from healthy and affected with nutrient imbalance were collected from Sharad Seedless vines raised on Dogridge rootstock during 2012-13 fruiting season to confirm earlier year's findings. Nutrient composition revealed toxic accumulation of sodium in both leaf blades and petioles leading to deficiency of potassium and reduced concentration of other nutrients like N, P, Ca and Mg and increased concentration of chloride in affected vines under saline irrigation on Dogridge rootstock (Fig. 10 and Table 8). The results confirmed our earlier findings that Dogridge could not restrict sodium accumulation when irrigated with water containing high sodium. The symptoms were more severe in vines having sparse canopy.

Fig. 10. Sodium toxicity in Sharad Seedless

Table 8. Petiole and leaf blade nutrient content in Sharad Seedless vines

	K (%)	Na (%)	Ca (%)	Mg (%)	N (%)	P (%)	Cl (%)
Petiole							
Upper healthy	1.29	1.22	1.52	0.85	0.64	0.27	0.52
Upper affected	0.25	2.11	1.47	0.89	0.54	0.17	0.82
Lower healthy	3.15	1.16	1.57	1.08	0.69	0.43	0.69
Lower affected	0.84	2.54	1.41	1.10	0.56	0.27	1.29
Leaf blade							
Upper healthy	0.86	0.22	2.19	0.61	1.96	0.27	0.23
Upper affected	0.40	1.65	1.77	0.41	1.66	0.22	0.60
Lower healthy	0.96	0.41	2.60	0.73	2.03	0.33	0.41
Lower affected	0.45	1.60	2.44	0.71	1.80	0.24	0.93

Nutrient imbalance in Jumbo Seedless from Nasik

Samples from healthy and affected vines were collected during 2013-14 fruiting season expressing overlapping chlorosis and its effect on fruitfulness (Fig. 11). There was significantly less K, P and Mg in petioles of symptomatic vines compared to healthy vines. Symptomatic vines had less fruitfulness (4 bunches/vine) compared to healthy vines (22 bunches/vine) (Fig. 12). The symptoms were corrected/halted after the application of potassium fertilizers. Growers were advised to apply potassium in fruit pruning season.

Fig. 11. Affected Jumbo Seedless vines

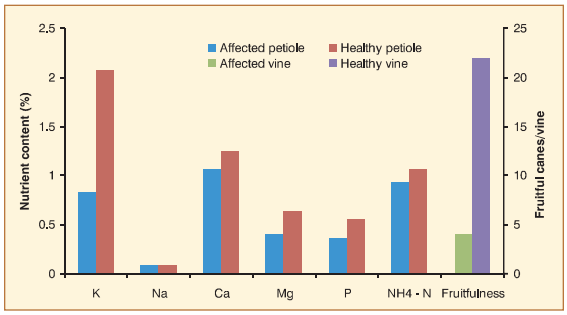


Fig. 12. Fruitfulness and petiole nutrient content of healthy and affected Jumbo Seedless vines

Critical limits of petiole nitrogen and phosphorus concentration in Cabernet Sauvignon vines

Critical limits of petiole nitrogen and phosphorus content at bud differentiation stage and full bloom (flowering) stage in Cabernet Sauvignon vines was determined based on yield and petiole N and P content respectively. Data was collected from different experimental vineyards/plots during last four years and analysed using scatter diagram technique of Cate and Nelson. Scatter diagrams of percent yield against petiole N content at fruit bud differentiation stage and full bloom stage used for determining critical levels of nutrients are shown in figure 13. Critical level for N at fruit bud differentiation stage and full bloom stage was estimated to be 0.65% and 0.75% respectively

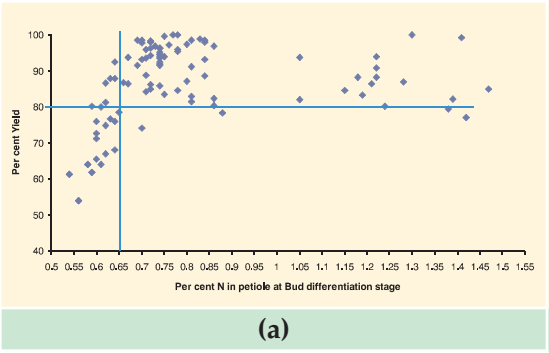


Fig. 13. Critical petiole N concentration in Cabernet Sauvignon grafted on 110R rootstock at (a) Bud differentiation stage and (b) full bloom stage

Scatter diagrams of percent yield against petiole P content at fruit bud differentiation stage and full bloom stage used for determining critical levels of phosphorus are shown in figure 14. Critical level of P at bud differentiation stage was found to be 0.30% whereas at full bloom stage it was 0.35%

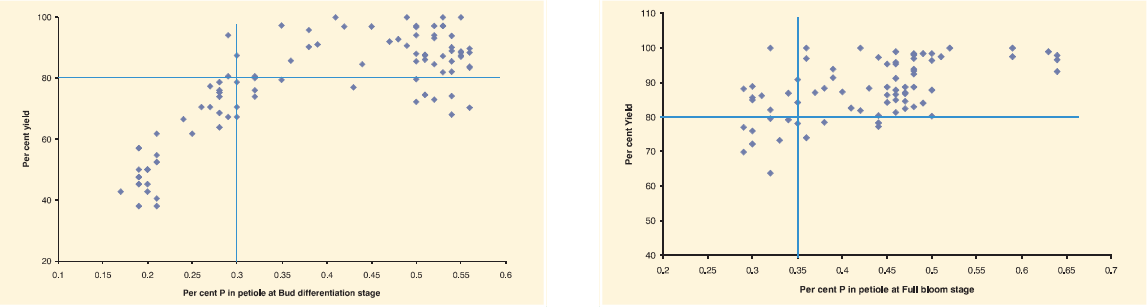


Fig. 14. Critical petiole P concentration in Cabernet Sauvignon grafted on 110R rootstock at (a) fruit bud differentiation stage and (b) full bloom stage

Physiological disorders and their management in grapes

Induction of rachis swelling disorder in different varieties of grapes

This experiment was conducted (Fig. 15) based on the previous results that Naphthalene Acetic Acid (NAA) induces rachis swelling in Thompson Seedless grapes. In present study also the application of NAA at 10 ppm to 50 ppm induced the rachis swelling disorder in Sharad Seedless. Bunches treated with higher concentration of NAA (more than 80 ppm) showed burning symptoms. The treatments such as application of sodium molybdate @ 2 g/l when the knot was visible and puncturing of knots were imposed on the affected bunches to reduce the incidence. Both the treatments did not show reduction in the incidence of rachis swelling.

Fig. 15. Knot swelling disorder

Incidence of Ukdya (burning of bunches), a new disorder in grapes

Many of the growers reported incidence of symptom/disorder witnessed in their vineyards, where in the berries on the clusters start burning (Fig. 16) and collapse gradually, causing considerable economic loss. In response to this, surveys were conducted in different gardens where the incidence occurred particularly in Nasik region.

Preliminary observations in the affected gardens were as follows:

- The symptoms appear at about 70-90 days after forward pruning, a stage just prior to veraison.
- The incidence was noticed in the vineyards where the pre veraison stage coincides with severely low night temperature (0 – 5°C)
- Relatively higher humidity (80%) coupled with higher temperature (30°C) during morning to early noon was identified as one of the possible predisposing factor

However, no conclusion could be derived about the reasons for occurrence of the disorder. Weather data from all the locations of incidence have been collected which will be analysed to understand the predisposing factors responsible for occurrence of the disorder.

Fig. 16. Ukadya, a berry burning symptom on Thompson Seedless grapes

Bioefficacy of new molecules

During the year following commercial formulations were tested for their bioefficacy to influence the growth, yield and fruit quality.

Sl. No.	Product name	Active ingredient	Dose and method of application	Observed effects
1.	Plantozyme	Biological derivative from sea algae and herbs	Spray @ 2.5 ml/l and soil application for granules @ 25 g/vine	Increased berry length and diameter, average bunch weight, TSS and yield of Thompson Seedless grapes
2.	Aura XL	Algal extract protein hydrolysate and chelated micro-nutrients	Spray @ 2.0 – 3.0 g/l	Increased leaf chlorophyll, yield quality of Thompson Seedless grapes
3.	Cabrio Top 60 WG	Metiram 55% and 5% pyraclostrobin	1000-3000 g/ha as a spray	Increased leaf size and leaf thickness, yield and quality of Thompson Seedless grapes
4.	Cynoboost	Tetraethyl rhodamine, natural β hydroxytri carballyic acid mixed with surfactants	0.5 ml/l as a swabbing and pruning	Uniform sprouting in Thompson Seedless grapes
5.	Elanta Super	Derivative of L-cysteine, folic acid with adjuvants	0.5 to 2.0 ml/l as a spray	Increased berry length, diameter, average bunch weight, TSS and yield/vine in Sonaka grapes

Sl. No.	Product name	Active ingredient	Dose and method of application	Observed effects
6.	Ethrel 39 SL	Ethrel 39% SL	1500 – 3500 ml/ha as a spray	5 to 10% leaf fall was recorded within 10 days. It was resulted in uniform sprouting in Thompson Seedless grapes
7.	ProGibb	GA_3 40%	10 to 50 ppm as a spray	Increased berry length, diameter, berry weight, TSS, acidity in Thompson Seedless grapes
8.	Pinknil	Mixture of abscisic acid (0.5% W/V), cytokinins 0.025% W/V, additives and diluents	2 ml/l as a spray	Reduced incidence of pink berry in Thompson Seedless grapes

Plant Health Management

Bio-prospecting for viticulturally important microorganisms

Control of anthracnose on field grown vines by *Trichoderma*

Seven promising isolates of *Trichoderma* were evaluated on field grown vines for their ability to control anthracnose disease of grapes on Thompson Seedless. All the isolates suppressed the disease as compared to untreated control. Isolates 32 and 17 provided more than 50% reduction in disease. The 'area under disease progress curve' (AUDPC) in these two isolates was 1031.9 and 1120.6 respectively as compared to 2858.9 in control and 681.8 in carbendazim treatment. These promising isolates will be tested in large scale field trials, either alone or in combination with safe fungicide(s).

Control of powdery mildew on field grown vines by *Trichoderma*

The seven promising isolates of *Trichoderma* were evaluated on field grown vines for their ability to control grape powdery mildew caused by *Erysiphe necator* on Thompson Seedless. All the isolates suppressed the disease as compared to untreated control. Isolates 1 and 3 provided more than 50% reduction in disease. The AUDPC in vines treated with these two isolates was 985.4 and 1057.0 respectively as compared to 2366.2 in control and 742.4 in sulphur and 647.4 in flusilazole treatments.

Control of anthracnose on field grown vines by *Bacillus*

The trial was conducted over a 2 month period during monsoon. Seven spray applications were made and the disease ratings were taken before each spray. The AUDPC in all *Bacillus* treatments was significantly lower than untreated control. Carbendazim recorded the least

AUDPC, followed by *Bacillus* isolates TS-204, TL-171, TS-205, DR-38, DR-39, CS-126, DR-219 and DRo-198. Earlier isolates TS-204 and TL-171 had given complete control of anthracnose on potted plants and consistently higher control on field grown vines. These two isolates appear to be promising for control of anthracnose.

Control of powdery mildew on field grown vines by *Bacillus*

The trial was conducted as given above during monsoon. The first application was made when the initial disease symptoms were observed. The AUDPC in all *Bacillus* treatments was significantly lower than control. However, the values were higher than those observed in treatments with the systemic fungicide flusilazole and the non-systemic fungicide sulphur. *Bacillus* isolates DR-38 and DR-39 recorded only 984.3 and 1054.8 AUDPC respectively as compared to 2366.2 AUDPC in uninoculated control showing very good control of disease. The isolates CS-126, DRo-219 and TL-171 were also effective recording 1240.8 to 1512.6 AUDPC.

Induction of systemic resistance against diseases by *Bacillus*

Two hundred and ninety three bacteria were screened for plant growth promotion. Twenty-two most promising growth promoting isolates, identified as *Bacillus* spp., reduced severity of downy mildew, powdery mildew and anthracnose diseases on Thompson Seedless potted plants. Isolates TS-45 and DR-92 gave maximum reduction in severity of anthracnose (88-92%) and powdery mildew (39-41%). Biochemical analysis showed that peroxidase, polyphenol oxidase, total phenols and total protein contents were highest in plants treated with these two isolates. Isolates TP-232, TL-171, TS-45 and DR-92 gave maximum reduction in severity of downy mildew disease (57-65%).

Induction of systemic resistance against diseases by *Trichoderma*

Thirty four *Trichoderma* isolates were evaluated for induction of systemic resistance against anthracnose, powdery mildew and downy mildew in grapes. The observations indicated least per cent disease index (PDI) of anthracnose in plants treated with isolate 24 (PDI 0.8) as compared to 81.2 in control. This was followed by isolates 34, 21, 28, 18, 33, 6, 2, 1, 22, 3, 4, all of which were at par with the best treatment of isolate 24. Powdery mildew severity was least in *Trichoderma* isolate 34 (PDI 35.80) which was statistically at par with PDIs in plants treated with isolates 28, 6, 24, 33, 23 and 14. Untreated control recorded 76.8 PDI. Plants treated with *Trichoderma* isolates 24 and 34 recorded increased levels of peroxidase, polyphenol oxidase, total phenols and total proteins. Downy mildew PDI in control was 63.20 and treatments with *Trichoderma* isolates 10, 33, 34, 23 significantly reduced it to 23.20 -29.20 PDI.

Control of powdery mildew on bunches by *Trichoderma* and *Bacillus*

Trichoderma isolates 1, 3, 17 and 34; and *Bacillus* isolates 39 and 171 alone and in combination (39+171) were tested in field for control of powdery mildew on bunches of Manjri Naveen. All treatments reduced powdery mildew. The *Trichoderma* isolates were more effective

than the *Bacillus* isolates. Least PDI was recorded in *Trichoderma* isolate 3 (PDI= 25.2), followed by isolates 1, 34 and 17 which were on par (32 to 36 PDI) but significantly less than isolate 3. Control recorded a PDI of 50.7.

In vitro growth of *Bacillus* at different temperatures and pH

Eight *Bacillus* isolates, promising for biological control of grape diseases, were evaluated for their growth at wide range of temperature (15 to 60°C) and pH (4 to 10). All eight bacteria showed good growth from 25 to 45°C temperature range, and slight growth at 15 and 60°C, too. The maximum growth of isolates DR-39, CS-126, TL-171, DRo-198, DRo-219 occurred at 30°C; of isolate TS-205 at 35°C; and of isolates DR-38, and TS-204 at 40°C. All isolates could grow well from pH 5 to pH 8 and CS-126 and TRo-129 could grow well in highly alkaline medium of pH 9 and 10.

Studies on biodegradation of triazole and MBC fungicides by *Bacillus* isolates

The biodegradation of myclobutanil, tetraconazole and carbendazim fungicides by four *Bacillus subtilis* strains, namely, DR-39, CS-126, TL-171, and TS-204 was studied in liquid culture and on grape berries. Each of the four *B. subtilis* strains enhanced the degradation of all the three fungicides in both matrices (Fig. 17). In Thompson Seedless grapes sprayed with myclobutanil and tetraconazole at a field doses, isolates DR-39 and TS-204 minimized the half-lives of myclobutanil from 11.5 days to 6.4 and 6.9; and of tetraconazole from 11.2 days to 4.8 and 5.1 days respectively. Similarly the half-life of carbendazim was reduced from 8.1 days in control to 3.1 and 3.5 days in treatment by isolates TL-171 and TS-204 respectively.

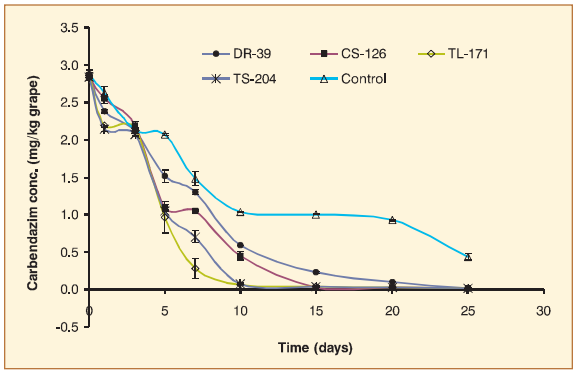


Fig. 17. Degradation of carbendazim on grape berries treated with 4 *Bacillus* isolates

Diagnosis and Management of Leaf Spot Disease of grapes

Diversity analysis

The culture collection was enriched by adding six isolates from UP. Based on morphological, cultural and molecular analysis they were identified as *Colletotrichum gloeosporioides*. These samples were collected during monsoon season and symptoms resembled typical anthracnose lesions (Fig. 18a). All these isolates showed high resistance to carbendazim. Leaf spot isolates were also added from samples collected from UP during winter season. These symptoms were restricted, discrete lesions (Fig. 18b) and the fungi isolated were identified as *Alternaria* sp. (51%) and *Cladosporium* sp. (41%). Additional isolates were collected from Solapur region from a vineyard which had shown presence of carbendazim resistant isolates. However,

these five isolates turned out to be sensitive. All these isolates were added to the culture collection.

(a)

(b)

Fig. 18. *Colletotrichum gloeosporioides* (a) and *Alternaria* and *Cladosporium* (b) lesions on grape leaf from UP

Epidemiology

Weather data viz. maximum temperature (Tmax), minimum temperature (Tmin), relative humidity maximum (RH max), relative humidity minimum (RH min), rainfall and leaf-wetness at regular intervals was recorded from the weather station at the research farm of the Centre. Disease severity was recorded at seven days interval on a 0 to 5 rating scale, and converted to PDI from which the AUDPC was calculated. Multiple linear regression analysis gave positive regression co-efficient (R) for Tmax and leaf wetness and negative for Tmin. The multiple correlation R value was high (0.912) indicating a strong association between AUPDC and Tmax, Tmin, leaf wetness. The co-efficient of determination value (R^2) was found to be high i.e. 0.831. This clearly indicates that at least 83.1 per cent of variation in AUPDC can be explained by the function of weather parameters as evident from multiple linear regression equation. Further, stepwise linear regression analysis identified leaf wetness, rainfall and RH Max as the two best predictor variable of anthracnose disease at a p value <0.05.

Model for prediction of anthracnose disease

A logical model was developed to predict the severity of anthracnose infections in grape. The model is developed in MS Excel and is based on "what-if" analysis of weather parameters of temperature, humidity and rainfall; plant growth stages susceptible for disease; and the level of inoculum in the vineyard. The model was evaluated on two years recorded weather and disease data and was found reasonably accurate in predicting disease.

Fungicide sensitivity of carbendazim resistant isolates

Twenty-two *Colletotrichum gloeosporioides* isolates which were resistant to carbendazim

(EC50=62.34 µg/ml) were found to be sensitive to a QoI (azoxystrobin) (EC50=6.79 µg/ml) and a DMI (flusilazole) (EC50=0.81 µg/ml) fungicide.

Development of a carbendazim resistant marker

Earlier twelve random primers were used to amplify DNA from 25 sensitive and 4 resistant isolates. All the primers detected polymorphism among these 29 isolates. Out of 89 bands generated by 12 primers, 71 were polymorphic. Primer OPA13 amplified a fragment of 320 bp which was uniquely present in resistant isolates.

This year, this unique fragment was sequenced and sequence information was used to develop a SCAR marker. SCAR marker was validated using 22 resistant and 32 sensitive isolates from different grape growing regions of Maharashtra, Karnataka and Uttar Pradesh. The SCAR marker also gave specific product when amplified with DNA extracted from infected leaf samples. Primers have been designed to sequence the beta-tubulin gene for further molecular analysis.

Biological control of anthracnose

Twenty-eight antagonistic bacterial isolates which had shown antagonism against one isolate of *C. gloeosporioides*, in an earlier study were tested for antagonism to one isolate from each of the 16 morphological groups of *Colletotrichum* spp. isolated from grapevines. Twenty three isolates inhibited the radial growth of all 16 isolates. Nine bacterial isolates showing high antagonistic activity were used in field trials against anthracnose and powdery mildew diseases of grapes. Very low disease severity was observed due to unfavourable weather; however, all 9 bacteria suppressed the disease on par to flusilazole and sulphur fungicide treatments.

Biology of grape pathogens

Molecular analysis of *Erysiphe necator*

Erysiphe necator is the causal agent of powdery mildew disease of grapes. Molecular analysis of 100 isolates of the fungus from different regions in Maharashtra and Karnataka using primers specific for mating-type idiomorphs showed that only one mating type idiomorph i.e. MAT1-2, which is also expressed as MAT- phenotype, is present in these regions. The absence of the opposite mating type idiomorph i.e. MAT1-1 indicates that *E. necator* is not sexually reproducing in these areas and explains the non-observance of cleistothecia (chasmothecia) in vineyards.

Fungicide resistance in *Plasmopara viticola*

Resistance to QoI and CAA fungicides in field populations of *P. viticola* from Sangli was detected by molecular analysis using nested PCR–RFLP method. Resistance to QoI fungicide was detected by restriction digestion of PCR products from cytochrome b gene with Fnu4HI restriction enzyme (Fig. 19). The resistant isolates gave 2 bands of about 133 and 200 bp after

restriction digestion. Resistance to CAA fungicide showed two bands with product size 107 bp and 37 bp after digestion by restriction enzyme AluI, indicating mutation at codon 1105 of the cellulose synthase gene PvCesA3 of *P. viticola*.

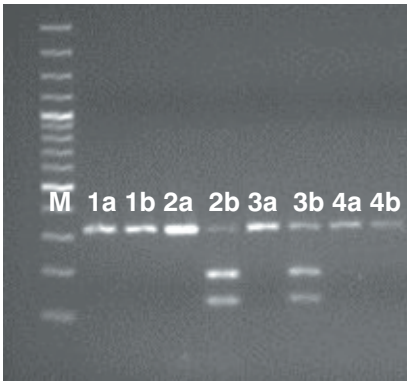


Fig. 19. Nested PCR-RFLP products of resistant and susceptible *P. viticola* isolates (products in lanes 'a' are without digestion and in lanes 'b' are after digestion. M indicates the 100bp ladder)

Insect biodiversity in grapevine ecosystem with emphasis on economically important grape pests

Collection and identification of various insect pests associated with grapevine ecosystem

Sixty-six insect species from 12 orders and 61 families have been collected from grapes and documented. Regular surveys were undertaken in the grapes growing areas of Maharashtra (Nashik, Solapur, Sangli, Pune districts) and Tamil Nadu (Theni, Cumbum, Coimbatore districts) to study the major insect pests, their species complex and associated natural enemies.

Mealybug, *Maconellicoccus hirsutus* and *Planococcus citri* were the predominant species of mealybug infesting grapevine. Three species of thrips viz., *Scirtothrips dorsalis*, *Rhipiphorothrips cruentatus* and *Retithrips syriacus* was found infesting grapevine. Among the three species, *S. dorsalis* was the major species causing economic damage to grapevine. Two species of stem borer viz., *Celosterna scabrator* and *Stromatium barbatum* were found to cause damage to grapevine.

Three encyrtid parasitoids viz., *Coccidoxenoides perminutus*, *Anagyrus dactylopii* and *Leptomastix dactylopii* was found to a effect natural parasitization of mealybug colonies in grapevine.

Studying the biology of major insect pests

The egg, larval, pre-pupal, pupal, pre-oviposition, oviposition and post oviposition period of stem borer were studied and found to be 12.40 ± 2.07, 269.2 ± 4.21, 11.60 ± 1.67, 25.8 ± 1.92, 4.00 ± 0.71, 47.2 ± 3.35, 6.0 ± 2.23 days respectively.

Collection, identification and evaluation of various parasitoids and predators associated with major insect pests of grapes

A. dactylopii and *C. perminutus* (Encyrtidae; Hymenoptera) was observed to parasitize the second and third instar nymphs of mealybug in the vineyards. In the vineyards, percent

parasitization of mealybug by *C. perminutus*, *A. dactylopii* and *L. dactylopii* was 56.25, 72.72 and 81.81 per cent, respectively during the peak incidence of mealybug. Even though mean population of *C. perminutus A. dactylopii* and *L. dactylopii* was 6.3, 5.4 and 5.9 individuals per vine. This indicated the higher functional response of the parasitoids.

The rate of parasitization of the mealybug was compared in debarked vines and vines with bark. The mean number of parasitoids recorded in the vines with bark (5.06 adults/vine) was significantly higher than that of debarked vines (1.02 adults/vine). The effect of different diets viz., red spider mites, aphids, pollen, honey and extra floral nectary over the biological parameters of acarophagous predator, *Stethorus rani* (Coccinellidae; Coleoptera) was studied. An artificial diet containing 20 ml honey in 100 ml distilled water, 5 g pollen can be used to maintain immature and adult stages of *S. rani* under *in vitro* conditions under sub-optimal or lesser availability of natural hosts.

Evaluation of microbial pathogens against economically important insect pests

Entomopathogenic fungi, *Verticillium lecanii* @ 2.4 x 10^7 spores/ml caused 53.95 % mortality of third instar nymphs of pink mealybug at 7 DAT with the lowest egg hatching percentage (27.18) against control (82.47).

Entomopathogenic nematode (EPN), *Heterorhabditis indica* @ 25 infective juveniles/ml recorded 85.65% mortality of larvae of stem borer (Fig. 20).

Fig. 20. Larvae of stem borer infected with *Heterorhabditis indica*

Compatibility of entomopathogenic nematodes with insecticides

Among the insecticides recommended for use in grapes, buprofezin 25 SC@ 1.25 ml/l recorded highest compatibility with no toxic effects on the mobility and activity of nematode *H. indica*. Lambda cyhalothrin 5 EC @ 0.5 ml/l was highly toxic to nematodes causing 64.86 % immobility.

Multi-pronged strategy for management of mealybug in grapes

Critical micelle concentration (CMC) of three surfactants, viz., sodium dodecyl sulphate (0.3%), trisiloxane polyether (0.01%), alkyl aryl alkoxylate 80% + fatty acids 20% (0.01%) were estimated in collaboration with Department of Physics, Pune University. Sodium dodecyl suphate at dose above CMC, trisiloxane polyether and alkyl aryl alkoxylate 80% + fatty acids 20% at dose above CMC, at CMC and below CMC were found to remove mealy covering from adult females of pink mealybug, *M. hirsutus* significantly (Fig. 21). Trisiloxane polyether at dose above CMC was found to cause significantly higher mortality of third instar of *M. hirsutus*

when compared with the dose at CMC which signified that in addition to reduction in surface tension, this surfactant may have other mode of action also (Fig. 22).

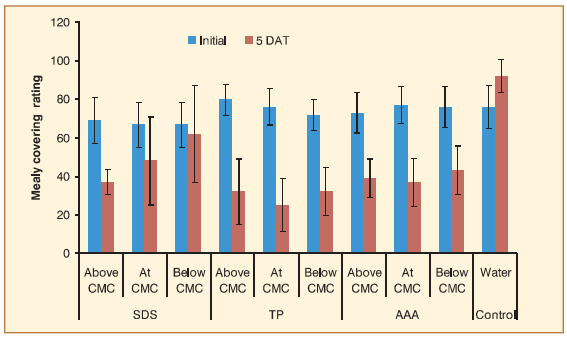


Fig. 21. Evaluation of bio-efficacy of various surfactants for removing mealy covering

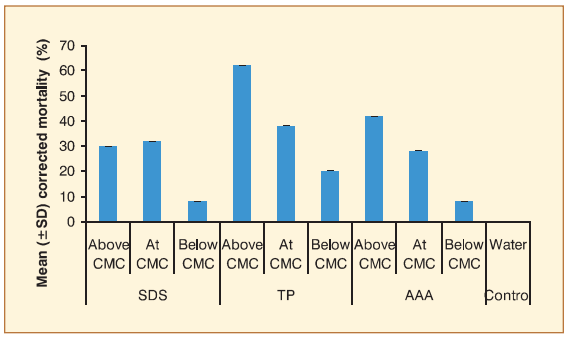


Fig. 22. Evaluation of various surfactants for effectiveness against mealybug

Development and calibration of 'Insect and mite pest risk assessment and advisory system' based on vine growth stage and weather parameters was done for six pests viz., thrips, mealybug, red spider mite, caterpillar, flea beetle and leafhopper in grapes.

Nine alternate host plants were found harbouring three species of mealybugs in vineyards. *M. hirsutus* and *N. viridis* were also found on grapevines but *Phenacoccus solenopsis* was found only on weed plants in the vineyards and not on the grapevines. Imidacloprid 70WG @ 0.6 g/vine and clothianidin 50WDG @ 0.275 g/vine as soil drenching; and spirotetramate 150 OD @ 0.6 ml/l were found effective against mealybugs in field experiments.

A nortriterpinoids based botanical was evaluated against *M. hirsutus* in grapes. At formulation dose of 1.0 ml per litre water, it was found effective in reducing mealybug population significantly (Fig. 23).

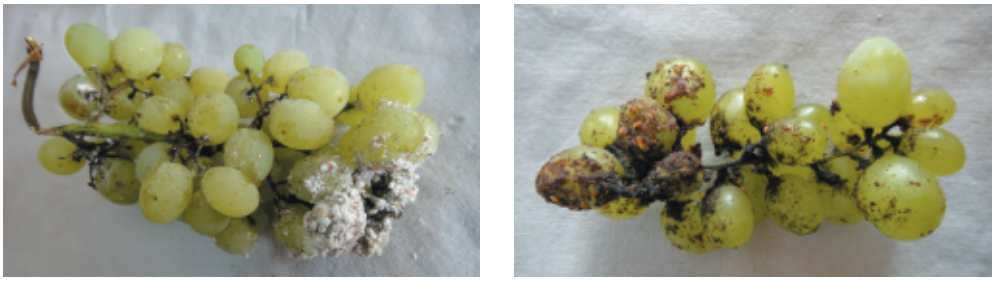


Fig. 23. Effect of nortriterpinoids based botanical on mealybugs. Untreated (left), treated (right)

An intestinal bacterium from *H. indica* was isolated and cultured on Maconkay Agar media. Both the bacteria and EPN resulted in 100 per cent mortality of adult mealybug, *M. hirsutus* females *in vitro* and their pathogenicity was proved.

Management of stem borer in grapes

Stem borer species found infesting grapes were identified as *Stromatium barbatum* (Fig. 24) and *Celosterna scaborator* Fab. (Fig. 25) in Nashik, Pune, Solapur, Kilari (Latur), Usmanabad and Bijapur areas.

Fig. 24. *S. barbatum* grub infesting grapevine

(a)

(b)

Fig. 25. *C. scabrator* damage symptoms in grapevine (a) fras removed (b) intervienal chlorosis

IIHR technology 'Sealer cum healer' was evaluated alone and in combination with insecticides, imidacloprid 17.8 SL, clothianidin 50 WDG and methomyl 40 SP (Fig. 26). All the four treatments were found to reduce *S. barbatum* infestation on treated vine parts.

Light traps (modified UV range) were found to attract adults of *S. barbatum* during rainy season; however they were ineffective in managing the stem borer infestation in the vineyards (Fig. 27 and 28). The maximum infestation of stem borer was found on vines within 18 feet circle of light traps (Fig. 29). Among other insects, chafer beetle, jassids and moths were the major insects catches (Fig. 30).

Fig. 26. Application of 'Sealer cum healer' on grapevines

Fig. 27. Light traps installed in vineyard

Fig. 28. Insect catches of a light trap showing *S. barbatum* adults

An intestinal bacterium from *H. indica* was isolated and cultured on Maconkay Agar media. EPNs were multiplied on both wax moth larvae and dog biscuit artificial diet. Both the bacteria and EPN resulted in 100 per cent mortality of *S. barbatum* grubs *in vitro* and their pathogenicity was proved (Fig. 31)

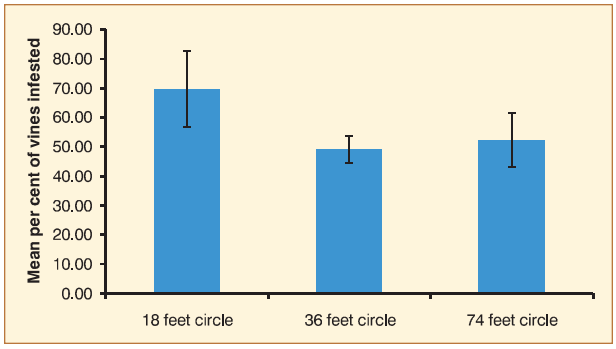


Fig. 29. Pattern of *S. barbatum* infestation on vines at different distance from light trap

Field experiments on bioefficacy of laboratory cultured *H. indica* against *C. scaborator* were conducted at Solapur where *H. indica* was found to provide 71.74 per cent control of grubs.

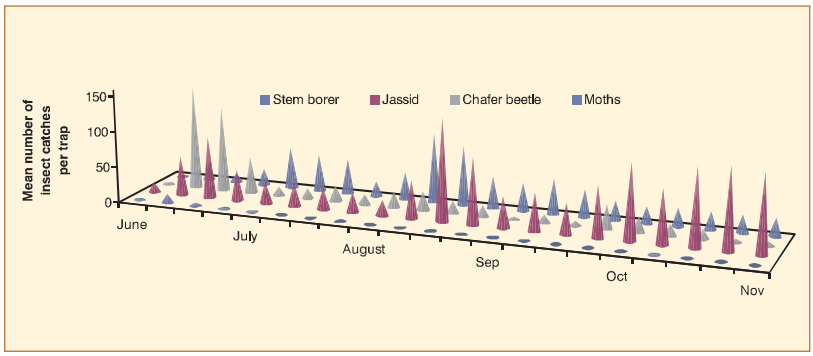


Fig. 30. Insect catches of light traps

Fig. 31. *S. barbatum* dead grub due to bacterial infection

Topical application bioassays (200 µl/grub) of ten chemicals, viz. emamectin benzoate 5 SG, lambda cyhalothrin 5 CS, imidacloprid 17.8 SL, methomyl 40 SP, fipronil 80 WG, azadirachtin 1% EC, spirotetramate 150 OD, cyantraniliprole 10 OD, spinetoram 12 SC and dichlorvos 76 EC on *S. barbatum* late instar grubs were conducted at 8 different doses which were 1, 2, 3, 4, 5, 6, 20 and 100 times of spraying doses. None of the chemicals resulted in significant mortality of the grubs even at 100 times doses.

Studies on dissipation rate of new generation pesticides with reference to changing MRLs

Dissipation and safety evaluation of kresoxim methyl in grape and during raisin making

A field dissipation study was conducted to evaluate the pre-harvest interval (PHI) and processing factor (PF) for kresoxim methyl (Ergon 44.3 SC) residues in grapes and during raisin making process at single dose (SD) and double dose (DD). Kresoxim methyl residues dissipated following 1st order kinetics with a half-life of 10 and 18 days at SD and DD, respectively. The

PHIs with respect to the EU-MRL of 1 mg/kg for grapes were 13 and 30 days at SD and DD, respectively. The degradation data during grape to raisin making process were best fitted to non-linear 1^{st}+1^{st} order kinetics with half-life ranging between 4 to 8 days for both shade drying and with raisin dryer at different doses (Fig. 32). The PFs were 1.19 and 1.24 with shade drying and 1.09 and 1.10 with raisin dryer, respectively, which indicates concentration of the residues during raisin making process. The dietary exposure of kresoxim methyl on each sampling day was less than the respective maximum permissible intake both at SD and DD. The residues of kresoxim methyl in market samples of grapes and raisins were well below the EU-MRL and were also devoid of any risk of acute toxicity related to dietary exposure.

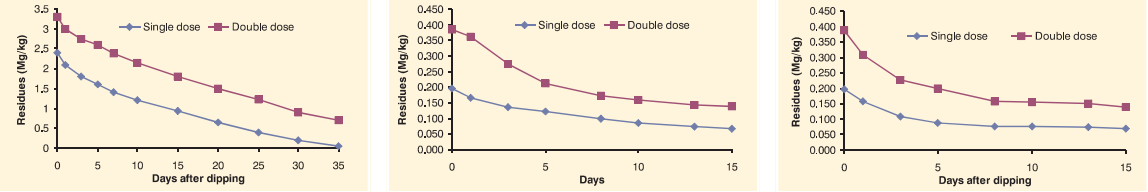


Fig. 32. Dissipation of kresoxim methyl in (a) grape and during drying (b) in resin dryer and (c) shade

Dissipation and safety evaluation of hexithiazox

A field study was conducted to evaluate the dissipation and to generate PHI of the insecticide hexythiazox (Endurer, 5.45 EC; Coromandel International Limited) residues in grapes at SD and DD. Residue dissipation was faster initially which slowed down with the passage of time, indicating a non-linear pattern of degradation. The residue of hexythiazox dissipated gradually at both the rates. The initial deposits of 3.38 and 6.20 mg/kg at recommended and double dose treatments dissipated with half-life of 7.5 and 9.5 days, respectively. The PHIs on the basis of the EU MRL of 1 mg/kg were found to be 21.5 and 32.0 days for recommended and double dose applications of hexythiazox, respectively.

Dissipation and safety evaluation of cyantraniliprole and spirotetramate

A field study was conducted at SD and DD for studying the dissipation kinetics and to evaluate the PHI for the insecticides cyantraniliprole and spirotetramate in/on grape. The residues were dissipated following 1^{st} + 1^{st} order kinetics with an average half-life of 10.2 and 8.2 days for cyantraniliprole and spirotetramate, respectively. The PHIs were 20 and 18 days for cyantraniliprole and spirotetramate, respectively.

Dissipation and safety evaluation of mancozeb 75% WP

Mancozeb 75% WP (M-45®, Indofil Industries Ltd, Mumbai, India) was sprayed at 2.5 (single) and 5 g/l (double) in grapes. Dissipation of mancozeb followed 1^{st} + 1^{st} order kinetics with PHI of 7 and 10 days at single and double dose of applications. Calculated dietary

exposure values based on average daily consumption of grapes were less than the Maximum Permissible Intake (MPI) at both the doses on all the days of sampling.

Dissipation and generation of processing factor for agrochemical residues during raisin making

Field dissipation study was conducted to evaluate the dissipation and processing factor (PF) for fungicides famoxadone, cymoxanil, pyraclosrobin and metiram during raisin making process at RD and DRD. During grape to raisin making process, pesticide degradation data were best fitted to 1^{st} + 1^{st} order kinetics with half-life value ranging between, 12 -13 days for famoxadone , 7 - 12 days for cymaoxanil, 6 - 7 days for pyroclostrobin and 4 days for metiram, respectively. The PF values calculated for drying were 1.95 - 2.09 for famoxadone, 1.35 - 1.99 for cymaoxanil, 1.10 - 1.34 for pyraclostrobin and 1.01-1.31 for metiram. PF value of > 1 for drying process indicates concentration of the residue during raisin making and it could be due to weight loss caused by the moisture loss. The dietary exposure of all the pesticides corresponding to average daily consumption of 4.3 g raisin per day on each sampling day was less than the respective MPI both at both the doses. The residues in market samples of raisins were also devoid of any risk of acute toxicity related to dietary exposure.

Monitoring of agrochemical residues in grape and grape produce

Validation of a GC-MS method for the estimation of dithiocarbamate fungicide residues in grapes

A sensitive and rugged residue analysis method was validated for the estimation of dithiocarbamate fungicides in grapes. The sample preparation method involved reaction of dithiocarbamates with Tin (II) chloride in aqueous HCl. The CS2 produced was absorbed into an isooctane layer and estimated by GC-MS selected ion monitoring. Limit of quantification (LOQ) was $\leq$ 40 µg kg^{-1} with average recoveries within 75-104% at LOQ. The method could be satisfactorily applied for analysis of real world samples.

Method development and validation for multi-pesticide residue analysis in raisin

A multi-pesticide residue analysis method was developed for raisin matrix for about 270 compounds. The method was developed with respect to homogeneity, sample size, sample to solvent ratio and clean up. The samples were extracted with ethyl acetate, cleaned by dispersive solid phase extraction (dSPE) using primary secondary amine (PSA) and estimated by LC-MS/MS. The method was thoroughly validated at 2.5, 5, 10 and 40 µg/ml levels, with recoveries within 70-120% fulfilling the method validation criteria of DG SANCO guidelines.

Monitoring of agrochemical residues in grape and wine

Eighty-four wine samples were collected from different wineries located at Nasik, Baramati and Pune region of Maharashtra. These samples were screened for >300 pesticides

including their metabolites using LC-Q.ToF MS and GC-MS/MS. All the samples were devoid of any pesticide residues (detection<LOQ).

A total of 78 market samples from Nasik (20), Solapur (34), Sangli (9) and Pune (15) were screened for agrochemical residues as per Annexure 9 on RMP in grapes. Out of total samples analysed, all the samples contained pesticide residues below PFA MRLs. Major residues detected in the sample were carbendazim, chlormequat chloride (CCC), lambda-cyhalothrin, dimethoate, thiophanate methyl, etc.

Quality evaluation of Indian wines

To provide a scientific basis for the finalization of standards for the Indian wines, 74 wine samples from different wineries including different type of wines viz.; red, white, rose, varietal, blended, sparkling, sweet and dry were collected. These samples were analyzed for various important parameters including alcohols, organic acids, heavy metals, Ocharatoxin A, sulphur dioxide, Na content, etc. The results of the analyzed parameters show that the concentration of all tested parameters are below the limits specified by the OIV and other international regulations and Indian wines are complying with these limits except for Na level. The reason for sodium levels in Indian wines is the cultivation of vines on Dogridge rootstock. Dogridge rootstock is supposed to absorb sodium and it may be transferred to wines. The proposed values for the maximum limits were suggested by comparing the BIS standards with those of other major wine producing countries including European Union, USA, Australia, South Africa, Argentina, and International Organization for Vine and Wine and possibility of their detection in Indian conditions. The details on proposed wine standards including parameters, their maximum limits in Indian wines were submitted to Indian Grape Processing Board (IGPB) for setting standards for the Indian wines.

Persistence studies of agrochemical residues in soil and water

Degradation kinetics of triazole fungicides in four different soils of India

The rates of degradation of difenoconazole, hexaconazole and flusilazole were studied in 4 different soils of India. In all the test soils, namely black (clay), brown (sandy loam), red (loamy sand) and saline (sandy loam (saline)) degradation rate was faster at the beginning, which slowed down with time, indicating a non-linear pattern of degradation. Degradation in all the soils followed 1st and 1^{st} + 1^{st} order kinetics with half-life ranging between 6 - 10 days for difenoconazole, 3 - 6 days for hexaconazole and 7 - 11 days for flusilazole in unsterilized soil. In sterilized soil, half-life ranging between 10 - 29 days for difenoconazole, 4 - 6 days for hexaconazole and 8 - 15 days for flusilazole, respectively. The results suggest that organic matter might be playing a major role in influencing the rate of degradation of selected fungicides in soil. Order of rate of degradation of selected fungicides in four different soils were black > brown > saline > red for difenoconazole, black > saline ≈ brown > red for hexaconazole, black > saline > red > brown for flusilazole respectively. Comparison of rate of

degradation in un-sterilized against sterilized soils suggests that microbial degradation might be the major pathway of residue dissipation (Fig. 33).

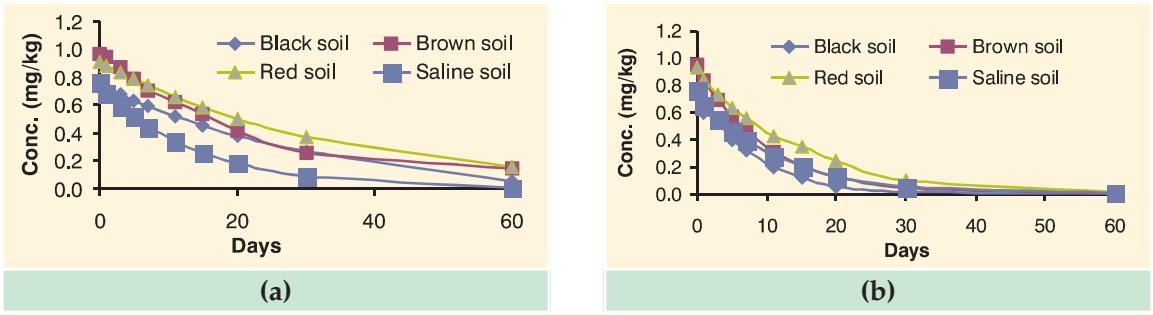


Fig. 33. Degradation of difenconazole in four different sterilized (a) and unsterilized (b) soils

Impact of kresoxim methyl residues on soil extra-cellular and intra-cellular enzymatic activity in four different soils of India

Effect of kresoxim methyl treatment on soil enzyme activities was studied using extra-cellular enzymes namely acid phosphatase, alkaline phosphatase, β-glucosidase and dehydrogenase. Although small changes in enzyme activities were observed, kresoxim methyl did not have any significant deleterious effect on the enzymatic activity of the various test soils. Simple correlation studies between degradation percentage and individual enzyme activities did not establish any significant relationships. The pattern and change of enzyme activity was primarily the effect of the incubation period rather than the effect of kresoxim methyl itself.

Profiling of grape varieties for its phenolic and aroma compounds from grape to wine

Optimization of extraction and analytical conditions for trace level estimation of wine volatiles

Gas chromatography-mass spectrometry with thermal desorption (GC/MS-TD) parameters were optimized for profiling of volatile compounds from wines considering the complexity of wine aromas. Sample preparation involved extraction of an 8 ml wine sample in a headspace vial with 2 g of sodium chloride (NaCl) and internal standard (IS). A preconditioned SPE-tD cartridge was used to adsorb the released volatile compounds while heating the vial on a magnetic stirrer for 40 minutes at 80 °C. A SPE-tD cartridge loaded with volatiles was inserted into a TD tube and the tube was placed in an auto sampler for analyses. The GC/MS-TD parameters viz., desorption time, desorption temperature, low and high trap temperatures, were optimized. The profile of 216 volatile compounds of Indian wines was qualitatively analyzed by GC/MS-TD. Targeted deconvolution was used to identify a large number of volatile compounds in wine samples in a shorter time. The tested wine samples were found to contain esters (65), alcohols (58), aldehydes (18), terpenes (18), organic acids

(17), ketones (13), ethers (7), phenols (5), lactones (4), pyrazines (3), and others (8). Based on the wine aroma profile of 15 Indian wines, they were placed into 3 groups. Out of the 15 wines, 13 could be largely grouped into a single category. Cinsaut and Gewurztraminer show significantly different concentrations of volatile compounds and, hence, were categorized separately (Fig. 34).

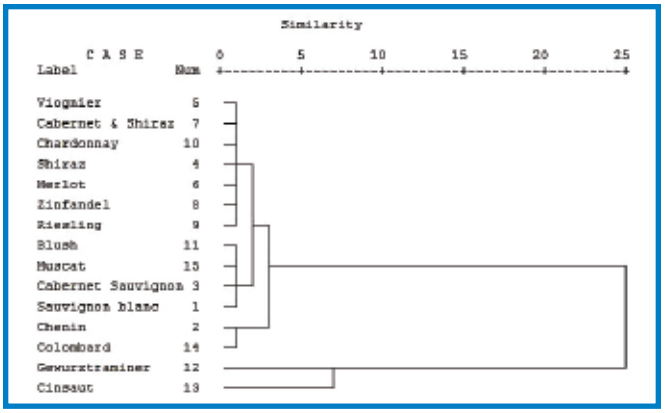


Fig. 34. Dendrogram of different varieties of wines analyzed for its volatile composition

Optimization of extraction and instrumental method for analysis of phenolic compounds in wine

A simple method was developed for quantitation of flavonols, flavone-3-ols, hydroxyl cinnamic acids, hydorxybenzoic acids, stilbene compounds and anthocyanins in grape varieties by using LC-MS/MS. The sample preparation involved the optimization of sample size, sample to extraction solvent ratio, vortexing and shaking time and dilution. 10g sample was homogenized with 20 mL methanol (1% formic acid) followed by centrifugation. The supernatant (1 ml) was diluted with 0.5 mL water and injected to LC-MS/MS. The separation of analytes was performed on Atlantis T3 (100 × 2.1 mm, 5µm) column with 0.1% formic acid in both mobile phases (90:10, water: methanol and 10:90, water: methanol), 0.350 ml/min flow rate and gradient chromatography. The LC-MS/MS analysis was performed with electro spray ionization (ESI) in positive polarity. The linearity range for the selected analytes was 50-1000 ng/ml with the correlation coefficient (R^2) ≥ 0.99. The limits of quantitation for all the analytes were in the range of 50-1000 ng/g grape matrices.

Postharvest Technology

Standardization of techniques for minimization of browning in raisin

The grape drying was performed in the raisin sheds and oven. Effects of combinations of ethyl oleate (eo) and potassium carbonate (pc) as well as ascorbic acid application (300 ppm on 3rd day of drying) were studied on various parameters. Treatment with ascorbic acid resulted in less browning than untreated. Dipping of bunches in solution of 15 ml ethyl oleate and 45 g potassium carbonate resulted in minimum browning in raisins (Table 9). However, colour intensity was the minimum in combination of 20 ml ethyl oleate and 45 g potassium carbonate. Treatments T5 and T6 recorded minimum browning and colour intensity. Minimum moisture

Table 9. Effect of combinations of ethyl oleate and potassium carbonate on raisin parameters

Treatments	Phenols (mg/g)	Browning	Colour Intensity	Moisture (%)
T1 (15 ml eo + 25 g/l pc)	1.962	0.493	0.706	11.94
T2 (20 ml eo + 25 g/l pc)	2.193	0.496	0.691	11.32
T3 (15 ml eo + 35 g/l pc)	2.169	0.406	0.604	10.68
T4 (20 ml eo + 35 g/l pc)	2.267	0.456	0.666	10.23
T5 (15 ml eo + 45 g/l pc)	2.373	0.382	0.537	10.18
T6 (20 ml eo + 45 g/l pc)	2.461	0.385	0.521	10.45
LSD at 5%	0.381	0.034	0.073	NS
SEM±	0.184	0.016	0.035	1.03

content was also found in raisins prepared from T5 which indicated faster grape drying in this treatment.

PPO activity in grape berries was monitored from veraison till harvest. In this experiment comparison was made in bunches covered by paper, treated with Difenconazole (Di) at the rate 12.5 and 25 ppm and control. Among four treatments, raisin prepared from uncovered bunches (control) recorded highest PPO activity (Fig. 35).

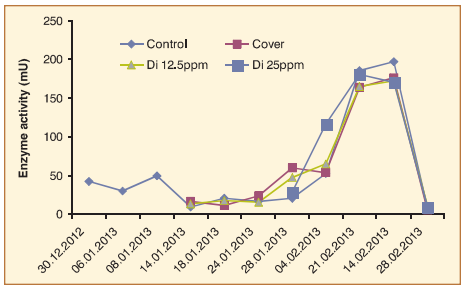


Fig. 35. PPO activity in berries of Thompson Seedless before harvest

Standardization of Pre-harvest factors for production of quality red wines

The experiments were conducted on the vines of Cabernet Sauvignon grafted at 110 R at vineyard of NRCG and Cabernet Sauvignon grafted on 1103 P and Shiraz grafted on Dogridge at Sula Vineyards at Dindori. In these experiments, bunch load was maintained at 20, 30 and 40 bunches per vine. The vines at NRCG were pruned on 14th, 21st and 28th September 2012 while at Dindori, prunings were done on 11th and 13th October 2012. The harvesting was at 150 days after pruning at NRCG, and on 154 and 156 days after pruning at Sula vineyards. The observations on must quality and wines were recorded.

Cabernet Sauvignon at NRCG, Pune

The must of grapes harvested from early pruned vines recorded higher TSS (22.43 °B). Similarly crop load of 40 bunches/vine resulted in higher TSS (22.6 °B). Interaction data showed that the maximum TSS was found in must of grapes which were collected from early pruned vines having maximum crop level (40 bunches/vine). The grapes from late pruning and lower crop level showed lower pH and total acidity.

The wines made from these grapes were very dry and super dry in nature. Ethanol content in wines was positively related to TSS content of must. The wine from second pruning recorded higher acidity as compared to other pruning dates. The same trend was observed for content of malic acid in wines. Wine made from grapes of early pruned vines had low pH (3.7) whearas wines from late pruning treatments had high pH (about 4). Wines made from second pruning treatments were having good colour while wines from third pruning were recorded with light colour intensity.

Cabernet Sauvignon and Shiraz at Sula Vineyard, Dindori

Must of both the varieties viz.; Cabernet Sauvignon and Shiraz had good acidity however, pH was higher than the recommended levels (3.4 – 3.6). Must of Shiraz from 30 bunches/vine crop level recorded the highest TSS. In Cabernet Sauvignon, lowest crop level i.e. 20 bunches/vine resulted in maximum TSS content in must. Higher must pH was recorded in second pruning and higher crop level in both the varieties.

All wines made from Shiraz were found within category of very dried. Crop level of 30 bunches/vine produced wine having maximum alcohol and maximum colour intensity. The wine produced from first pruning coupled with 30 bunches/vine was recorded with minimum value of pH i.e. 3.61. Maximum malic acid content was found in wine produced from grapes of second pruning with 40 bunches/vine but colour intensity was minimum in this wine. More alcohol (10.3 %) was recorded in wine from first pruning coupled with lowest crop level i.e. 20 bunches per vine. The maximum malic acid content was also recorded in this treatment. The differences in pH levels in all the treatments were non-significant. Second pruning produced poor coloured wines.

Information Technology

NRCG - DIPS - A system for diagnosis and management of important diseases and insect pests of grapes

GUI design and program code modules were developed to store data required for diagnosis of disease and pest problems and to assist users in diagnosis of disease and pest problems (Fig.36). It included modules that facilitate to add, delete, and edit text and picture data to the database, affected parts of grapevine, symptom keys and symptom description for the problem and data on problem profiles. Designing and coding was carried out for module to create and maintain user logins to ensure protected access to data entry and modification, module for user registration to provide authorized access to the diagnosis software, module to specify the affected part which shows symptoms of the problem, module to select key symptom related to an affected part from the list of key symptoms, module to show detail symptom descriptions for the selected key symptom, module to display problem details and management solutions. Testing and rectification of identified errors was carried out for all the modules and accordingly changes in the program logic, code and GUI were made. Symptom keys and

symptom descriptions for disease and pest problems were defined for entry in to the database. Data entry on disease and pest diagnosis data was carried out. User documentation was done

Fig. 36. Screen showing home page of the software

Collaborative and Externally Funded Projects

i. National Referral Laboratory for monitoring pesticide residues for export of table grapes from India to EU countries (funded by APEDA)

This was the 11th year of the Residue Monitoring Program for controlling agrochemical residues in table grapes for export to the EU countries. The total number of registered farms for export in Maharashtra, Karnataka and Andhra Pradesh states was 23095 as per record on GRAPENET. Out of these farms, 23063 farms were from Maharashtra state alone, accounting for 99.8% of the total number of farms registered. Out of the 7686 total analyzed samples, 1020 samples failed for EU-MRL compliance and those materials were not allowed for export to the EU countries. A total 1226 internal alerts were issued by NRL. On re-sampling, 206 alerts were subsequently revoked on the basis of the MRL compliance in analysis reports.

Validation of a residue analysis method for streptomycin and tetracycline and their food safety evaluation in pomegranate

A single-step methanol extraction based method was developed and validated for simultaneous estimation of the residues of streptomycin and tetracycline group compounds in

pomegranate fruits by LC-MS/MS multiple reaction monitoring. A field experiment on the dissipation of streptomycin and tetracycline (including 4-epimers) residues in pomegranate fruits with regards to field applications of the commercial formulation Streptocycline® SP (streptomycin sulphate 90% + tetracycline hydrochloride 10%) at 200 and 400 g a.i./ha indicated pre-harvest intervals of 45 and 55 days for streptomycin and 12 and 15 days for tetracycline, respectively. The study will be useful in promoting effective residue monitoring and ensuring safe use of these antibiotics in managing bacterial diseases of pomegranate.

Optimization of representative sampling methodology in okra

A field sampling methodology was optimized in okra to ensure representative sampling with appropriate sample size and to minimize laboratory-to-laboratory variation. The optimized sampling plan suggests that a one hectare field be divided into 16 equal blocks and 24 pods be drawn from each block for analysis of pesticide residue.

Dissipation of selected agrochemicals in okra and brinjal

As one of the mandate of the residue monitoring program and extension of NRL activities to other fruits and vegetables, dissipation study of fipronil, imidacloprid, carbendazim, kresoxim methyl, difenoconazole, flubendiamide, buprofezin, and hexaconazole was conducted on okra. Based on the data PHI and half-life were generated. Similarly, the dissipation of kinetics of imidacloprid, carbendazim, kresoxim methyl, flubendiamide, lambda-cyhalothrin, hexaconazole and captan was studied in brinjal for estimation of PHI and half-life.

Multiresidue analysis of multiclass veterinary drugs in foods of animal origin

A quantitative screening method based on 'scheduled multiple reaction monitoring (sMRM) to information dependent acquisition - enhanced product ion (IDA-EPI) workflow' was developed for about 90 veterinary drug residues belonging to different chemical classes using LC-MS/MS Q Trap system.

Participation of nominated laboratories and proficiency test (PT) programs

The Proficiency Testing (PT) round on grapes among the 20 laboratories including NRL was organized on 23rd December 2013 for the chemicals viz. 6-benzyl adenine, atrazine, chlorfenvinphos, dimethoate (including omethoate), fenamidone, HCH (sum of isomers, except the gamma isomer), lambda-cyhalothrin. The laboratory results were compared to the assigned values and the 'z'-scores were determined for individual chemicals pertaining to different laboratories as per the International Harmonized Protocol for the Proficiency Testing of the Analytical Laboratories (2005) issued by the International Union of Pure and Applied Chemistry. From the results of PT test it was found that 'z' scores for 14 participant laboratories were satisfactory.

A second PT round on grapes among the 8 laboratories including NRL was organized on

24th January 2014 for the chemicals viz. carbaryl, diazinon, endosulphan, lambda-cyhalothrin, malathion. The laboratory results were compared to the assigned values and the z-scores were determined as mentioned above. From the results of PT test it was found that z-scores for 7 participant laboratories were satisfactory.

Proficiency testing on okra

A PT round on Okra among the 20 commercial testing laboratories including National Referral Laboratory was organized on 13th August 2013. Out of the 20 participating laboratories, four laboratories did not submit the results. Z-scores of 13 out of the 16 laboratories for chlormequat and 15 out of 16 laboratories for monocrotophos, acetamiprid and dimethoate were within the satisfactory range of -2 to +2. In case of chlorpyriphos, 14 out of 16 laboratories were within the satisfactory z-score values.

Proficiency test for aflatoxins in peanuts

As a mandate of the NRL under residue monitoring program (RMP) in peanut and peanut products for export through the control of aflatoxin residues of APEDA, a proficiency testing was conducted among 19 testing laboratories. Out of 19 participating laboratories, two laboratories did not submit the results. z-scores of 14 out of the 17 laboratories who reported the results were within the satisfactory range of -2 to +2 for aflatoxin B1, whereas, the results were satisfactory for 16 laboratories for aflatoxin B2.

Assessment of nominated laboratories

Inspection and assessment of the nominated laboratories was carried out during the season. 10 labs were assessed during the ongoing season and counter samples were collected from all the labs for comparative analysis at NRL. On analysis of the counter samples at NRL, the NRL results were found to be comparable with those of nominated laboratories. One laboratory was found to be non-compliant to guidelines set by APEDA and NRL and was thus disqualified to carry out sampling and analysis of grape samples for the current grape season. QPS Bioserve, Hyderabad; First Source, Hyderabad and TUV SUD India Pvt. Ltd, Bangalore were assessed for APEDA recognition and report for the same has been submitted to APEDA.

Compliance check: 5% sample analysis as per RMP in grape

Five per cent samples of the total number of samples analysed through GrapeNet, consisting of samples from pack-houses (166), farms (20) and nominated laboratories (91) were analyzed for confirmatory testing at NRL. The results of all the samples tasted at NRL were similar to corresponding laboratory results.

Support to other ICAR institutes

Indian Institute of Vegetable Research, Varanasi

Residue dynamics and safety assessment of the combination fungicide trifloxystrobin 25% + tebuconazole 50%-75 WG in tomato

Residue dynamic and their corresponding pre-harvest intervals (PHI) with reference to the maximum residue limits (EU) of a combination fungicide trifloxystrobin (25%) + tebuconazole (50%) in tomato was investigated. The residues of both the compounds on all the sampling days were below the European Union maximum residue limits (EU-MRLs) and the maximum permissible intakes (MPIs) were calculated on the basis of prescribed acceptable daily intake (ADI).

Validation and uncertainty analysis of a multi-residue method for pesticides in chilli

An ethyl acetate based method was validated for chilli matrix for about 200 pesticides using liquid chromatography–tandem mass spectrometry (LC-MS/MS). A buffered approach was adopted to adjust the sample pH between 5.5-6 and thus, broaden the spectrum of analysis by improving recoveries of certain chemicals.

Residue dynamics of combination fungicide fluopyram 20% + tebuconazole 20%-40 SC in chilli

Residue dynamic and their corresponding pre-harvest intervals (PHI) with reference to the maximum residue limits (European Union) of a combination fungicide fluopyram 20% + tebuconazole 20%-40 SC in chilli was investigated. A sample preparation method based on ethyl acetate extraction and estimation by LC-MS multiple reactions monitoring was validated in chilli fruits and residue dissipation studies were conducted in field at single and double doses.

National Research Centre for Citrus, Nagpur

The acid lime samples sent by NRC Citrus were tested for carbendazim and CCC residues.

National Research Centre for Pomegranate, Solapur

The pomegranate sample submitted by NRC on pomegranate were tested for agrochemical residues. The samples were detected with steptomycin (0.06 mg/kg), dithiocarbamates (0.09 mg/kg, estimated as CS_2 residue) and lead (0.03 mg/kg) above the EU-MRL level.

Indian Institute of Spices Research, Calicut

Identification of antifungal bio-active compounds in extract of Serratia

The fungal extract has been screened for bio-active compounds using high resolution LC MS/MS (LC-Q ToF-MS/MS). The data acquisition was performed in resolution mode (R=20000) with MSE scan mode in the range of 100-1200 amu. The MSE scan mode provides

the MS data in low energy (4V) and MS/MS data high energy ramping (15-45V). Leucine Enkaphalin (monoisotopic mass = 556.2771 Da in positive polarity) was used as a reference mass or a lock spray mass for mass correction with a flow was 5 µl/min at 30 s interval. The fungal extract was having more than 10 peaks in the chromatograms, but the major 6-7 peaks were selected for the identification.

CIFT, Cochin

Multiresidue analysis of multiclass pesticides and polyaromatic hydrocarbons in fatty fish

A selective and sensitive method for determination of 119 chemicals including pesticides and polyaromatic hydrocarbon (PAH) residues in high fatty matrix (fish) was developed and validated using gas chromatography tandem mass spectrometry (GC-MS/MS) method. Different extraction parameters viz. extraction solvent, amount of hexane used during extraction and dispersive clean-up were optimized.

DGR, Junagadh

Simultaneous analysis of four herbicides by LC–MS/MS in peanut

A simple and rapid method for simultaneous analysis of the residues of four herbicides viz. pendimethalin, oxyfluorfen, imazethapyr and quizalofop-p-ethyl in peanut by LC-MS/MS was developed. The proposed method was successfully applied for analysis of these herbicide residues in peanut samples harvested from the experimental field and the residues were below the LOQ.

Central Tobacco Research Institute, Rajahmundry

Optimization of a sample preparation method for multiresidue analysis of pesticides in tobacco

A selective and sensitive multiresidue analysis method, comprising 47 pesticides, was developed and validated in tobacco matrix. The optimized sample preparation procedure in combination with gas chromatography mass spectrometry in selected-ion-monitoring (GC-MS/SIM) mode offered limits of detection (LOD) and quantifications (LOQ) in the range of 3-5 and 7.5-15 ng/g respectively, with recoveries between 70-119% at 50-100 ng/g fortifications.

ii. Validation of DUS characters for Grapes (funded by PPV & FRA)

During the year, about 100 identified reference varieties for development of DUS descriptors were *in situ* grafted on Dogridge rootstock. Each variety was replicated three times with four vines per replication. Erection of Y trellises to train the grafted vines was completed. Of the total grafted vines, more than 70% success rate was recorded. The vines will be re-cut during first week of April 2014 to obtain the uniform growth of all the vines in the block. In addition to this, in the institute's germplasm block, about 17 morpho - phenological characters and 10 fruit characters for the selected 100 varieties were recorded to validate the shortlisted DUS characters. As a part of project, one day training cum awareness program on PPV and FR Act - 2001 was organized on 5th March 2014. About 75 participants attended the program, where

they were educated about objective and role of PPV and FR Authority, protection of farmer's rights, importance of DUS testing to register the varieties in the name of farmers, breeders, organization etc.

iii. Decision support system for enhancing productivity of grapes under moisture and temperature stress conditions (funded by NFBSRA)

It is a multi-institutional project with public and private partnership. The Institutions involved are NRC Grapes (Lead institute), IARI (New Delhi) and Shivrai Technologies (Pune). This project was started in June, 2012. The objectives include development of data library for crop growth model and decision support system, initiating grape model development and developing decision support system for improving crop productivity under moisture and temperature stress conditions.

Collection and development of data libraries for grapes: Surveys in different vineyards in Maharashtra were conducted for identified problems and queries raised by the farmers for incorporation in DSS software. The existing data library was augmented and symptoms of different temperature/moisture stresses, and effect on crop due to unseasonal rains in different grape growing regions were documented. Due to shortage of irrigation water, staggering and delaying the foundation pruning from April to May month is a common strategy amongst grape growers to avoid moisture stress to vines. However, in 2013, the early onset of monsoon in the first week of June affected the fruitfulness of the vines pruned in May. Data on effect of early onset of monsoon on fruitfulness was recorded from 57 vineyards (Thompson Seedless and its mutants Tas-A-Ganesh, 2A clone) pruned at different dates between 1st April and 22nd May 2013 in Nasik region. Excess soil moisture and cloudy weather conditions due to early onset of monsoon during bud differentiation stage in vineyards pruned in the month of May, 2013 reduced the number of fruitful canes/vine drastically. Average fruitfulness in vineyards pruned between 1st to 26th May was 23% compared to 89% in vines pruned between 1st April to 24th April 2013 (Fig. 37).

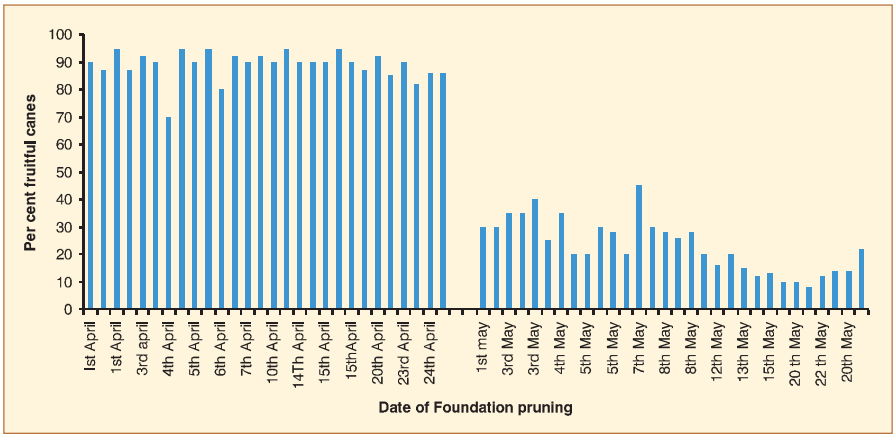


Fig. 37. Per cent fruitful canes in different vineyards

Field experiments for characterizing the moisture and temperature effects on plant growth and yield

Experiment 1:

To improve decision making based upon possible yield losses due to moisture an experiment was conducted to quantify the effects of moisture stress at different crop growth stages in a heavy black cotton type soil. The treatment details are given in figure 38. The regular rainfall from 3rd June , 2013 coupled with unseasonal rains vitiated the treatments where moisture stress was imposed after fruit bud differentiation stage after foundation pruning and during shoot growth stage after fruit pruning.

Treatments	Foundationpruning		Fruit pruning			
	Shoot growth days	Shoot growth to Fruit Pruning	Shoot growth	Berry set and shatter	Berry development to veraison	Veraison to harvest
T1						
T2						
T3						
T4						
T5						
T6						
T7 (Recommended irrigation)						

Recommended irrigation | 50% of the recommended irrigation | No irrigation

Fig. 36. Treatment details of moisture stress

The yield loss which was significant in different moisture stress scenarios ranged from 6.0 to 9.7% (Table 10). The yield reduction (9.7%) was greatest in vines irrigated @ 50% of the recommended level up to 30 days followed by without irrigation between 30 to 60 days after foundation pruning. Pruned biomass at foundation pruning and bunch number/vine were also least in the same treatment. Moisture stress (irrigation @ 50% of the recommended level) during foundation pruning resulted in uneven and less bud break, reduced pruned biomass leading to less bunch number per vine. Moisture stress during berry development stage to harvest reduced the yield by 8.90% compared to recommended irrigation. These results will be useful in answering farmer's queries and decision making process. The total quantity of irrigation water applied was highest in recommended irrigation treatment (T7) whereas the least irrigation water was applied in treatment T2, which also produced the lowest yield.

Though the water use efficiency was highest in treatment T2, the expected loss was ₹ 54000/- as compared to T7 at a farm gate price of ₹ 25/- per kg grapes.

Table 10: Effect of treatments on yield and yield related parameters

Treatments	Yield (t/ha)	% Yield reduction	Irrigation water applied (mm)	WUE (kg/mm of irrigation water)	Bunch number	Bunch weight (g)
T1	20.91	6.0	156.2	133.9	55	212
T2	20.09	9.7	134.0	149.9	50	225
T3	22.10	0.7	224.7	98.4	63	196
T4	20.72	6.9	206.9	100.1	63	189
T5	20.27	8.9	191.9	105.6	63	179
T6	20.84	6.3	156.2	133.4	54	215
T7	22.25	0	224.7	99.0	63	199
SEm±	0.49	-	-	-	1.30	4.43
LSD (p=0.05)	1.07	-	-	-	2.82	9.65

Experiment 2:

To establish relationship between temperature and phenology of grapevine and its impact on grapevine productivity, an experiment was started on Thompson Seedless (Tas-A-Ganesh) vines raised on Dogridge rootstock in 2013-14. The whole block of vines was divided into two subplots and pruned at one month interval during foundation pruning. Each subplot was further divided into two plots and pruned at two different intervals. The treatment details are given in table 11.

Table 11: Pruning treatment details

Treatments	Foundation Pruning date	Fruit Pruning date
P1	1st April, 2013	3rd October, 2013
P2	1st April, 2013	16th October, 2013
P3	1st May, 2013	2nd November, 2013
P4	1st May, 2013	16th November, 2013

The vines pruned on 1st May, sprouted earlier (12 days) as compared to the vines pruned on 1st April (17 days). This difference in days taken to sprout in the vines pruned on 1st April could be attributed to low day time RH (< 20%) along with high temperatures between 9 am to 6 pm. Vines pruned on 1st May 2013 had less number of fruitful canes which could be

attributed to early onset of monsoon leading to cloudy weather conditions. The accumulated growing degree days to reach minimum TSS: acid ratio of 20:1 as per Agmark standards was recorded. The vines were harvested when 18 °B sugar in berries was achieved. The P1 and P2 pruned vines had significantly higher yield as compared to P3 and P4 pruned vines, but, they were on par with each other (Table 12). The vines from P4 produced significantly lowest yield. Bunch numbers were significantly higher in P1 and P2 pruned vines than P3 and P4 pruned vines. The accumulated growing degree days ranged from 1450.6 to 1464.6 in different pruning dates. However, the number of days taken to accumulate the growing degree days ranged from 117 to 128 under different pruning treatments (Table 12). The heat units accumulated to reach different phenological stages are given in Fig. 39.

Table 12. Effect of treatments on yield and yield related parameters

Treatments	Yield (t/ha)	Fruitful canes/vine	Growing degree days (°C)	Duration after fruit pruning (days)
P1	22.25	37.4	1464.40	117
P2	22.58	36.8	1453.00	124
P3	19.16	32.2	1450.70	128
P4	16.58	31.2	1450.60	125
SEm ±	0.51	1.2		
LSD at 5%	1.10	2.6		

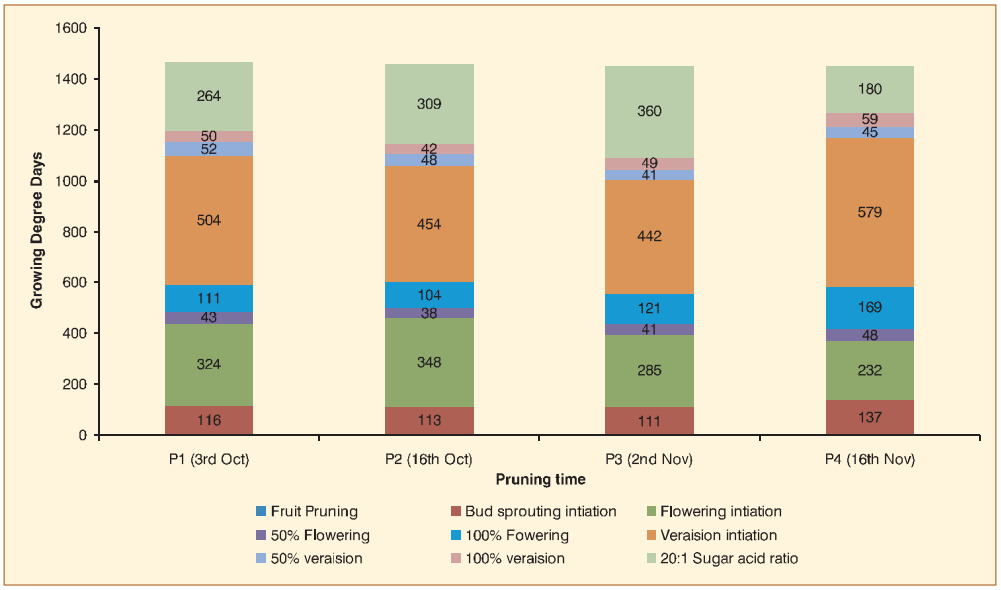


Fig. 39. Growing degree days at different phenological stages under different pruning treatments

IV. Functional analysis of salinity stress response in grapevine (DBT funded)

Report presented at page 10.

V. Understanding the rachis and berry elongation in response to GA_3 application in Thompson Seedless grapes using functional genomics approach (DBT funded)

Report presented at page 12.

VI. Studies toward enhancement of source – sink relationship by ^{14}C – Gibberellic acid as a radiotracer (funded by BRNS-BARC)

This new project was initiated with funding from BRNS-BARC. Vines of Thompson Seedless were raised in pots, which will be used for radiotracer experiment at BARC. In field experiment, the application of GA_3 at 3-4 and 6-7 mm berry size stages were carried and samples were collected for dissipation studies.

Programme for NEH and TSP

Under the XII Plan programme for North Eastern Hills (NEH) and Tribal Sub-Plan (TSP), the Centre has developed a project for development of grape industry in Mizoram with the Department of Horticulture, Mizoram State as cooperating partner. Presently about 2380 ha area is under grape cultivation in Mizoram mainly confined in Champhai district. The foremost grape variety being grown is Bangalore Blue. In Mizoram, major part of the crop growing period from fruit setting to harvest falls under rainy season, and hence it poses a challenge for sustainable cultivation.

Dr. S. D. Sawant, Dr. R. G. Somkuwar and Dr. A. K. Upadhyay visited Mizoram in November, 2013 and interacted with the Director (Horticulture) and their team from Mizoram State Horticulture Department for the development of grape industry in Mizoram. This was followed by survey of the grape growing areas in the Champhai district. Based on the discussions and visits, following action points were formulated for development of grape industry in Mizoram:

1. Establishment of one acre area by NRC Grapes in Mualkawi area of Champhai district for developing suitable package of practices.
2. Detailed Survey of the grape growing areas and interaction with farmers to identify production related constraints.
3. Development of grape nursery for ease of availability of quality planting material
4. Upgradation of the technological and knowledge base of resource persons from Department of Horticulture (Mizoram) and grape growers through need based interventions.

During 2013-14, the following activities were carried out under NEH and TSP project:

- An Action Plan for the 'Development of Grape Industry in Mizoram' under NEH and TSP was prepared based upon the availability of funds from the ICAR. A Memorandum of Understanding for implementation of NEH and TSP with Department of Horticulture, Mizoram State was prepared. This has been duly signed by NRC for Grapes, Pune and Department of Horticulture, Mizoram State.

Interaction of Mizoram State Horticulture Extension Officers with the Scientists

Mizoram State Horticulture Extension Officers at Four Season's winery, Baramati

- Orientation programme on Viticulture for Horticulture Extension Officers from Mizoram was organised at NRC Grapes during 28-30th October 2013. The scientists trained the participants on various viticulture techniques for production of quality grapes. They were taken to Four Seasons winery at Baramati to expose them to techniques in wine making. Dr. A.K. Upadhyay coordinated this training programme.

- A team of scientists of NRC Grapes along with officials of Mizoram State Horticulture Department and Scientist from ICAR Research Complex for NEH Region, Mizoram Centre visited Champhai district in November 2013 and identified a suitable plot for establishing vineyard and conducting field experimentation in Mualkawi area. It was decided to raise a plot of Bangalore Blue to develop package of practices. Another plot of wine grape varieties will be established to study their suitability in this region.

- An orientation programme on wine grape cultivation was organised for Director (Horticulture) and the officials from State Department of Horticulture, Mizoram during 4-6th February 2014. The officials were taken to the Research Farm of the Centre and cultural practices followed were explained to them. The officials were taken on visit to Sula Winery, Nasik where they were exposed to the techniques involved in wine making.

Officials of the Mizoram State Horticulture Department with NRC Grapes Officials during finalization of the MOU

Scientists interacting with the Officials of the Mizoram State Horticulture Department in the Institute's Research Farm

- A survey was carried out in the Champhai district in November, 2013 and March, 2014. Based upon the insight gained during the visit to the vineyards, the farmers were sensitised about the necessity of maintaining the leaves in the vineyard after harvest and not allowing it to be dropped through disease incidence. Further to avoid delayed and uneven sprouting which leads to harvest span stretching to 2 months, farmers were made aware about the need for introducing hydrogen cyanamide as bud breaking chemical for uniformity and timely bud sprouting. The importance of VSP trellis system was explained to harvest maximum sunlight for quality production.

Application of hydrogen cyanamide led to early and uniform bud sprouting (left) and delay and irregular sprouting (right) at Champhai, Mizoram

- A training programme for setting up of nursery for the production of quality planting materials in grapes was organized at Champhai district of Mizoram. A total of 32 participants were trained for the nursery activities to be carried out. Dr. R.G. Somkuwar trained the participants.

Dr. S. D. Sawant, Director inaugurating the Training programme on 'Production of quality planting materials in grapes' at Champhai, Mizoram

Dr. R. G. Somkuwar delivering lecture on 'Production of quality planting materials in grapes' at Champhai, Mizoram

Technology Assessed and Transferred

Several technologies developed and assessed at the Institute, were disseminated to the grape growers through several field visits, participation in growers' seminar and by organizing training programmes at Institute or their site as per the request. Some of the important technologies which were disseminated are given below:

1. Use of rootstocks for sustainable grape production under abiotic stress
2. Irrigation schedule, use of mulch, and subsurface irrigation under water deficit conditions
3. Rationalisation of fertilizer use
4. Use of bioregulators for improving grape quality
5. Strategies for insect pest and disease management
6. Use of biocontrol agents
7. Disease forecasting

Grape Day

A Grape Day was organized at the Centre on 20th February 2014 to showcase the available varieties, promising hybrids and various other technologies developed at the Centre. Four hundred and ten grape growers participated in the field visits and technical sessions.

Field Visits

At each demo location a scientist or a member of his/her team explained about the variety or technology as given below, were shown to the farmers:

- The promising varieties meant for raisin and juice were shown and farmer's feedback was taken on a score card based on quality and sensory parameters.
- Performance of Thompson Seedless and Red Globe grafted on different rootstocks.
- The yield and quality of Red Globe grapes on 110 R and 140 Ru rootstocks.
- The effects of different pruning dates on Thompson Seedless fruit quality and yield.
- Impact of various irrigation schedules on the performance of Fantasy Seedless and the low irrigation water requirement of this variety vis-à-vis Thompson Seedless.
- The efficacy of different bio regulators viz. GA_3, CPPU and homobrassinolide with respect to TSS and berry size in table grape variety. The significant results obtained from GA_3 + CPPU were emphasized and explained to the farmers.
- Use of sticky traps for monitoring jassids, aphids and thrips,

and use of light traps in the vineyard for trapping adults of stem borer, chafer beetles and moths during rainy season and jassids during October-December period. A method of preparing home-made light traps was also demonstrated.

- A chart depicting the life cycle of stem borer was displayed along with all stages of preserved specimens of two species of stem borer and infested vines showing symptoms of damage. Comparison of extent of infestation of new species of stem borer, *Stromatium barbatum* in the old and new vineyards.

- The effect of shoot tipping to reduce the incidence of thrips in the vineyards.
- Pre-harvest treatments with *Trichoderma* to control powdery mildew and improve the shelf life of grapes.

Technical session

A technical session was organized under the Chairmanship of Dr. N. K. Krishna Kumar, DDG (HS), ICAR, New Delhi. Dr. S. D. Sawant, Director, NRC for Grapes welcomed the dignitaries and growers. Sh. Abhaykumar Nandrekar, President, Karnataka State Grape Growers' Association, Bijapur and Sh. Ashok Gaikwad, President, MRDBS, Pune; expressed their thankfulness to the Centre for organizing the event and deliberated the needs of growers with respect to import of varieties to overcome short varietal base, import of new machineries for mechanization to overcome labour shortage. Sh. Sopan Kanchan, Chairman, Grape Growers' Federation of India expressed the need of partnership with the industry for the import of agricultural machineries. Dr. G. S. Prakash, Ex-Head, Division of Fruits Crops, IIHR, Bengaluru also addressed the growers.

Release of Centre's Vision 2050 document during Grape Day

In his presidential address, DDG (HS), ICAR, assured the support from Council for

the import of promising varieties of desired traits. He emphasized about the maintenance of repositories for promising clones of grapes in the Institute, research on organic farming of grapes, the need for the production of branded quality grapes, market intelligence, branding of wine and grapes as pesticide free for improving their market value. He also stressed on public – private partnership for addressing some of the needs of the Industry and that all efforts should be relevant on a national level and not be restricted to regional problems.

Opening / inauguration of new activities

A juice counter was opened at the hands of Dr. N.K. Krishna Kumar, DDG (HS). Juice made from the hybrid 'Medika' developed at the Centre was served to the participants and was very well appreciated by them. A research winery with 20 steel fermenters of 25 liter capacity was also inaugurated by DDG (HS).

Growers-scientists interaction

The growers-scientists interaction was organized under the Chairmanship of Dr. S. D. Sawant, Director of the Centre. The queries raised or the information sought by the farmers were addressed by the scientis. After the growers-scientist interaction session, the programme ended with the vote of thanks to the dignitaries and the participants.

Exhibition

An exhibition was arranged for the benefit of the farmers. In the NRCG stall, charts depicting the raisins made from different grape varieties, detection of resistance in pathogens to QoI fungicides, weather forecast based advisory services, bio-control methods of insect pest and disease management, various specimens of insects, natural enemies of insect pests, cultures

of beneficial microbes, agrochemical residue analysis methods were displayed. Publications of the Centre were also available for the participants. M/s. Syngenta India Ltd., Bayer Crop Science, E. I India Dupont Ltd., Elantos Super, Rallis India Ltd., Dhanuka Ltd., Privi, Isagro Ltd., BASF Pvt Ltd., Omega Crop Science, UPL Ltd, Bhumi Agro Ltd., Drakshtar Ltd., Pralsar Ltd. participated in the exhibition.

On farm demonstration of technology

A Demonstration project on "Techniques to improve water use efficiency in Thompson Seedless vines" has been formulated in collaboration with MRDBS. Demonstration plot is being developed in Jath Taluka of Dist. Sangli. Six treatment combinations on both surface drip irrigation technique and subsurface drip irrigation technique at recommended and 75% of the recommended irrigation dose has been planned.

Field visits to address the problems reported by the growers

To identify the causes of chlorosis and drying of grafted Manik Chaman vines in Sangli and Solapur region

One grape grower from Palshi, Sangli and one from Mangalwed, Solapur brought vines of Manik Chaman grafted on rootstock which were wilted and dried in their fields for unknown reason. As per the saying of farmer's there was sudden drying and wilting, leading to death of vines. To examine the same, team of scientists consisting of Dr. R. G. Somkuwar, Dr. A. K. Upadhyay, Dr. J. Sharma, Dr. J. Satisha and Dr. D. S. Yadav visited their plots during the month of May and June respectively to identify the cause of such failures.

As per the investigations carried out both at field and in lab, it appeared a case of graft incompatibility leading to poor growth and root development, reduced nutrient translocation. The ungrafted rootstock plants did not exhibit any symptoms of leaf chlorosis and/or necrosis. The abnormal callusing was attributed to accumulation of food material translocated from scion leaves above graft joint (similar to girdling), and the poor development of root system was due to non-availability of food material required for good growth and development of root system. In both the gardens, the affected vines had some unidentified rootstock which was not

110R as claimed by the growers and there may be a chance of mixture of rootstock when it was supplied by the nursery. This clearly indicates the importance of procuring rootstocks from certified nursery which supplies genetically pure and disease free planting materials to the growers.

Survey and field advise on snail incidence in vineyards in Nashik

A survey was conducted to collect snail specimens for identification, and to estimate level of incidence and extent of damage caused by snails in Nashik grape region.

The survey was planned based on repeated inquiries over telephone by grape growers of Nashik region regarding management of snail. In response to the above inquiries, team of scientists consisting of Dr. D. S. Yadav and Mrs. Amala U., Scientists (Entomology) surveyed Nashik region on 19th and 20th August 2013.


Snail on grapevine


Snail on grapevine


Snail on grapevine

The snail infested vineyards were selected for survey in association with MRDBS, Nasik. Snail specimens were collected, nature and extent of damage was estimated based on visual symptoms in seven vineyards. For identification of the snail species, live specimens were sent to Dr. N. A. Aravind Madhyastha, Scientist Fellow, Biodiversity and Conservation Genetics Unit (Ashoka Trust for Research in Ecology and Environment), Bengaluru who identified it as Giant African Snail, *Lissachatina fulica* (Achantinidae: Pulmonata).

Both snail and their slime were found on different parts of vines such as trunk, cordons, leaves and on soil around the vine. The leaf feeding and defoliation was observed in all the visited vineyards. But the damage by snail could not be established due to simultaneous presence of *Spodoptera litura* larvae. Snail eggs were fluorescent green in colour and were found laid in groups on soil surface around the vines. No snails were observed feeding on roots.

Giant African Snail, *Lissachatina fulica* is an introduced, highly invasive species of snails. Therefore, the growers were advised not to transport them from one place to another and cull them on field itself. *L. fulica* is also a vector of a nematode, *Angiostrongylus cantonensis* causing human disease called meningitis. Therefore, grape growers were advised to always wear gloves while handling this species of snails. Continuous rainfall and cloudy conditions during July and

August months created favourable conditions for high incidence levels. As per *in vitro* studies *L. fulica* could feed on grapevine leaves, therefore, it is a potential pest of grapes. The growers were advised to collect and cull the snails by applying methomyl 40 SP @ 1.0 g/l water or 15% salt solution.

Outbreak of downy mildew in early pruned vines

There was outbreak of downy mildew disease in early pruned vineyards in Sangli (Manerajuri and Sony) and Baramati (Bori) areas. Dr. S.D. Sawant, Director in association with Maharashtra State Grape Growers' Association visited the area. Use of low doses of fungicides for spray and poor coverage of sprays were the major problems identified and accordingly the advice was given to growers in a growers' meeting organized at Tasgaon on 12th October 2013. Based on analysis of collected samples, it was found to to associated with resistance to commonly used fungisides of QoI and CAA group. Growers were asked to control disease in vineyards in which fruit pruning was not taken and where downy mildew inoculum was multiplying as it was a source of inoculum of pathogen in vineyards where fruit pruning was taken early.

Report on new clone

A farmer in Bedek, Sangli reported occurrence of clone with distinct features. Dr. S.D. Sawant, Dr. J. Satisha and Dr. Roshni Samarth visited his plot on 4th November 2013 to observe and study the new clone. The close observation reveals that the clone seems to be similar to Manjri Naveen in some characters like loose clusters, sensitive to GA_3 application etc. But, the uneven berry size in bunches and some other morphological characters were varying slightly. Cuttings were brought to plant in institute's plot and observe the characters for their consistency.

Field evaluation of hybrids

Dr. Indu S. Sawant, Dr. R. G. Somkuwar, Dr. S. D. Ramteke and Dr. Roshni Samarth visited the Hol farm of Agharkar Research Institute (ARI), Pune on 26th February 2014 for on-field evaluation of the hybrids developed and maintained by ARI. Total eight hybrids (H 516, H 1301, H 1164, H 435, ARI 228, H 144, H 27 and H 327) were scored for their performance in respect to vine growth and productivity, disease and pest, bunch quality and berry quality. Hybrid H516 was found suitable for juice making. The juice from H516 was also served to RAC members for their opinion.

Survey of hailstorm affected vineyards in Baramati and Sangli district

Due to unseasonal rains and hailstorm during March 2014, vineyards in Maharashtra and Karnataka suffered heavy losses. Teams of scientists comprising of Dr. R. G. Somkuwar, Dr. A. K. Upadhyay, Dr. J. Satisha, Dr. A. K. Sharma, Dr. J. Sharma and Dr. D. S. Yadav visited hailstorm affected vineyards of different grape growing regions of Maharashtra like Baramati,

Sangli, Solapur, Latur, Osmanabad and Nashik and Northern Karnataka districts such as Bijapur, Athani, Bagalkot etc. The nature of damage, extent of losses caused in both old and new vineyards were recorded. Some of the vineyards had collapsed whereas in many affected vineyards leaves were partially damaged but damage to bunch ranged from 30-100%. Site specific advice like cleaning of rotten berries in the bunch and spraying of chitosan and *Trichoderma* to prevent further rotting etc. were given. The report was compiled and presented in the interactive meeting to develop strategies to minimise the losses, which was held on 20th March, 2014 at NRCG, Pune. Representatives from MRDBS, Karnataka Grape Growers Association, MPKV, Rahuri and University of Horticultural Sciences, Bagalkot etc. were present in the meeting. After thorough discussions, a brief report was prepared wherein depending upon the extent of damage suffered by the vineyard; the affected vineyards were divided into five categories stating the extent of damage, likely consequences of this damage and the recommendations. The following were the recommendations for different categories of damage:

Category I: Severe damage on permanent vine parts (trunk, arms, cordons).

Recommendations:

- To retain 1 to 2 basal buds (spur pruning) on canes after back pruning.
- To take trial pruning on few vines to fix the level of back pruning.
- Spraying of copper based fungicides like Bordeaux mixture, copper oxychloride on trunk, arms and cordons to reduce secondary infection.

Category II: 100 % defoliation with few damaged bunches retained on vines.

Recommendations:

- As no leaves on vines, there is no scope for increase in sugar content in berries. Hence, recommended to immediately harvest the bunches to reduce the translocation of food reserves.
- Not to delay back pruning for more than 15 days to avoid sprouting on old shoots.

Category III: Leaves partially damaged but damage of bunches ranges from 30-100%.

Recommendations:

- Cleaning of rotten berries in the bunch.
- Spray of Chitosan and Trichoderma to prevent further rotting.
- Spray of Nuvan to soil.

Category IV: Toppling of vines due to high intensity wind coupled with hailstorm

Recommendations:

- Recover the vines as much as possible and manage the vineyard efficiently as per the package of practices.

Category V: Damage in young vineyards.

Recommendations:

- If the majority of the vines are damaged, take re-cut above the graft union leaving one or two matured basal buds and apply recommended fertilizers to boost the growth.

Participation in Growers' Seminar

- Dr. S. D. Sawant, Dr. R. G. Somkuwar, Dr. S. D. Ramteke, Dr. J. Sharma and Dr. D. S. Yadav, participated in the Charchasatra organized by MRDBS at Sangli on 18th April 2013 and guided grape growers on various remedial and preventive measures with respect to their specialization.
- Dr. S. D. Sawant and Dr. D. S. Yadav, participated in the Charchasatra organized by MRDBS at Baramati and Solapur on 1st and 3rd May 2013 respectively and guided grape growers on various remedial and preventive measures with respect to their specialization.
- Dr. S. D. Sawant, Dr. R. G. Somkuwar, Dr. S. D. Ramteke and Dr. D. S. Yadav, participated in the Charchasatra organized by MRDBS at Nasik on 16th May 2013 and guided grape growers on various remedial and preventive measures with respect to their specialization.
- Dr. S. D. Sawant, Dr. J. Sharma and Dr. D. S. Yadav, participated in the Charchasatra

organized by MRDBS at Nasik on 7th June 2013 and guided grape growers on various remedial and preventive measures with respect to their specialization.

- Dr. A. K. Upadhyay participated in seminar organised by Abhinav Grape Growers association at Junnar on 17th May and delivered a lecture on Nutrient and Water Management.
- Dr. S. D. Sawant, Dr. J. Sharma and Dr. D. S. Yadav, participated in the Charchasatra organized by MRDBS at Nasik – Satana area on 2nd July 2013 and guided grape growers on various remedial and preventive measures with respect to their specialization.
- Dr. S. D. Sawant, Dr. J. Sharma and Dr. D .S. Yadav, participated in the Charchasatra organized by MRDBS at Latur – Usmanabad area on 6th July 2013 and guided grape growers on various remedial and preventive measures with respect to their specialization.
- Dr. S. D. Sawant and Dr. D. S. Yadav, participated in the Charchasatra organized by MRDBS at Killari, Latur on 12th July 2013 and guided grape growers on various remedial and preventive measures with respect to their specialization.
- Dr. S. D. Sawant, Dr. K. Banerjee and Dr. D. S. Yadav, participated in the Grape Forum organized by M/s. Bayer Crop Sciences Ltd., M/s. Univeg Exporters and Grape Growers of Nasik at Nasik during 19-20th August 2013.
- Dr. S. D. Sawant participated in the Seminar organized by MRDBS on 2nd September 2013 at Sangli to discuss important package of practices after fruit pruning and delivered lecture on 'Plant protection after fruit pruning'.
- Dr. S. D. Sawant, Dr. R. G. Somkuwar, Dr. S. D. Ramteke, Dr. J. Sharma and Dr. D. S. Yadav participated in the Charchasatra organized by MRDBS at Solapur on 20th September 2013 and guided grape growers on various remedial and preventive measures with respect to their specialization in present situation.
- Dr. S. D. Sawant delivered lecture in the Regional Charchasatra organized by MRDBS at Rahata, Dist. Ahmednagar on 25th September 2013.
- Dr. S. D. Sawant delivered lecture in the Regional Charchasatra organized by MRDBS at Nasik on 26th September 2013.
- Dr. S. D. Sawant delivered lecture in the training programme to users of weather data based advisory at Nashik on 27th September 2013.
- Dr. S. D. Ramteke participated and delivered a talk on Judicious use of PGR at technical meet organised by Abhinav Grape grower's association at Junnar on 18th October, 2013.
- Dr. R.G. Somkuwar, Dr. J. Sharma and Dr. D. S. Yadav guided grape growers on nutrient management in "Growers' Meet cum Training Programme" organized by State Agriculture

Department at Tasgaon, Sangli on 8th October 2013. Also visited vineyard having leaf necrosis problem. The Grower had used tank mixtures of fungicides which led to leaf scorching. He was advised to use only recommended doses of fungicides to avoid such problems.

- Dr. S. D. Ramteke participated in Krishi 2013 organised at Nashik and delivered a talk on Plant Growth Regulator.
- Dr. S. D. Sawant, Dr. R. G. Somkuwar and Mrs. Amala U. delivered lecture in their field of specialization in regional charachasatra organised by MRDBS at Nashik on 2nd December, 2013.
- Dr. R. G. Somkuwar and Dr. D. S. Yadav guided grape growers in the Charchasatra organized by MRDBS at Solapur on 18th January 2014.
- Dr. S. D. Ramteke guided the grape growers in the 'Workshop for grape exporting farmers' organized by the Director of Horticulture, Pune at Savlaj, Taluka Tasgaon, District Sangli on 7th February 2014.

Participation in Krishi Vigyan Mela / Exhibitions

To impart the knowledge and technologies generated by NRCG to various stakeholders, stalls of this institute were arranged in the following five exhibitions:

1. Sakal Agrowon Expo -2013 during 22 – 26th November, 2013 at Pune,
2. KISAN, during 11-17th December, 2013 at Pune,
3. Agriculture Technology Exhibition, 18-20th January, 2014 at New Campus of KVK, Baramati,
4. Krishi Vasant, 9-13th February, 2014 at Nagpur and
5. Pusa Krishi Vigyan Mela, 26-28th February, 2014 at New Delhi

The generated technologies and results of various studies were displayed in the form of posters. During Agriculture Technology Exhibition at Baramati, His Excellency Sri Pranab Mukherjee, President of India along with Sri Sharad Pawar, Minister of Agriculture, GOI, Dr. Charan Das Mahant, Minister of Agriculture for state, GOI, Mr. Pruthviraj Chavan, Chief Minister, Maharashtra, Mr. Ajit Pawar, Dy. CM, Maharashtra State, Mr. Harshavardhan Patil, Minister of Cooperatives, Maharashtra State, Mr. Radha Krushn Vikhe-Patil, Minister of Agriculture, Maharashtra State, visited stall of NRCG on 19th Feb., 2014. Dr. S. Ayyappan, DG, ICAR was also present on our stall at the time of

arrival of president. During exhibition, approximately 2200 visitors from different parts of country visited Centre's stall. Beside charts, posters and publications, the live samples of different varieties of grapes and raisins made from different grape varieties and using different processing methods were also displayed. The institute also arranged sale of publications related to various aspects of grape growing and processing

Radio Talk

The programmes on following topics were recorded and telecasted on Aakashwani, Pune

- "Judicious use of bioregulators in grapes" on 11th October 2013.
- "Canopy management after fruit pruning" on 16th October 2013.
- "Weather information based disease management in vineyards and saving on cost of production" on 19th October 2013.

Education and Training

Deputation Abroad

Dr. S. D. Sawant visited Spain and Italy with the delegation of Maharashtra Rajya Draksha Bagaitdar Sangh during 31st July - 4th August 2013. He also visited Fruit Logistica Exhibition at Berlin, Germany during 5-9th February 2014 with the delegation of MRDBS.

Dr. K. Banerjee was deputed for participation in 127th AOAC International 2013 Annual Meeting & Exposition in Chicago, during 25-28th August 2013. He presented posters on 'Analytical method development for pesticide residue analysis in fish and application of high resolution GC-MS/MS for accurate identification and quantification of residues in fruits and vegetables'. He also presented work on "Screening of fruits, vegetables and processed commodities for emerging food contaminants by high resolution QToF LC-MS: An Indian perspective".

Training Acquired

- Dr. S. D. Sawant participated in 'Executive Development Programme on Leadership Development' organized by National Academy of Agricultural Research Management (NAARM), Hyderabad during 22-26th February 2014.
- Dr. Anuradha Upadhyay attended a training program on "NGS software tools for crop genome data analysis" held at NBPGR, New Delhi during 23rd - 26th October, 2013. The training program was held under NAIP consortium on National Agricultural Bioinformatics Grid (NABG).
- Mrs. Kavita Y. Mundankar participated in six week online training program 'Mobile for Development', a massive online course by IIT Kanpur and Common wealth of learning from 2nd October 2013.
- Mrs. Kavita Y. Mundankar participated in one day 'Sensitization cum Training Workshop for Nodal Officer of IPv6' organized by Indian Agricultural Statistics Research Institute, New Delhi on 27th February, 2014.
- Dr. Roshni Samarth participated in the Brainstorm Meeting cum Training on Cryopreservation and *in vitro* conservation of H-PGR organized by Society for Promotion of Horticulture, Bengaluru in collaboration with Indian Institute of Horticultural Research, Bengaluru during 21st - 22th February, 2014.
- Mrs. Amala U. attended 10 days ICAR sponsored short course on, "Detection and measurement of insecticide resistance including molecular aspects in Insects" at National Bureau of Agriculturally Important Insects (NBAII), Bangalore on September 2nd - 11th, 2013.
- Ms. Shailaja V. Satam participated in the workshop-cum-installation training programme for NAIP Consortium "Strengthening Statistical Computing for NARS" organized at Central Institute of Fisheries Education, Mumbai on 30th August 2013.

- Mrs. Pallavi Tated participated in the programme on "CSP for Assistants (DR) of ICAR" organized by Institute of Secretariat Training and Management, Delhi during 31st December 2013 - 10th January 2014.
- Dr. Dasharath Oulkar attended a training program on "The state-of-the-art of IMS enabled MS technology" at Manchester on 24th September, 2013.
- All the NRL staff attended one day workshop cum training program on "Analytical method validation on veterinary drug residue analysis in food commodities" organized on 31st May, 2013 at NRC for Grapes. The training was given by D. Glenn Kennedy, Agri-Food & Biosciences Institute, Northern Ireland, United Kingdom.
- Dr. Sagar Utture, Chemist National Referral laboratory participated in "Technical training on risk analysis for SAARC countries" organized by FAO Regional Office for Asia and the Pacific (RAP), Bangkok, Thailand in collaboration with the Quality Council of India Delhi, India at Ghaziabad, Uttar Pradesh, India, 17th - 21st June 2013.
- Dr. Sagar Utture attended a one day workshop on GC-QToF technology at Centre of Excellence, Agilent Technologies, Bangalore on 23rd December 2013 organised by Agilent Technologies, Bangalore.

Training Programmes Organized

Following training programmes were organized at the Centre and scientists were resource persons for their field of specialization.

- "Recent Advances in Viticulture" for eight officials of Dow AgroSciences India Pvt. Ltd., Mumbai during 18-19th June 2013. Dr. S. D. Ramteke coordinated the programme.
- "Plant Protection in Two Pruning Single Cropping System in Viticulture" during 7th - 8th August 2013 for forty officials of DuPont India Ltd. Dr. Indu S. Sawant and Dr. D. S. Yadav coordinated the programme.
- "Plant Protection in Two Pruning Single Cropping System in Viticulture" during 3-4th September 2013 for forty-three officials of Bayer India Ltd. Dr. Indu S. Sawant and Dr. D. S. Yadav coordinated the programme.
- "Mycotoxin Residue Analysis in Various Commodities" on 16-17th September 2013 for the testing laboratories or organizations involved in testing of food commodities for 44 officials. Dr. Ahammed Shabeer T. P. coordinated the program.
- "Plant Protection and Nutrient Management in Two Pruning and Single Cropping System in Viticulture" during 23-24th September 2013. Fifteen persons participated in the training programme. Dr. D. S. Yadav and Dr. A. K. Upadhyay coordinated the programme.

- Two training programmes on "Advanced Viticulture" for grape growers were organized in collaboration with MRDBS during 21st - 30th June 2013 and 4-13th July 2013.
- "Multi-residue Method for Pesticide Residue Analysis" during 30th Septmeber-4th October, 2013. A total of 8 officials including 5 from Spices Board, Cochin and 3 from Dept. of Agri., Govt. of Rajasthan participated in the program. The program was coordinated by Dr. Kaushik Banerjee and Dr. Ahammed Shabeer T. P.
- A hand on training program on "Pollen Cryo preservation" during 27th - 28th November 2013. Dr. Ganeshan (Principal Scientist & Head, Division of Plant Genetic Resources) from Indian Institute of Horticultural Research, Bengaluru was invited for demonstrating the pollen cryopreservation in grapes.
- "Pesticide Residue Analysis using GC-MS in Various Commodities" on 11th December, 2013 in collaboration with Shimadzu India for the testing laboratories or organizations involved in testing of food commodities. A total of 40 people participated in the program and the program was coordinated by Dr. Kaushik Banerjee.
- "Sampling of Grapes from Field for Pesticide Residue Analysis as per RMP for Grapes" on 21st December, 2013 at NRCG for the participants from Centre for Food Testing, Bharati Vidyapeeth University, Pune. A total of 9 people participated in the training. Similarly, on request training on sampling was also given to FirstSource Laboratory Solutions LLP, Hyderabad (19 participants) and SGS, Kolkata (9 participants). The program was coordinated by Dr. Kaushik Banerjee.
- "Workshop on Persistent Organic Pollutants (POPs) including dioxins" for the nominated labs where international regulations and analytical methods for POPs were deliberated.
- One day awareness "Training program on ISO 9001:2008" on 7th January 2014 at NRC Grapes.
- A one day "Training cum Awareness Program on Protection of Plant Varieties and Farmers Rights Act – 2001" on 5th March 2014 under the Chairmanship of Dr. R. R. Hanchinal, Chair-person, PPV&FR Authority, New Delhi. Dr. S. D. Shikhamany, Ex Vice Chancellor, Dr. YSR Horticultural University, West Godavari, Andhra Pradesh; Dr. R. C. Agarwal, Registrar General, PPV and FR Authority, New Delhi, Dr. S. D. Sawant, Director, NRC for Grapes, Pune, Shri. Subhash Arve, Vice President, MRDBS, Pune were the other dignitaries presided during this program. About 75 persons comprising of grape growers, scientists, research fellows and technical persons etc. participated in the

program. During the occasion, the technical bulletin entitled "Characterization of Grape varieties for DUS (Distinctiveness, Uniformity and Stability)" was released by the hands of Dr. R. R. Hanchinal.

In the program the grape growers were educated about the functions and role played by the PPV and FR Authority, registration of varieties under farmer's rights, etc.

The grape growers showed keen enthusiasm over registering the new mutants/clones identified by them and enquiring about when to submit application. Since, the registration for grapes is yet to be notified in gazette, the Chairperson, PPV&FRA assured about opening of registration in few months. It was decided that, once the registration is open, the information will be intimated to all growers through mail/phone and also uploaded on institute's website.

Four technical presentations were also made on different aspects of PPV and FRA-2001, importance of DUS testing, DUS descriptors of Vitis spp. and Procedures of Registering varieties etc. by Dr. G.S. Karibasappa, Dr. J. Satisha and Dr. Roshni R. Samarth. The training program was coordinated by Dr. J. Satisha, Sr. Scientist (Horticulture) and Dr. Roshni R. Samarth, Scientist (Plant Breeding).

- "Production of Quality Grapes through Good Viticultural Practices for Peninsular India" during 11-13th March 2014. Thirty-three field staff from M/s. Syngenta India Ltd. participated in this training programme.

Training given / summer training / invited lectures

- Dr. J. Sharma delivered presentation on 'Precision Grape Farming' in the Advance Workshop on "Integrated Approaches of Precision Farming" organized by Deepak Fertilisers and Petrochemicals Corporation Limited at YASHDA, Pune on 18th October 2013.
- Dr. K. Banerjee imparted three months professional attachment training to Dr. Anirban Dutta, Scientist trainee of IARI, New Delhi and Mr. Yengkhom Bijen Kumar of Indian Institute of Vegetable Research, Varanasi.
- Dr. S. D. Ramteke was resource person for training program on Residue Monitoring Plan in grapes organised by State Govt. of Maharashtra on 21st October, 2013 at Pune. He delivered presentation on Importance of PGR in grape for export to European Union.

Doctoral Research

Scientists of the Centre are recognised as Ph.D. guide by Shivaji University, Kolhapur and University of Pune. At present 25 students are registered for their Ph.D. research under different scientists.

Post Graduate Project Work

Following scientists gave project training for a period of 4-6 months to PG students from across the country. The research work pertained to ongoing project activities.

Name of Scientist	Title of the project	No. of students	Institution / University
Dr. Indu S Sawant	Studies on production of extra cellular enzyme by *Bacillus* spp.	1	MATS University, Raipur, Chattisgarh
	Studies on production of extra cellular enzyme by *Trichoderma* spp.	1	Dr. D.Y. Patil Biotechnology and Bioinformatics Institute, Pune
	Degradation of grape pruning waste using *Trichoderma* spp.	1	
	Induced Systemic Resistance (ISR) effects of *Bacillus* spp. against grape diseases	1	Institute of Biosciences and Biotechnology, CSJM, University, Kanpur
Dr. R.G. Somkuwar	Maturity standards in relation to temperature of different wine varieties	1	MATS University, Raipur, Chattisgarh
	Growth performance and yield in relation to wine quality in different white wine varieties	1	MGM College of Agricultural Biotechnology, Aurangabad
	Vegetative growth and biochemical changes in relation to growth stages in different red wine varieties	1	
Dr. Anuradha Upadhyay	Identification of candidate genes for hormone response and analysis in grapevine	1	Centre for Converging Technologies, University of Rajasthan, Jaipur
Dr. S. D. Ramteke	Impact of leaf thickness on biochemical yield and quality parameters of grape genotypes	1	Rajashri Shahu Mahavidyalaya, Latur
Dr. K. Banerjee	Phenolic profiling of grape varieties Merbin Seedless and Sonaka and effect of processing on phenolic contribution	1	MATS University, Raipur, Chattisgarh

Name of Scientist	Title of the project	No. of students	Institution / University
Dr. A.K. Sharma	Improvement in quality of ice cream by adding winery by product	1	Guru Gobind Singh Indraprastha University, New Delhi
	Use of winery waste in food	1	North Maharashtra University, Jalgaon
	Enrichment of Yoghurt through addition of wine lees	1	Amity University, Noida
Dr. Ahammed Shabeer T.P.	Phenolic profiling of grape varieties Sharad Seedless and Bangalore Blue	1	MATS University, Raipur, Chattisgarh
Dr. Roshni Samarth	Morphological characterization of grape hybrids	2	MATS University, Raipur, Chattisgarh

Faculty for M.Sc. (Wine Technology) course of Pune University

All the scientists were the resource person for their respective field of specialization for viticulture course of M.Sc. (Wine Technology) of Pune University. This post-graduate degree course is being offered by Vasantdada Sugar Institute, Pune.

Short term training to under graduate students

Dr. R. G. Somkuwar coordinated one week training on Practical Vineyard Technology for 13 B.Sc. (Wine Technology) students of New Arts Commerce and Science College, Ahmednagar

Awards and Recognitions

Awards

- National Referral Laboratory of the Centre has been accriditated by NABL for chemical testing and Accreditation Certificate No. T-2813 (Chemical Testing) valid till 30.01.2016 has been received.
- Dr. Indu S. Sawant received "Best Woman Scientist Award" during "International Conference: Biodiversity, Bioresources and Biotechnology" organized by Association for the Advancement of Biodiversity Science; Society for Applied Biotechnology; Imperial Scientific Publishing during 30-31st January 2014. She also delivered an award lecture on "Microbial diversity".
- Dr. A.K. Sharma received first award for his slogan in a competition organized by Rajbhasha Section of ICAR during celebration of Hindi month. He received his award on 1st Jan 2014 in a special function of ICAR at New Delhi.
- Poster presentation "Degradation Kinetics of Forchlorfenuron, 6-Benzyl adenine, Gibberellic acid (GA3) and Ethephon in Grapes (*Vitis vinifera)*" by Ugare et al received best poster award in National Conference of Plant Physiology – 2013 organized at Directorate of Groundnut Research, Junagadh held on 13-16th December, 2013.
- Dr. S. D. Ramteke received the "Best citizens of India award 2013" by The International Publishing House, New Delhi.
- Poster presentations "Development of analytical method for analysis of volatile compounds from Indian wines using gas chromatography mass spectrometry coupled with thermal desorption system" by Kamble, N. et al. and "Degradation kinetics of Buprofezin, Imidacloprid and Flubendiamide residues in Okra (*Abelmoschus esculentus* L. (Moench)" by Hingmire, S. et al. received 1st and 2nd prize respectively in National Seminar on "New Trends in Pest Management" organized at Shivaji University, Kolhapur on 31st January, 2014.

Recognitions

Fellows of Societies

- Dr. Indu S. Sawant is elected as Fellow of the Association for the Advancement of Biodiversity Science, Karnataka.
- Dr. K. Banerjee was elected as Fellow of the National Academy of Agricultural Sciences, New Delhi.

Editorial Boards

- Dr. Indu S. Sawant continued as a member in National Editorial Board of The Horticultural Society of India during the year.

- Dr. A. K. Sharma was nominated as the member Editorial Board of 'Progressive Horticulture' Journal of Indian Society of Horticultural Research and Development.

Invited Speakers

- Dr. S. D. Sawant was invited to deliver a talk on "Strategies for safe and judicious use of pesticides in grape" in seminar on "Safe and judicious use of agrochemicals and application of green chemistry" organised by FICCI on 10th March, 2014 at Pune.
- Dr. Indu S. Sawant was invited to deliver a talk on "*Trichoderma* - Biotechnology and strategies for biocontrol of foliar fungal pathogens" in International Conference on Advances in Biotechnology and Bioinformatics 2013' at Pune during 25-27th November, 2013.
- Dr. Indu S. Sawant was invited to deliver a talk on "Utilization of the functional diversity of plant associated microbes for biological control of fungal diseases of horticultural crops" in the International Conference Biodiversity, Bioresources and Biotechnology, Mysore during 30th - 31st January, 2014.
- Dr. Indu S. Sawant was invited to deliver a talk on "Biological control of *Phytopthora* using *Trichoderma* spp." in the "National Citrus Meet" organized by PPV&FRA and NRC for Citrus on 13th August, 2013 at Nagpur.
- Dr. Anuradha Upadhyay was invited as expert speaker during national seminar on "Accelerating Biology 2014: Computing Life" held during February 18-20, 2014 at Pune and organized by cDAC Pune. She deliverd talk on "RNA seq based analysis of salinity stress response in grapevine (*Vitis vinifera* L.)".
- Dr. Kaushik Banerjee was invited to deliver a lecture "Challenges in pesticide residue analysis in India" in Waters Food Summit at ITC Grand Chola, Chennai during 27-28th May, 2013.
- Dr. Kaushik Banerjee was invited to deliver a lecture "Screening of fruits and vegetables for the residues of pesticides and other emerging food contaminants by GC-MS and LC-MS" in Analytica Anacon. Session: "Food Safety and Standards - Priorities for India" at Mumbai on 13th November, 2013.
- Dr. Kaushik Banerjee was invited to deliver a lecture "Application of molecular imprinting technology in contaminant residue analysis" in Indo-UK Seminar "Molecular Imprinting: Strategies, Applications & Future Perspective" organized by National Environmental Engineering Research Institute (NEERI), Nagpur, during 5-7th February, 2014.
- Dr. Ahammed Shabeer T. P. was invited to deliver a lecture "Organic contaminants in fruits and vegetables" in National Seminar on "Soil Fertility, Degradation and Contaminants" organized by Dapoli Chapter of Indian Society of Soil Sciences, DBSKKV, Dapoli during 8-9th May 2013.

Members of Committees

- Dr. S. D. Sawant was nominated as DG's nominee to Board of Management of UHS, Bagalkot and Executive Council of MPKV, Rahuri.
- Dr. J. Satisha and Dr. A. K. Upadhyay were nominated by ICAR as member of Institute Management Committee of NRC Grapes, Pune for the period of three years from 2013-14.
- Dr. A. K. Upadhyay was nominated by ICAR as Vigilance Officer at the Centre.
- Dr. Anuradha Upadhyay was nominated as external expert in Institute Biosafety committee (IBSC) of MPKV Rahuri by DBT and attended a meeting of IBSC on 23rd January, 2014.
- Dr. Kaushik Banerjee was nominated as member of Review Committee constituted by the Director General- Indian Council of Medical Research to review the progress of the project on Nutritive Value of Indian Foods currently ongoing at the National Institute of Nutrition, Hyderabad. The review was carried out on 8th March 2014.
- Dr. Kaushik Banerjee, Dr. Ahammed Shabeer T.P. and several other staff of NRL were nominated as the Chairman and members of Electronic Working Groups set up by the Food Safety Standards Authority of India (FSSAI) for drafting the Indian standards for harmonization with the International standards. They prepared the draft standards for several agricultural commodities and submitted to FSSAI.
- Dr. S. D. Ramteke was nominated as a member of Department Promotion Committee to clear probation of 4 scientists at National Institute on Abiotic Stress Management, Baramati.

Examiners / Reviewers

- Dr. R. G. Somkuwar and Dr. J. Satisha were invited as external examiner for qualifying viva - voce of Ph. D (Pomology) student at MPKV, Rahuri on 11th September 2013.
- Dr. Indu S. Sawant judged posters presented in the "International Conference on Advances in Biotechnology and Bioinformatics 2013" during 25-27th November 2013.
- Dr. Indu S Sawant was DG's nominee as subject expert for CAS- DPC of Scientist Plant Pathology (DOG, Rajgurunagar) on 25th January, 2014.
- Dr. Anuradha Upadhyay recognized as a reviewer by Biologia Plantarum (Springer publication), Journal of Ecosystem (Hindawi publication) and Journal of Horticultural Sciences (SPH publication).
- Dr. Anuradha Upadhyay and Dr. J. Satisha were invited on 17th April 2013 as external members in the interview committee for selection of JRF's at NCL, Pune for DBT funded projects.

- Dr. A.K. Upadhyay was nominated as Controller of Examinations for conducting exams for recruitment of LDC, Stenographer and AFAO at the Centre.
- Dr. S. D. Ramteke was member of selection committee at DOGR, Rajgurunagar for recruitment of T1 (farm) and lab technicians and at NIASM, Baramati for selection of SRF.
- Dr. J. Satisha was recognized as examiner for setting up question paper for Viticulture course WT 1 and Practical examination for the Fermentation Technology course offered by Pune University at Vasantdada Sugar Institute, Pune.
- Dr. Ahammed Shabeer T. P. was nominated as member of recruitment committee for filling of the post of lower division clerk at NRC for Pomegranate, Solapur.

Session Chairman / Convener

- Dr. S. D. Sawant was Chairman for the session on "Plant Protection" during XXI Group discussion of AICRP on Fruits at Dapoli from 22nd - 25th January, 2014.
- Dr. Roshni R. Samarth was Convener for the Session on Planting Density, Propagation and Rootstocks (Session-II) during XXI Group Discussion of AICRP on Fruits at Dapoli from 22nd - 25th January, 2014.

Linkages and Collaboration

Collaborating and Externally Funded Projects

i. National Referral Laboratory for monitoring pesticide residues for export of fresh grapes from India (APEDA).

ii. Intellectual Property Management and Transfer/Commercialization of Agricultural Technology (NAIP-ICAR Scheme).

iii. Validation of DUS Characters for Grapes (PPV & FRA).

iv. Decision Support System for Enhancing Productivity of Grapes under Moisture and Temperature Stress Conditions (NFBSRA).

v. Understanding Rachis and Berry Elongation in Response to GA_3 Application in Thompson Seedless Grapes using Functional Genomics Approach (DBT).

vi. Functional Analysis of Salinity Stress Response in Grapevine (DBT).

Publications

Research Articles

A. Institutional work

1. Amala U. and Yadav D. S. 2013. Effect of natural hosts and alternate food sources on the biological parameters of acarophagous predator., *Stethorus rani* Kapur. *Pest Management for Horticultureal Ecosystems*. 19(2): 169-172.

2. Amala U. and Yadav D. S. 2013. Study on life table parameters and predatory potential of *Stethorus rani* Kapur on red spider mite, *Tetranychus urticae* Koch, Biopesticides International. 9(2): 113–119 (NAAS 2013 4.5).

3. Amala U., Yadav D. S. and Bhosale A.M. 2013. Studies on parasitoid complex of mealybug infesting grapes in Maharashtra. *Journal of Applied Horticulture*. 15(2): 117-119 (NAAS 2013 4.5).

4. Goswami A. K., Somkuwar R. G., Samarth Roshni R., Sharma A. K., Nawale Supriya, and Itroutwar Prerna. 2013. Evaluation of coloured seedless table grape varieties for increase in shelf-life. *HortFlora Research Spectrum*. 2(40): 324-328.

5. Jadhav M. R., Utture S. C., Banerjee Kaushik, Oulkar D. P., Sabale R. and Ahammed Shabeer TP. 2013. Validation of a residue analysis method for streptomycin and tetracycline and their food safety evaluation in pomegranate (*Punica granatum* L.). J. *Agric. Food Chem*. 61(36): 8491-8498 (NAAS 2013 7.8).

6. Nagarajan G., Khan Z., Utture S. C., Dasgupta S., Banerjee Kaushik. 2013. Ensuring selectivity and sensitivity by timed- and ultra-selective reaction monitoring during gas chromatography tandem mass spectrometric determination of pesticides. *Journal of Chromatography* A. 1318:226-233 (NAAS 2013 8.2).

7. Ramteke S.D., Bhange M. A., Somkuwar R. G., and Kor R. J. 2012. Efficiency of weedicide (UPH 707) to control complex weed flora in Thompson Seedless grape vineyard. *Progressive Horticulture*. 45 (2): 259-264 (NAAS 2012 3.6).

8. Ramteke S. D., Rajurkar A.B., Bhange M. A., and Kor R. J. 2012. Chemical management of broad leaved weeds in grapes. *Indian Journal of Weed Science*. 44(3): 198–202 (NAAS 2012 2.9).

9. Sabale R., Ahammed Shabeer T. P., and Banerjee Kaushik. 2013. Dissipation kinetics, safety evaluation and assessment of pre-harvest interval (PHI) and processing factor for kresoxim methyl residues in grape. *Environmental Monitoring and Assessment*. 186 (4): 2369-2374 (NAAS 2013 7.5).

10. Salunkhe Varsha P., Sawant Indu S., Banerjee Kaushik, Rajguru Yogita R., Wadkar Pallavi N., Oulkar D. P., Naik D. G., and Sawant S. D. 2013. Biodegradation of profenophos by

Bacillus subtilis isolated from grapevines. *Journal of Agricultural Food Chemistry*. 61: 7195-7202 (NAAS 2013 7.8).

11. Satisha J., Oulkar D. P., Banerjee Kaushik, Sharma J., Patil A. G., Maske S. R., Somkuwar R. G. 2013. Biochemically induced variations during some phonological stages in Thompson Seedless grapevines grafted on different rootstocks. *South African Journal of Enology and Viticulture*. 34 (1): 36-45 (NAAS 2013 7.6).

12. Satisha J., Oulkar D. P., Vijapure Amruta N., Maske Smita R., Sharma A. K., and Somkuwar R.G. 2013. Influence of canopy management practices on fruit composition of wine grape cultivars grown in semiarid tropical region of India. *African Journal of Agricultural Research*. 8 (24): 3462-3472. DOI. 10.5897/AJAR/ 12.2066 (NAAS 2013 6.0).

13. Satisha J., Ramteke S. D., Sharma Jagdev, and Upadhyay A. K. 2014. Moisture and salinity stress induced changes in biochemical constituents and water relations of different grape rootstock cultivars. *International Journal of Agronomy*, pp: 1-8. DOI: http://dx.doi.org/10.1155/2014/789087.

14. Satisha J., Sharma A. K., and Adsule P. G. 2014. Rootstock influence on the biochemical composition and polyphenol oxidase activity of 'Thompson Seedless' grapes and raisins. *International Journal of Fruit Science*, 14(2): 133-146. DOI: 10.1080/15538362.2013.817767.

15. Sawant Indu S., Shetty D. S., Narkar Shubhangi P., Ghule S., and Sawant S. D. 2013. Climate change and shifts in etiology of anthracnose disease of grapevines in India. *Journal of Agrometeorology*. 15: 75-78 (NAAS 2013 6.6).

16. Sharma A. K., Kumar R., Azad ZRAA and Adsule P. G. 2013. Use of fine wine lees for value addition in ice cream. *Journal of Food Science and Technology*. http://link.springer.com/article/10.1007/s13197-013-1007-x# DOI: 10.1007/ s13197-013-1007-x (NAAS 2013 6.9).

17. Shinde Manisha P., Upadhyay Anuradha, Aher Lalitkumar B. and Karibasappa G.S. 2013. Molecular marker analysis to differentiate a clonal selection of Centennial Seedless grapevine. *African J. of Biotechnology*. 12(14):1594-1597. 3 April 2013 (NAAS 2013 6.0).

18. Siddharth and Sharma A. K. 2013. Blending of Kokum extract in Concord grape juice: Study on physico-chemical characteristics, sensory quality and storage. *International Journal of Food and Fermentation Technology*. 3(1): 79-83.

19. Somkuwar R. G., Bondage D. D., Surange M., Navale S., and Sharma A. K. 2013. Yield, raisin recovery and biochemical characters of fresh and dried grapes (raisin) of Thompson Seedless grapes (*Vitis vinifera*) as influenced by different rootstocks. *Indian Journal of Agricultural Sciences*. 83(9): 924-927 (NAAS 2013 6.6).

20. Somkuwar R. G., Samarth Roshni R., Satisha J., Ramteke S. D, and Itroutwar Prerna. 2013. Status of dry matter at harvesting stage in commercially grown varieties under tropical climatic condition. *HortFlora Research Spectrum*. 2(2): 110-115.

21. Somkuwar R. G., Satisha J., and Ramteke S. D. 2013. Berry weight, quality and biochemical changes in relation to cane thickness of own rooted and grafted Tas-A-Ganesh grapes. *Journal of Horticultural Sciences*. 18(1): 30-34 (NAAS 2013 3.6).

22. Somkuwar R .G., Sharma J., Satisha J., Khan Ishrath, and Itroutwar Prerna. 2013. Effect of zinc application to mother vines of Dogridge rootstock on rooting success and establishment under nursery conditions. *Intl. J. Scientific. Tech. Res*. 2: 198-201.

23. Ugare B., Banerjee Kaushik, Ramteke S. D., Pradhan S., Oulkar D. P., Utture S. C., and Adsule P. G. 2013. Dissipation kinetics of forchlorfenuron, 6-benzyl aminopurine, gibberellic acid and ethephon residues in table grapes (*Vitis vinifera*). *Food Chemistry*. 141 (2013) 4208-4214 (NAAS 2013 8.0).

24. Upadhyay A. K., Sharma Jagdev, and Satisha J. 2013. Influence of rootstocks on salinity tolerance of Thompson Seedless grapevines. *Journal of Applied Horticulture*, 15(3): 173-177 (NAAS 2013 4.5).

25. Upadhyay Anuradha, Aher Lalithkumar B., Shinde Manisha P., Mundankar Kavita Y., Datre Anuj, and Karibasappa G.S. 2013. Microsatellite analysis to rationalize grape germplasm in India and development of a molecular database. *Plant genetic resources: characterization and utilization*. 11(3): 225–233 (IF 0.73).

B. Collaborative work

26. Ahammed Shabeer T. P., Saha Ajoy, Gajbhiye V. T., and Gupta Suman. 2013. Optimization and validation of LLE/HPLC-DAD method to determine the residues of selected PAHs in surface water. *International Journal of Agriculture, Environment & Biotechnology*. 6(2): 241-248 (NAAS 2013 3.9).

27. Mazumdar M., Das S., Saha U., Chatterjee M., Banerjee Kaushik, Basu D. 2013. Salicylic acid-mediated establishment of the compatibility between *Alternaria brassicicola and Brassica juncea* is mitigated by abscisic acid in *Sinapis* alba. *Plant Physiology Biochemistry*. 70: 43-51 (NAAS 2013 7.8).

28. Mujawar S., Utture S. C., Fonesca E., Matarrita J., Banerjee Kaushik. 2013. Validation of a GC-MS method for the estimation of dithiocarbamate fungicide residues and safety evaluation of mancozeb in fruits and vegetables. *Food Chemistry*. 150: 175-181 (NAAS 2013 8.0).

29. Saha S., Banerjee Kaushik, and Rai A. B. 2013. Bioefficacy, residue dynamics and safety assessment of the combination fungicide trifloxystrobin 25% + tebuconazole 50% 75 WG in managing early blight of tomato (*Lycopersicon esculentum* Mill.). *Journal of Environmental Science and Health*. Part B 49: 134-141 (NAAS 2013 7.3).

30. Satisha J., Keith R Striegler, Eli Bergmeier, and Jackie Harris. 2013. Influence of canopy management practices on canopy characteristics, yield and fruit composition of Norton grapes (*Vitis aestivalis* Michx). *International Journal of Fruit Science*. 13: 441-458.

Papers Presented at Symposia / Workshops / Meetings

A. International

1. Banerjee Kaushik, Ahammed Shabeer T. P., Utture S., Kamble N., Khan Zareen, and Chaterjee Niladri. 2013. Multi-pesticide residue analysis by GC-MS/MS: ensuring selectivity and sensitivity by timed- and ultra-selective reaction monitoring. Poster presented in 127th AOAC International Meeting and Exposition at Chicago, Illinois, USA during 25-30th August 2013.

2. Banerjee Kaushik, Utture S., Khan Zareen, and Gayathree N. 2013. Multiresidue analysis of 119 chemicals including pesticides and PAHs in fish by gas chromatography tandem mass spectrometry. Poster presented in 127th AOAC International Meeting and Exposition at Chicago, Illinois, USA during 25-30th August 2013.

3. Banerjee Kaushik. 2013. Screening of fruits, vegetables and processed commodities for emerging food contaminants by high resolution QToF LC-MS: an Indian perspective. Session: Quantitative and Qualitative Analysis of Emerging Substances of Concern (ESOCs) Using Liquid Chromatography High Resolution Mass Spectrometry (LC-HRMS): Method Development, Method Verification/Validation, and Method Harmonization. In 127th AOAC International Meeting and Exposition at Chicago, Illinois, USA during 25-30th August 2013.

4. Banerjee Kaushik. 2014. Application of molecular imprinting technology in contaminant residue analysis. Invited lecture in Indo-UK Seminar organized by National Environmental Engineering Research Institute (NEERI), Nagpur, between February 5-7, 2014 on the topic "Molecular Imprinting: Strategies, Applications & Future Perspective".

5. Ramteke S. D., Khot A. P. and Ahire K. D. 2013. Bioefficacy, phytotoxicity and terminal residue analysis of Diuron on narrow and broad leaf weeds in grapes. Accepted for oral presentation and publication in Life Sciences International Research Journal in International Conference on Agriculture, Veterinary and Life Sciences-2014, 24-25th January, 2014, Vijayawada, Andhra Pradesh, India. Ref. No: S035B Dated: 26-12-2013.

6. Salunkhe Varsha P., Sawant Indu S., Kaushik Banerjee, Pallavi N. Wadkar, Dashrath P. Oulkar, and Sawant S. D. 2014. Kinetics of degradation of carbendazim on grape by *B subtilis* isolates: possibility of *in situ* detoxification. In the International Conference Biodiversity, Bioresources and Biotechnology, Mysore, 30th - 31st Janaury, 2014.

7. Wadkar Pallavi N., Sawant Indu S., Salunkhe Varsha P., Sawant S. D., and Nishant Srivastava. 2014. Induction of systemic resistance in grapes against fungal diseases: a means to minimize fungicide use. In the International Conference Biodiversity, Bioresources and Biotechnology, Mysore, 30th - 31st Janaury, 2014.

B. National

8. Hingmire S., Oulkar D. P., Utture S., Wagh S., More S., Ghadage Sujata, Patil S., Ahammed Shabeer T.P. and Banerjee Kaushik. 2014. Degradation kinetics of Buprofezin, Imidacloprid and Flubendiamide residues in Okra (*Abelmoschus esculentus* L. (Moench)). Poster presented in National Seminar on "New Trends in Pest Management" organized at Shivaji University, Kolhapur on 31st January, 2014.

9. Kamble N., Utture S., Ahammed Shabeer T. P., Kandaswamy Chandrasekar, Kulkarni S., and Banerjee Kaushik. 2014. Development of analytical method for analysis of volatile compounds from Indian wines using gas chromatography mass spectrometry coupled with thermal desorption system. Poster presented in National Seminar on "New Trends in Pest Management" organized at Shivaji University, Kolhapur on 31st January, 2014.

10. Ramteke S. D. Khot A. P. and Dhakad R. B. 2013. Physiological effects of Cabrio top (60%WG) on yield and quality parameter of Thompson seedless grapes. Poster paper presented at National Conference of Plant Physiology 13-16th December 2013 at DGR, Junagadh, Gujarat, India. Abs no. P 5-1, pp. 821-822.

11. Ramteke S. D., Dhakad R. B., Ahire K. and Khot A.P. 2013. Bio-efficacy of Milagro in Tas-A-Ganesh grapes. In National conference on recent trends on plant sciences, its future prospects and biodiversity conservation at YC College of Science, Karad during 29-30th November 2013 Abs.no 38 page 42.

12. Ramteke S. D., Dhakad R. B., Ahire K. and Khot A.P. 2013. Bio-efficacy, phytotoxicity and residue dissipation of CPPU in Tas-A-Ganesh grapes grafted on Dogridge rootstock. Poster paper presented at National conference on recent trends on plant sciences, its future prospects and Biodiversity Conservation at YC College of Science, Karad during 29-30th November 2013. Abs no. 39, page no 43.

13. Ramteke S. D., Dhakad R. B., Ahire K. and Khot A.P. 2013. Standardization of bio-regulators schedule for improving quality and yield of Manjri Naveen grapes. In National conference on recent trends on plant sciences, its future prospects and biodiversity conservation at YC College of Science, Karad during 29-30th November 2013 Abs.no 37 page no 41.

14. Ramteke S. D., Kor R.J., and Khot A. P. 2013. Effect of Vitormone (Biofertilizer) on quality and yield parameters of Thompson Seedless grapes grafted on Dogridge rootstock. Poster paper presented at National Conference of Plant Physiology 13-16th December 2013 at DGR, Junagadh Gujarat, India. Abs no. P 5-9, pages no 837-838.

15. Ramteke S. D., Kor R.J., Bhange M. A., and Khot A.P. 2013. Impact of bio-regulators on gas exchange parameters, yield and quality of Manjri Naveen grape variety. Oral presented at National Conference of Plant Physiology 13-16th December 2013 at DGR, Junagadh Gujarat, India. Abs no. O 4-5, pp. 835-836.

16. Shinde Manisha P., Upadhyay Anuradha, Upadhyay A. K., and Sarika. 2014. Expression analysis of salinity responsive transcription factors in grapevines (*Vitis vinifera* L.). Oral presentation in National Symposium on Advances in Plant Molecular Biology and Biotechnology held at IISER, Pune during 10-12th March, 2014.

17. Ugare B., Banerjee Kaushik, Ramteke S. D. and Khot A. P. 2013. Determination and dissipation kinetics of homobrassinolide and 1-naphthyl acetic acid in grapes (*Vitis venifera*). Oral presented at National Conference of Plant Physiology 13-16th December 2013 at Directorate of Groundnut Research, Junagadh Gujarat, India. Abs no. P 4-39, pp. 809-810.

18. Ugare B., Banerjee Kaushik, Ramteke S. D., Khot A. P., Jadhav Manjusha, Oulkar D. P., and Deshmukh M. 2013.. Determination and dissipation kinetics of homobrassinolide and 1-Naphthylacetic acid in grapes (*Vitis vinifera*). In National Conference of Plant Physiology - 2013 organized at Directorate of Groundnut Research, Junagadh held on 13-16th December, 2013.

19. Ugare B., Banerjee Kaushik, Ramteke S. D., Pradhan Saswati, Oulkar D. P., Utture S. C., and Adsule P. G. 2013. Dissipation kinetics of forchlorfenuron, 6-benzyl aminopurine, gibberellic acid (GA_3) and ethephon residues in table grapes (*Vitis vinifera*). Poster presentation at National Conference of Plant Physiology 13-16th December 2013 at Directorate of Groundnut Research, Junagadh Gujarat, India.

20. Ugare B., Banerjee Kaushik, Ramteke S. D., Pradhan Saswati, Oulkar D. P., Utture S., Deshmukh M. 2013. Degradation Kinetics of Forchlorfenuron, 6-Benzyl adenine, Gibberellic acid (GA_3) and Ethephon in Grapes (*Vitis vinifera*). Poster presented in National Conference of Plant Physiology - 2013 organized at DGR, Junagadh held during December 13-16, 2013.

21. Utture S., Vanarase Mrunmayee, Kamble N., Ahammed Shabeer T.P., and Banerjee Kaushik. 2014. Development of a sample preparation method for multiresidue analysis of 277 pesticides in wine. Poster presented in National Seminar on "New Trends in Pest Management" organized at Shivaji University, Kolhapur on 31st January, 2014.

Technical Bulletin

1. Ramteke S. D. 2013. Use of Bioregulators for production of quality grapes. 2nd Edition. National Research Center for Grapes, Pune.

2. Satisha J., Samarth Roshni R., Karibasappa G. S., Upadhyay Anuradha, Adsule P. G. and Sawant S. D. 2014. Characterization of *Vitis* spp for Distinctiveness, Uniformity and Stability. Technical Bulletin No. 15. NRC Grapes, Pune. Pp. 24.

3. Somkuwar R. G. and Satisha J. 2014. Establishment of New Vineyards - Do's and Don'ts. Technical Bulletin No. 12. NRC Grapes, Pune. Pp: 32

4. Somkuwar R. G. and Satisha J., 2014. Foundation pruning in grapes - Do's and Don'ts. Technical Bulletin No. 13. NRC Grapes, Pune. Pp: 36

5. Somkuwar R. G. and Satisha J., 2014. Fruit pruning in grapes - Do's and Don'ts. Technical Bulletin No. 14. NRC Grapes, Pune. Pp:36

Books

1. Ramteke S. D. 2013. Techniques of quality grape management. Godava pub.

Book Chapters

1. Ravishankar K. V., Kanupriya Rekha A., Upadhyay Anuradha, Vasugi C., Vijayakumari N., Pooja Kishnani and Dinesh M.R. 2013. Omics Approaches in Tropical Fruit Crops. In: OMICS applications IN CROP SCIENCE (ed. D. Barh) CRC Press (Taylor and Francis group) pp 285-324.

2. Sawant Indu S. and Sawant S. D. 2013. Grapes (*Vitis vinifera* L.). In. H.P. Singh, M. Anandaraj and A.I. Bhat (Eds), Advances in Horticulture Biotechnology — Diagnostics for Horticulture Crops (Volume VII), Westville Publishing House, New Delhi; 81-107

Institutional publications

1. Adsule P. G., Upadhyay Anuradha, Satisha J., Sharma A. K. and Yadav D. S. (eds). 2013. Annual Report 2012-13, National Research Centre for Grapes, Pune. Pp. 106.

2. Adsule P. G., Upadhyay Anuradha, Sharma A. K., Satisha J. and Yadav D. S. 2014. Vision 2050, NRC Grapes, Pune, Perspective plan, pp. 26

3. A technical folder on राष्ट्रीय अंगूर अनुसंधान केंद्र : एक संक्षिप्त परिचय.

Approved On-Going Institute Programmes

1. Management of genetic resources of table, wine, raisin, juice and rootstock grape varieties
2. Germplasm utilization and genetic enhancement
3. Application of biotechnological research in grapes
4. Development of propagation and nursery technology
5. Use of rootstocks for grape cultivation
6. Horticultural practices for quality and yield in table and wine grapes
7. Nutrient and soil management in grapes
8. Water management in grapes
9. Grape physiology including use of bioregulators
10. Studies on viticulturally important microorganisms
11. Integrated disease management in grapes
12. Integrated insect and mite pest management in grapes
13. Management of agrochemical residues and environmental contaminants in grapes
14. Development of post-harvest technologies
15. Development of information and documentation systems

Commercialization of Technology

Distribution of planting material under Material Transfer Agreement

During the year approximately 4500 cuttings belonging to different commercial varieties, newly developed hybrids and varieties, rootstocks as well as germplasm were distributed under material transfer agreement to research institutes like IARI, New Delhi, CHES, Hirehalli, Directorate of Horticulture, Mizoram, ARI, Pune, MPKV Rahuri and grape growers and private nurseries in Jalgaon, Sangli, Pandharpur and Nasik regions of Maharashtra and Hyderabad in Andhra Pradesh.

Sale of planting material

Approximately 41 thousands cuttings of rootstocks and grafted and own rooted cuttings of table and wine grapes were raised and sold as planting material. Through the sale of these planting materials, the Centre earned approximately 2.65 lakh rupees as revenue.

Meetings of QRT, RAC, IMC, IRC with Significant Decisions

Research Advisory Committee (RAC) Meeting

The following are the members of newly constituted Research Advisory Committee (RAC) of the Centre.

1.	Dr. B.M.C. Reddy, Vice Chancellor, Dr YSR Horticultural University, Andhra Pradesh	Chairman
2.	Dr. G.S. Prakash, Former Head, Division of Fruit Crops, IIHR, Bengaluru	Member
3.	Dr. B.L. Jalali, Former Director of Research, HAU, Haryana	Member
4.	Dr. R. Palaniyappan, Former Pr. Scientist, IIHR, Bengaluru	Member
5.	Dr. E.R. Suresh, Former Pr. Scientist, IIHR, Bengaluru	Member
6.	Dr. K. Srinivasan, Chief Scientist – Agricultural Research, Tractors and Farm Equipment Ltd., Tamil Nadu	Member
7.	The Assistant Director General (Hort.-I), ICAR, New Delhi	Member
8.	Dr. S.D. Sawant, Director, NRC for Grape, Pune	Member
9.	Dr. R.G. Somkuwar, Pr. Scientist (Hort.), NRC for Grapes, Pune	Member Secretary

The 16th meeting of the RAC was held on 7th March 2014 under the Chairmanship of Dr. B.M.C. Reddy at NRC for Grapes, Pune.

In the beginning, the committee along with the scientists visited experimental vineyards viz. germplasm block, rootstock and canopy management trial block, rootstock and cultural practices trial on Fantasy Seedless, irrigation scheduling trial on Fantasy Seedless, evaluation trial on Red Globe grafted on different rootstocks, performance trial on Thompson Seedless grafted on different rootstocks, nutrition trial on Cabernet Sauvignon wine grapes, Indo-French collaborative research project on performance of white and red wine varieties and trial on performance of Cabernet Sauvignon grafted on different rootstocks, trial on standardization of cultural practices in Cabernet Sauvignon and different blocks of rootstock accessions in the nursery

After visit to the vineyards, the meeting started with playing of ICAR song floowed by welcome of the Chairman and Committee members by Dr. S. D. Sawant, Director which was followed by introduction of the Members of RAC and scientists. The Director presented Action Taken Report on the recommendations of last RAC. Subsequently, all the ongoing research projects were presented by respective Investigators. The following were the major suggestions.

- Attempts should be made for expansion of grape cultivation in non-traditional areas.
- Priority should be given to obtain IC number from NBPGR for all germplasm collected.
- Promising clones identified by the farmers should be collected and evaluated at the Centre.

- Constitute a Varietal Release Committee at the Centre. Naming any new variety should follow systematic procedure with suitable prefix.
- To initiate impact analysis of the technologies in the area of grape improvement, production and protection.
- To initiate research on the identified grape varieties for juice making.
- Develop package of practices for superior clones identified by farmers and being cultivated on large area should be developed.
- Expertise of Dr. E.R. Suresh should be utilized for formulation of enological research programme.
- IC number to be allotted to the new accessions collected.
- Catalogue for another 100 varieties may be prepared.
- Cost-benefit analysis to be worked out to compare different sources of organic matter in grapevine including pruned biomass.
- Evaluate water use efficiency of commercially important table grape varieties raised on Dogridge rootstock.
- Ensure the production of GLRV3 free certified planting material of wine varieties.
- Continue promising studies on biocontrol of grape diseases in field and for improving shelf life directly or through Induced Systemic Resistance (ISR) and degradation of pruning wastes.
- Initiated studies on effect of umbelliferus plants to enhance activity of mealybug parasitoids need to be.
- Due to non-availability of microbiologist at the Centre, instead of isolating new yeast strains, the strains already available at IIHR, Bengaluru may be collected and evaluated for β-glucosidase activities.

It was also suggested that next RAC meeting should be convened for two days which may include visit to research laboratories, grape vineyards / pack houses followed by discussions

The meeting ended with a vote of thanks by Member Secretary.

Institute Research Committee Meeting

The 18th Institute Research Committee meeting was held on 23rd, 27th August and 30th September 2013 under the chairmanship of Dr. S. D. Sawant, Director. All the scientists attended the meeting.

At the outset ICAR song was played, Dr J. Satisha, Member Secretary, IRC welcomed all the members to the meeting. During the meeting, issues related to PME guidelines were discussed. It was decided to follow the PME guidelines on conduct of RAC and IRC and accordingly dates for these two meeting were decided. It was also decided to process contract research proposal through PME. This was followed by presentation of progress report and detailed technical program for coming fruiting season.

Institute Management Committee (IMC) Meeting

The 34th meeting of Institute Management Committee (IMC) was held on 20th March 2014 under the Chairmanship of Dr. S.D. Sawant, Director. Agenda items viz. review of progress of works like i) construction of biotechnology laboratory ii) construction of APEDA - NRL laboratory, iii) guest house iv) express feeder line for electricity supply, v) commissioning of second water storage:, vi) supply of irrigation water to the research farm of MRDBS were discussed.

Priority setting, Monitoring and Evaluation (PME) Committee Meeting

During the year, three meetings of PME Committee were held under the Chairmanship of Dr. S. D. Sawant, Director. During the meeting held on 4th May 2013, five new research projects received by PME Committee were approved after incorporating necessary suggestions made by the PME Committee. In the meeting on 28th June 2013, recommendations of QRT were deliberated and based on those recommendations and needs of the grape industry, five priority areas of research were identified for 12th plan. Apart from this, it was decided to initiate work on farm mechanization and to study the performance of new varieties / clones developed by the institute in the experimental plots of the institute. Another meeting was held on 10th January 2014, during which approval was given for submitting RPP-III for the project "Standardization of irrigation schedule for Cabernet Sauvignon raised on 110R rootstock". Two RPP-I were presented by Dr. Shabeer Ahammed and Dr. A. K. Sharma. For both the projects, few suggestions were given by the committee and PIs were asked to incorporate the suggestions and modify the project accordingly before resubmitting to PME Committee for approval. All the three meetings were coordinated by Dr. J. Satisha, I/c PME Cell.

RFD Committee Meeting

RFD Committee meeting was held on 26th March 2014 under the chairmanship of Dr. S. D. Sawant, Director. The agenda of the meeting was to discuss the draft RFD 2014-15 of

the institute. Based on the suggestions received from the council regarding setting realistic trend values for success indicators, thorough discussion was held and values were set taking into consideration the views of concerned scientists. The reporting officers were identified and assigned the responsibilities of providing achievements for each success indicators to facilitate easy compilation of monthly, mid-term and annual RFD progress report. The Chairman also briefed the administrative and accounts officer about importance of mandatory objectives and instructed them to make serious attempts to achieve targets set for mandatory objectives in time to score full marks so that institute can get excellent grade when it is evaluated at Council. The meeting was coordinated by Dr. J. Satisha, Nodal Officer, RFD.

Other important meetings / workshops

- A meeting was organised on "Harmonization of India's food standards with Codex and other international best practices" on 13th May, 2013 at the Centre in collaboration with FSSAI, Ministry of Health and Family Welfare. The Chairman and members of different Electronic Working Groups set by FSSAI for drafting the Indian standards for harmonization with the International standards attended the meeting. Shri. S. Dave, Advisor, FSSAI chaired the meeting.

- A one day workshop on 'Analytical method validation on veterinary drug residue analysis in food commodities' was organized at the Centre on 31st May 2013. The lead talk was given by Dr. D. Glenn Kennedy, Veterinary Science Division, Agri-food & Bioscience Institute, Northern Ireland, UK.

- Dr. Man Singh, Professor, Water Technology Centre and Incharge, Farm Operation Service Unit, IARI, New Delhi was invited to visit the water logged area of vineyard and make suggestions on the installations of drainage system on 28th August 2013. He presented the advantages and detailed plans for reclamation of water logged lands.

- A meeting was organized with stakeholders of the grape industry including officials from APEDA, exporters, nominated laboratories, state govt. officials, nominated laboratories on 21st September, 2013 to finalize Annexure 5 and Annexure 9 of the Residue Monitoring Plan document of APEDA in grapes for the season 2013-14.

- The brain storming session on "Mechanization in vineyard" to deliberate in detail about the equipment required for carrying out various cultural operations was organized at the Centre on 25th October 2013. The session was chaired by Dr. V. M. Mayande, Ex. Vice Chancellor, Dr. Punjabrao Deshmukh Krishi Vidyapeeth, Akola. The President and the Chairman, Central Research Committee of MRDBS; President, Grape Growers Federation of India, Pune; grape growers, agriculture engineers and scientists working in the field of viticulture, machineries importers, service providers attended the session. Certain equipment like new sprayers for bioregulators and pesticides, pruning machines, weeders, equipment for fixing trellises, trench opener for FYM application in the existing vineyards, etc. were identified for

importing and testing on priority at this Centre. It was suggested to prepare and submit a proposal in this regard to NHB, NHM, RKVY for necessary funding.

- A meeting was organized on 7th November, 2013 to know about the promising hybrids developed and being maintained by Agharkar Research Institute (ARI), Pune. Dr. Sujata Tetali, Genetist and Plant Breeder, ARI presented the information. Dr. S. C. Misra, Scientist (S) and Incharge, Genetic department also attended the meeting.
- A meeting was conducted on 20th November 2013 to discuss the possibilities of import of patented grape varieties from Spain and Italy. All the scientists of the Centre and representatives from MRDBS attended the meeting. During the meeting, Mr. Duncan, Consultant, SNFL, Spain made a presentation on promising coloured varieties available with SNFL.
- Briefing meeting on National Advisory Board for Managing Plant Genetic Resources (NABMGR) was organized on 29th November 2013 at the Centre by Dr Ganeshan, Convener NABMPGR. Scientists involved in Genetic Resource Management from different horticultural institutes participated in the meeting. Dr. Anuradha Upadhyay and Dr Roshni Samarth covered the proceedings of the meeting.
- Second meeting of the ICAR-Bioversity International Work Plan 2012-2016 was held at the Centre on 17th January 2014 under the Chairmanship of Dr N. Krishna Kumar, DDG (HS). Dr. Prem Mathur, South Asia Co-ordinator, Bioversity International, Dr BMC Reddy, Vice Chancellor, YSRHU, Venkataramennagudem, Dr V.A. Parthasarathy, National Coordinator GEF-TFT Project and Directors of horticultural institutes were present for the meeting. The progress of different projects under GEF-TFT was reviewed. Dr. Anuradha Upadhyay and J. Satisha covered the proceedings of the meeting.

Participation of Scientists in Conferences, Meetings, Workshops, Seminars, Symposia etc.

National Seminars / Symposia / Conferences

Name of the scientists	Title of Seminars / Symposia / Conferences	Period	Organizer and place
Dr. S. D. Sawant and Dr. A. K. Sharma	National Level Conference on wine	26-27th December 2013	Karnataka Wine Board, Bengaluru
Dr. Indu S. Sawant	National Citrus Meet	12 – 13th August 2013	PPV&FRA and NRC for Citrus, Nagpur
Dr. Indu S. Sawant	International Conference on Advances in Biotechnology and Bioinformatics 2013	25-27th November 2013	Dr. D.Y. Patil Biotechnology and Bioinformatics Institute and Biotech Research Society, India at Pune
Dr. Indu S. Sawant	International Conference: Biodiversity, Bioresources and Biotechnology	30-31st January 2014	Association for the Advancement of Biodiversity Science; Society for Applied Biotechnology; Imperial Scientific Publishing organized at Mysore.
Dr. Anuradha Upadhyay	National Seminar of Horticulture Biotechnology 2013	14th June 2013	Indian Institute of Horticultural Research, Bengaluru
Dr. Anuradha Upadhyay	National Seminar on "Accelerating Biology 2014: Computing Life"	18h-20, February 2014	cDAC, Pune
Dr. S. D. Ramteke	National Conference of Plant Physiology-2013 on "Current Trends in Plant Biology Research"	13-16th December 2013	DGR and ISPP at DSGR, Junagadh
Dr. J. Satisha	National Seminar on Application of Bioinformatics in Agriculture	11-12th November 2013	CPCRI, Kasaragod
Dr. Ahammed Shabeer T. P.	National Seminar on "Soil Fertility, Degradation and Contaminants"	8-9th May 2013	Dapoli Chapter of Indian Society of Soil Science, Dr. BSKKV, Dapoli

Workshops / Meetings

Name of the scientists	Title of meeting	Duration	Organizer and place
Dr. S. D. Sawant and Dr. D. S. Yadav	Pest disease survey, guidance and management of horticultural crops project meeting	4th June 2013	Commissionerate of Agriculture, Pune
Dr. S. D. Sawant	Meeting regarding mechanization in grape cultivation and practices, and inclusion of grapes under Patent Act	25th June 2013	Hon'ble Agriculture Minister, Govt. of India, New Delhi
Dr. S. D. Sawant	Meeting for discussion on "Performance Indicators" and "Interaction meeting with Director, PDFSR"	15th July 2013	Secretary, DARE & DG, ICAR, New Delhi
Dr. S. D. Sawant	18th meeting of the Board of Management of UHS, Bagalkot	22nd July 2013	UHS, Bagalkot at Bengaluru
Dr. S. D. Sawant and Dr. A. K. Sharma	National Workshop on "Study on assessment of post-harvest losses of major horticultural crops, animal and fishery products in India"	29th August 2013	DDG (HS), ICAR, New Delhi
Dr. S. D. Sawant	State Level Workshop on Winenet	5th September 2013	Department of Agriculture, Govt. of Maharashtra at NHRDF, Nashik
Dr. S.D. Sawant	ICAR-Horticulture Australia Limited (HAL) meeting to advance the cooperation in research in horticulture between ICAR and HAL	3-4th October 2013	DDG (HS), ICAR at Bengaluru
Dr. S. D. Sawant	National Meet on Fruit Crops: Farmers, Traders and Researchers Interface	22nd October 2013	DDG(HS), ICAR at NBAII, Bengaluru
Dr. S. D. Sawant	Meeting to discuss proposal on purchase of patented varieties of table grapes on payment of one-time charges	11th December 2013	DDG (HS), ICAR, New Delhi
Drs. S. D. Sawant, R. G. Somkuwar, J. Sharma, D.S. Yadav, Roshni R. Samarth	Workshop of XXI Group Discussion of AICRP on Fruits	22-25th January 2014	Project Coordinator (Fruits), Dr. BSKKV, Dapoli

Name of the scientists	Title of meeting	Duration	Organizer and place
Dr. S. D. Sawant	Krishi Vigyan Mela and Innovative Farmer Award Ceremony for 2014	28th February 2014	IARI, New Delhi
Dr. S. D. Sawant	Meeting with the DDG (HS), ICAR along with representatives of MRDBS in relation to legal vetting of MoU with SNFL	28th February 2014	DDG (HS), ICAR
Dr. S. D. Sawant	Meeting to discuss strategies and norms for rejuvenation of horticulture crops damaged due to recent hail storm	22nd March 2014	Secretary (A & C), Ministry of Agriculture, New Delhi
Dr. S. D. Sawant	Meeting to discuss legal issues with advocate related to import of new patented grape varieties for table and raisin purpose	29th March 2014	DDG (HS), ICAR at CIFE, Mumbai
Dr. Indu S. Sawant	Annual meeting of ORP on Leaf Spot Project	9-10th April 2013	Central Potato Research Institute, Shimla, HP
Dr. Indu S. Sawant and Dr A. K. Upadhyay	Consultation meeting for identifying theme areas for XII plan for Horticultural crops under NICRA	7th June 2013	CRIDA, Hyderabad
Dr. Indu S. Sawant	Annual meeting of AMAAS Project.	23-24th October 2013	NBAIM, Mau, UP
Dr. R. G. Somkuwar	Rural Programme Advisory Committee meeting	21st June 2013	Aakashwani, Pune
Drs. R. G. Somkuwar, Anuradha Upadhyay, J. Satisha and Roshni Samarth	Briefing meeting of NABMGR	29th November 2013	NRC for Grapes, Pune
Drs. R. G. Somkuwar, Anuradha Upadhyay, J. Satisha and Roshni Samarth	Second Meeting of Bioversity International	17th January 2014	NRC for Grapes, Pune
Drs. Anuradha Upadhyay and Roshni Samarth	Meeting of DBT expert committee on "Biological interventions for improving productivity of fruits and vegetable crops"	26th November 2013	Department of Biotechnology (DBT), New Delhi
Dr. Anuradha Upadhyay	Meeting of DBT task force	19th December 2013	DBT, New Delhi

Name of the scientists	Title of meeting	Duration	Organizer and place
Dr. A. K. Upadhyay	Meeting of Scientific Advisory Committee of KVK Narayangaon	11th July, 2013	Krishi Vigyan Kendra, Narayangaon
Drs. A. K. Upadhyay and J. Sharma	Third Annual Review Workshop of the NFBSFARA (National Fund)	22-23rd July, 2013	New Delhi
	Advisory Committee meeting of DSS project	17th Sep., 2013	New Delhi
Dr. S. D. Ramteke	Crop Insurance meeting	30th Aug., 2013 30th Oct. 2013 8th Jan. 2014	Mantralaya, Maharashtra State Govt.
Dr. A. K. Sharma	Meeting to finalize Indian wine standards	12th April 2013	Karnataka Wine Board and IGPB, Bengaluru
Dr. A. K. Sharma	Workshop on Raisin Quality and Export.	8th November 2013	MRDBS, Sangli.
Dr. A. K. Sharma	Executive Committee meeting of Indian Grape Processing Board.	22nd March 2014	Nasik
Dr. Roshni R. Samarth	8th review meeting for DUS	28th Feb to 1st March, 2014	Dharwad, Karnataka

Distinguished Visitors

- Dr. S. Ayyappan, Secretary (DARE) and Director General (ICAR) visited the Centre on 24th August, 2013. During his visit, he addressed the scientists and other staff of the Centre. He visited the experimental vineyards and reviewed the progress of the ongoing research in different laboratories. He suggested that the ongoing research projects should be merged into 4-5 mega research projects. He also enquired about the progress of RFD Cell, PME cell and PAC activities, research publications, activities of ITMU, status of institute's budget utilisation.

- Dr. N. Krishna Kumar, Deputy Director General (Horticultural Science) visited the Centre on 6th July, 2013. In a joint address, he interacted with the scientists and other staff of the Centre, which was followed by scientific discussion. He also visited the experimental vineyards and laboratories.

  During field visit, DDG was apprised about the severity of stem borer in grapes, new species found affecting grapes, symptoms of damage and their egg laying pattern and the ongoing experiments on light traps and IIHR technology 'Sealer cum Healer'. He also visited nursery and gave several suggestions to improve it.

  In his address to the staff, Dr Krishna Kumar complemented the new Director and expressed the hope that the Centre will rise to new heights under his leadership. He congratulated the Centre on its excellent performance and the good name it has generated for itself within the ICAR system and that the Horticulture Division is proud of NRC for Grapes. He advised that the Centre should also focus on basic-strategic research and the quality of research should be of high standard results of which should be published in high impact journals. He emphasized the need to have demonstration blocks of the potential mutants/clones developed or identified at the Centre and other promising technologies to make their impact visible o the growers. Other areas of research which require focus should be pollen cryopreservation, use of new information and techniques for incorporating downy mildew resistance, physiological disorders like uneven ripening and berry cracking, pesticide resistance management, natural enemies for

insect management, mapping of agro climatic zones for grape cultivation. He advised to collaborate with national and international institutes working on grapes.

- Dr. C. P. Du Plessis from South Africa visited the Centre on 4th May, 2013 and interacted with the Scientists of the Centre.
- Shri D.K. Samantaray, CEO, FSSAI and Shri S. Dave, Advisor, FSSAI visited National Referral Laboratory, NRC for Grapes on 16th September, 2013. They appreciated work carried out by NRL in the field of Food Safety. They also expressed that the knowledge developed by the NRL needs to be transferred to other organizations.
- Dr. Uma Lele an international leader, thinker, and policy analyst with extensive research and operational experience visited on 30th October, 2013 and had interactions with the Scientists.
- Dr. Abraham Verghese, Director, NBAII Bengaluru visited field and laboratories of the Centre on 14th November, 2013 and discussed regarding bio-control options for insect management. The entomologist of the centre interacted with him to discuss the effective management of the emerging problem of stem borer in grapes and alternative strategies involving new bio-agents, botanicals and insecticides apart from the IIHR patented technology of 'Sealer cum Healer' for testing in vineyard.
- Mr. Santosh Sarangi, Secretary, APEDA visited the Centre on 15th November, 2013.
- Ms. Madhavi Kataria, Special Secretary, Agriculture, Punjab Government visited on 26th November to get an update on the grape scenario in India, future prospects for Punjab and activities of NRCG.
- Dr. R. Zotawna, Director of Horticulture, Govt. of Mizoram, Aizwal visited NRC Grapes along with his team of officers on 4th February, 2014 as a follow up on the Centre's action plan for development of grape industry in Mizoram.
- Dr. Vijay Mehta, Ex-Vice Chancellor, Dr. BSKKV, Dapoli visited on 24th February, 2014 after reading newspaper reports on "Medika".

Farmers' Visit

During the year, 1580 farmers from Maharashtra, Karnataka, Gujrat, Andhra Pradesh etc. visited the Centre to educate themselves on Viticulture.

Education Tours

- Final Year B.Sc. (Hort.) students of College of Horticulture (UHS), Mysore visited on 30th September, 2013.
- Final Year B.Sc. (Agri.) students (67) of College of Agriculture (UAS), Raichur visited on 11th October, 2013.

- Academic visit of M.Sc. (Analytical Chemistry) Students (50) of Vidya Pratishthan's Arts, Science & Commerce College, Baramati on 11th October, 2013.
- Final Year B.Sc. (Hort.) students (27) of College of Horticulture, UHS, Koppal (Munirabad) on 21st October, 2013.
- Final Year B.Sc. (Hort.) students (50) of College of Horticulture, UAHS, Mudigere visited on 24th October, 2013.
- PGDCBM participants from Vaikuntha Mehta National Institute of Cooperative Management (VAMNICOM), Pune visited on 30th October, 2013.
- Second Year PGDM-ABM Students (47) of VAMNICOM, Pune visited this Centre on 10th December, 2013.
- Final Year B.Sc. (Hort.) students (45) of College of Horticulture, Bagalkot visited this Centre on 17th February, 2014.

Personnel

1.	Dr. P. G. Adsule	Director (till 31.05.2013)
2.	Dr. S. D. Sawant	Director (w.e.f. 01.06.2013)
Scientific		
3.	Dr. G. S. Karibasappa	Principal Scientist (Horticulture) (till 30.06.2013)
4.	Dr. Indu. S. Sawant	Principal Scientist (Plant Pathology)
5.	Dr. S. D. Sawant	Principal Scientist (Plant Pathology) (till 31.05.2013)
6.	Dr. R. G. Somkuwar	Principal Scientist (Horticulture)
7.	Dr. Anuradha Upadhyay	Principal Scientist (Biotechnology)
8.	Dr. A. K. Upadhyay	Principal Scientist (Soil Science)
9.	Dr. K. Banerjee	Principal Scientist (Agricultural Chemistry)
10.	Dr. S. D. Ramteke	Principal Scientist (Plant Physiology)
11.	Dr. J. Sharma	Principal Scientist (Soil Science)
12.	Dr. J. Satisha	Principal Scientist (Horticulture)
13.	Dr. A. K. Sharma	Senior Scientist (Horticulture)
14.	Mrs. Kavita Y. Mundankar	Scientist (Computer Applications in Agriculture)
15.	Dr. D. S. Yadav	Scientist (Entomology)
16.	Dr. Roshni R. Samarth	Scientist (Plant Breeding)

17.	Dr. Ahammed Shabeer T.P.	Scientist (Agricultural Chemistry)
18.	Mrs. Amala U.	Scientist (Entomology)
Technical		
19.	Mr. U.N. Borse	Technical Officer
20.	Mr. P. B. Taware	Technical Officer (till 30.06.2013)
21.	Mr. P. B. Jadhav	Senior Technical Assistant
22.	Mr. B. B. Khade	Senior Technical Assistant
23.	Ms. Shailaja V. Satam	Senior Technical Assistant
24.	Mr. B. J. Phalke	Senior Technical Assistant
25.	Mr. S. S. Bhoite	Technical Assistant
26.	Mr. E. G. Kamble	Senior Technician
Administrative		
27.	Mr. S. M. Sahare	Administrative Officer (till 09.07.2013)
28.	Mr. S.N. Salve	Administrative Officer (w.e.f. 01.08.2013)
29.	Mr. O. Babu	Assistant Administrative Officer
30.	Mr. Munish N. Ganti	Assistant Finance and Acccounts Officer (w.e.f. 19.11.2013)
31.	Mr. B. M. Chavan	Private Secretary
32.	Mr. K. Ali	Assistant
33.	Mr. N. S. Pathan	Assistant
34.	Mrs. Anita Mathew	Assistant
35.	Ms. Pallavi K. Tated	Assistant
36.	Mr. P.P. Kalbhor	UDC
37.	Mr. V.D. Gaikwad	UDC
Supporting Staff		
38.	Mr. S. S. Donde	Skilled Supporting Staff
39.	Mr. K. G. Raskar	Skilled Supporting Staff
40.	Mr. B. R. Chakankar	Skilled Supporting Staff
41.	Mr. S. V. Lendhe	Skilled Supporting Staff
42.	Ms. Lata Pawar	Skilled Supporting Staff
43.	Mr. N. K. Najan	Skilled Supporting Staff
44.	Mr. K. K. Kale	Skilled Supporting Staff

Infrastructure Development

Laboratory

Vacuum concentrator, sample mill grinder, soil moisture monitoring system, water purification system and tractor with spraying unit were procured during the year.

Research Winery

A winery unit having 20 tanks with capaity of 20-30 l was inaugurated by DDH (HS) on 20th February, 2014. Fermentation tanks with floating lid facility and pumps were procured for the same.

IT Infrastructure

IT infrastructure was strengthened by procuring latest configuration computers and networking items under NAIP funds to meet the requirements of office automation as per ICAR guidelines.

New Structures

The construction of guest house was completed during the year. The guest house was inaugurated by Dr. P. G. Adsule on 24th May, 2013.

Library

During the year, 13 books and 4 journals were added to the library.

Other Activities

हिन्दी पखवाड़ा

राजभाषा हिन्दी के समुचित विकास को बढ़ावा देने के लिए प्रत्येक वर्ष की तरह इस वर्ष दिनांक 14 सितंबर से 30 सितंबर 2013 तक हिन्दी पखवाड़ा का आयोजन किया गया।

निदेशक महोदय द्वारा हिन्दी पखवाड़ा का उदघाटन दिनांक 16 सितम्बर 2013 को सभी अधिकारियों एवं कर्मचारियों द्वारा अपना अधिक से अधिक कार्यालयीन कामकाज राजभाषा में करने की शपथ लेकर शुरू हुआ। इस समय केंद्र के प्रशासनिक अधिकारी और निदेशक महोदय द्वारा हिन्दी भाषा के विकास तथा उसमें रुचि लेने पर भाषण दिया गया। साथ साथ कर्मचारियों द्वारा हिन्दी भाषा के प्रयोग को बढ़ाने का आह्वान किया गया। पखवाड़ा के दौरान कविता पाठ, व्याकरण, पत्रलेखन, प्रश्नमंच, निबंध लेखन, कम्प्यूटर पर हिन्दी टंकण लघुनाटक आदि प्रतियोगिताओं का आयोजन किया गया।

पखवाड़ा का समापन समारोह दिनांक 30 सितंबर 2013 को संपन्न हुआ। इस अवसर पर मुख्य अतिथि के रूप में जाने माने साहित्यकार श्री. संजय भारद्वाज को आमंत्रित किया गया। समापन समारोह का आरंभ परिषद गीत के साथ शुरू हुआ। निदेशक द्वारा पुष्पगुछ, शाल, श्रीफल देकर मुख्य अतिथि का स्वागत किया गया। मुख्य अतिथि द्वारा विभिन्न प्रतियोगिताओं के विजेताओं को पुरस्कार वितरित किए गए। पुरस्कार वितरण के बाद केंद्र के प्रशासनिक अधिकारी ने अधिक से अधिक कार्यालयीन कामकाज हिन्दी में करने की अपील की। निदेशक महोदय ने अपने भाषण में पूरे वर्ष के दौरान केंद्र में किए गए हिन्दी के कार्य की समीक्षा की। कार्यालय में नियमित प्रयोग किए जाने वाले सभी प्रपत्र द्विभाषी हैं, इसकी सराहना की गई।

संस्थान के 2011-12 वार्षिक प्रतिवेदन को भारतीय कृषि अनुसंधान परिषद ने उत्कृष्ट प्रतिवेदन के रूप में सम्मानित किया इसकी जानकारी दी, साथ ही साथ वर्ष 2012-2013 के वार्षिक प्रतिवेदन को द्विभाषी रूप मे तैयार करने के प्रयास को सराहा । इस प्रतिवेदन के हिन्दी रूपांतरण में योगदान देने वाले अधिकारी डॉ. अनुराधा उपाध्याय, डॉ. अजय कुमार शर्मा एवं डॉ. दिपेन्दर सिंह यादव की सराहना की गई।

निदेशक महोदय ने वित्त एवं लेखा अनुभाग द्वारा राजभाषा में किए जा रहे कार्यों की सराहना की। उन्होने अन्य अनुभागों से कहा कि वह भी अपना अधिक से अधिक कार्य हिन्दी मे ही करें जिससे निर्धारित लक्ष्यों को प्राप्त किया जा सके।

मुख्य अतिथि ने हिन्दी पखवाड़े के दौरान प्रतियोगिताओं के विजेताओं का स्वागत किया। कार्यालयीन कामकाज में हिन्दी भाषा की कठिनाइयों पर सुझाव तथा दैनिक कामकाज में राजभाषा के प्रयोग का अनुरोध किया। हिन्दी में काम

करने के आसान तरीकों से अवगत कराया। मुख्य अतिथि ने संस्थान के हिन्दी में किए गए कार्य तथा हिन्दी में कार्य करने वाले अधिकारी, कर्मचारियों की सराहना की।

मुख्य अतिथि के भाषण के बाद डॉ. अजय कुमार शर्मा हिन्दी अधिकारी एवं वरिष्ठ वैज्ञानिक द्वारा धन्यवाद ज्ञापन के साथ हार्दिक आभार प्रकट करते हुए समापन समारोह 5.30 बजे संपन्न हुआ। हिन्दी पखवाड़ा के समापन समारोह कार्यक्रम का संचालन डॉ. अनुराधा उपाध्याय, प्रधान वैज्ञानिक द्वारा किया गया।

हिन्दी कार्यशाला

दिनांक 30.09.2013 को संस्थान के हिन्दी अधिकारी डा. अजय कुमार शर्मा, वरिष्ठ वैज्ञानिक द्वारा वैज्ञानिक लेखन में आने वाली समस्यायें एवं निराकरण विषय पर हिन्दी कार्यशाला का आयोजन किया गया। इस कार्यशाला में संस्थान के वैज्ञानिक शामिल हुए।

तिमाही प्रतिवेदन तथा बैठक

केंद्र में नियत समय पर परिषद के राजभाषा अनुभाग को तिमाही प्रतिवेदन प्रस्तुत किया गया। इस प्रतिवेदन में हिन्दी में किये गए कार्यों की जानकारी दी गई। हिन्दी कार्यों की समीक्षा तथा हिन्दी के प्रयोग को रुचिकर बनाने के लिए नियत समय पर हिन्दी कार्यकारिणी की बैठक हुई। बैठक में प्राप्त निर्देशों पर साथ ही साथ विचार किया गया।

ICAR Directors' Conference

The Centre assisted ICAR HQ in organizing ICAR Directors' Conference on 20th January, 2014 at Pune. All the scientists and staff members contributed enthusiastically towards making arrangements for accomodation, transport, venue etc.

NRCGrape Agropedia

A knowledge management (KM) platform has been started on the URL http://nrcgrapes.agropedia.in

Office Automation

An intranet application "Employee Tour System" to manage tour program data of all the employees was developed in Visual Studio dot net and SQL Server 2008. Analysis, designing, coding, testing and documentation were carried out for the development of this application. It is implemented on windows server 2008. The application will automate the process of submission of tour programs by employees till their approval from the Director. It will create a database on tours and tour reports. It will help in generating the information required for preparation of grape news-letter, annual report and various reports on field visits and various HRD activities (training, seminar, workshops) from the Centre. GUI design and program code modules have been developed to provide functionality for user login, manage data on staff which includes staff personal details, change user password, create new login, (Un)assign roles,

modify login details, reset user password. Also GUI design and program code modules have been developed to manage Tour data which includes module to create tour program, modify tour program, approval by Director, status of tour program.

Personnel

Promotion

Dr. J. Sharma was promoted as Principal Scientist with effect from 9th June 2012 based on his performance in CAS interview conducted by ASRB, New Delhi.

Dr. J. Satisha was promoted as Principal Scientist with effect from 1st January, 2013 based on his performance in CAS interview conducted by ASRB, New Delhi.

New Joining

Shri S.N. Salve, Administrative Ofiicer joined on 1st August, 2013 subsequent to his transfer from CICR, Mumbai.

Shri Munish N. Gunti was appointed as Assistant Finance and Accounts Officer and he joined this Centre on 19th November, 2013.

Transfer

Dr G. S. Karibasappa Principal Scientist (Horticulture) was transferred to IIHR, Bangalore on 29th June, 2013.

Dr P. B. Taware, Technical Officer was transferred to NIASM, Baramati on 29th June, 2013.

Shri. S. M. Sahare, Administrative Office was transfered to NRC Citrus, Nagpur on 9th July, 2013.

Celebrations

Independence Day

Independence Day was celebrated at the Centre on 15th August, 2013 with joy and gaiety. Dr. S. D. Sawant, Director hoisted the flag and all the staff members and their families saluted the national flag. Dr Sawant called upon all the staff members to work as a team for fulfilling the aspirations of growers in the country.

Vigilance Week

The Vigilance Awareness Week was observed during 28th October to 2nd November, 2013. The theme of the vigilance week was "Promoting good governance - Positive contribution of Vigilance". The observance of the week was started with the pledge by all the employees. Dr. S. D. Sawant, Director requested all the staff members to remain vigilant and maintain integrity in their work. Mr. S. N. Salve, Administrative officer also delivered a talk on good governance during the week.

Republic Day

Republic day was celebrated on 26th January, 2014. Dr. S. D. Sawant, Director hoisted the flag and addressed the staff members and their families. He honoured selected staff members for their stupendous efforts for different institute activities like organisation of Director's conference and selection of staff.

Professional Society

Society for Advancement of Viticulture and Enology (SAVE) was formed and registered with its head quarter at NRC for Grapes, Pune.

SAVE is a non-profit scientific society that is dedicated to cultivate and promote research, education and development of viticulture and enology in India and abroad and disseminate knowledge on all aspects of viticulture and enology. SAVE is registered under Society Registration Act 1860. The membership of society is open to any individual interested in advancement of viticulture and enology sector. Grape Day was organized by SAVE jointly with NRC for Grapes on 20th February, 2014. This programme was attended by about 600 participants.

At present SAVE has following office bearers:

Dr. S. D. Sawant	President
Dr. G. S. Karibasappa and Dr. Indu S. Sawant	Vice President
Dr. Ajay Kumar Sharma	Secretary
Dr. J. Satisha and Dr. Roshni Samarth	Joint Secretary
Dr. S. D. Ramteke	Treasurer
Dr. J. Sharma	Editor
Dr. Anuradha Upadhyay and Dr. D. S. Yadav	Asstt. Editor
Dr. R. G. Somkuwar, Dr. K. Banerjee and Dr. Ajay Kumar Upadhyay	Councillors

Meteorological Data

Year and Month	Air temperature (°C)		Relative humidity (%)		Pan evaporation (mm)	Sunshine duration (hr.)	Total rainfall (mm)	No. of rainy days
	Min.	Max.	Min.	Max.				
Apr 2013	22.0	36.0	25.6	65.1	8.8	11.0	4.0	1
May 2013	24.3	37.2	32.5	79.2	8.7	11.1	10.2	1
Jun 2013	22.9	29.4	71.1	96.9	2.23	12.4	243.4	16
Jul 2013	21.6	26.7	78.4	98.5	0.8	11.5	147.6	19
Aug 2013	21.1	28.2	64.8	96.6	2.73	11.8	37.8	7
Sep 2013	20.4	30.1	55.7	98.1	2.66	11.3	121.8	9
Oct 2013	20.5	31.4	42.6	96.1	3.7	11.1	0.0	0
Nov 2013	15.3	30.0	45.9	98.6	3.3	10.0	0.0	0
Dec 2013	11.0	29.0	38.2	99.8	2.7	9.7	0.0	0
Jan 2014	12.4	28.8	35.4	95.0	3.1	10.2	0.0	0
Feb 2014	12.4	30.9	27.8	89.1	4.4	10.7	0.0	0
Mar 2014	16.0	34.5	23.9	79.4	5.3	11.2	9.5	2
Total	–	–	–	–	–		**574.3**	–

Source: Weather station, NRC for Grapes, Pune

Abbreviations

ABA	:	Abscissic Acid
ADI	:	Acceptable Daily Intake
AMAAS	:	Application of Microorganisms in Agriculture and Allied Sector
AOAC	:	Association of Official Analytical Chemist
APEDA	:	Agricultural and Processed Food Products Export Development Authority
ARIS	:	Agricultural Research Information System
ASRB	:	Agricultural Scientists Recruitment Board
AUDPC	:	Area Under Disease Progress Curve
BRNS-BARC	:	Board of Research in Nuclear Sciences-Bhabha Atomic Research Centre
CCC	:	Chlormequat Chloride
CHES	:	Central Horticultural Experiment Station
CIFE	:	Central Institute of Fisheries Education
CIFT	:	Central Institute of Fisheries Technology
CMC	:	Critical Micelle Concentration
CPCRI	:	Central Plantation Crops Research Institute
CPPU	:	N-(2-chloro-4-pyridyl)-N'-phenyl urea
CRIDA	:	Central Research Institute for Dryland Agriculture
DARE	:	Department of Agricultural Research and Education
DBT	:	Department of Biotechnology
DD	:	Double Dose
DDG (HS)	:	Deputy Director General (Horticulture Science)
DG	:	Director General
DGR	:	Directorate of Groundnut Research
DMI	:	DeMethylation Inhibitors
DOGR	:	Directorate of Onion and Garlic Research
DR BSKKV	:	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth
DSS	:	Decision Support System
DUS	:	Distinctness, Uniformity and Stability
EC	:	Electrical Conductivity
EPN	:	Entomopathogenic Nematode
ESI	:	Electro Spray Ionization
ESS	:	Electrostatic Spraying System
FSSAI	:	Food Safety and Standards Authority Act of India
FYM	:	Farm Yard Manure
GA3	:	Gibberellic Acid
GC/MS-TD	:	Gas Chromatography-Mass Spectrometry with Thermal Desorption
GLRaV	:	Grapevine Leaf Roll associated Virus
HCH	:	Hexachlorocyclohexane
HPLC	:	High Pressure Liquid Chromatography
I3PS	:	Inositol 3 Phosphate Synthase
IAA	:	Indole Acetic Acid
IARI	:	Indian Agricultural Research Institute
IDA-EPI	:	Information dependent acquisition - enhanced product ion
IGPB	:	Indian Grape Processing Board
IJSC	:	Institute Joint Staff Council
IRC	:	Institute Research Committee
ISPP	:	Indian Society of Plant Physiology
ITMU	:	Institute Technology Management Unit
LC-MS/MS	:	Liquid Chromatography-Tandem Mass Spectrometry
LOD	:	Limits of Detection
MPI	:	Maximum Permissible Intake
MRDBS	:	Maharashtra Rajya Draksha Bagaitdar Sangh
MRL	:	Maximum Residue Limit
NAA	:	Naphthalene Acetic Acid
NABMGR	:	National Advisory Board for Managing Plant Genetic Resources
N-ATCa	:	N-AcetylThiazolidine-4-Carboxylic Acid
NBAIM	:	National Bureau of Agriculturally Important Microorganisms
NEH	:	North Eastern Hills
NFBSRA	:	National Fund for Basic and Strategic Research in Agriculture
NHB	:	National Horticulture Board
NHM	:	National Horticulture Mission
NHRDF	:	National Horticulture Research and Development Foundation
NICRA	:	National Initiative on Climate Resilient Agriculture
OD	:	Oil Dispersion
OIV	:	International Organisation of Vine and Wine
ORP	:	Out Reach Programme
PAH	:	Polyaromatic Hydrocarbon
PDI	:	Per Cent Disease Index
PF	:	Processing Factor
PFA	:	Prevention of Food Adulteration
PHI	:	Pre-Harvest Interval
PME	:	Priority Setting, Monitoring and Evaluation
PPV & FRA	:	Protection of Plant Variety & Farmer's Rights Authority
PRD	:	Partial Rootzone Drying
PT	:	Proficiency Testing
PVC	:	Polyvinyl Chloride
QRT	:	Quinquennial Review Team
QTL	:	Quantitative Trait Loci
RAC	:	Research Advisory Committee
RKVY	:	Rashtriya Krishi Vikas Yojana
RMP	:	Residue Monitoring Plan
SC	:	Soluble Concentrate
SCAR	:	Sequenced Characterized Amplified Region
SD	:	Single Dose
sMRM	:	Scheduled Multiple Reaction Monitoring
SNFL	:	Special New Fruit Licensign Ltd.
SPE-tD	:	Solid-phase Extraction-thermal Desorption
TSP	:	Tribal Sub-Plan
TSS	:	Total Soluble Solids
UAHS	:	University of Agricultural and Horticultural Sciences
UAS	:	University of Agricultural Sciences
UHS	:	University of Horticultural Sciences
UPOV	:	Union for Protection of New Varieties of Plants
VAMNICOM	:	Vaikuntha Mehta National Institute of Cooperative Management
VSP	:	Vertically Shoot Positioned
WDG	:	Water Disposable Granules
WG	:	Wettable Granule
WUE	:	Water Use Efficiency
YASHADA	:	Yashwantrao Chavan Academy of Development Administration

हर कदम, हर डगर
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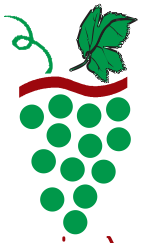

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