

वार्षिक प्रतिवेदन
Annual Report
2014-15





भा.कृ.अनु.प.–राष्ट्रीय अंगूर अनुसंधान केंद्र, पुणे
ICAR - National Research Centre for Grapes, Pune

Cover page illustrates the activities and initiatives taken up by ICAR-NRC for Grapes to reach out to new areas of grape cultivation in India; Srinagar and Leh, Jammu and Kashmir (Photos 1 and 2); Champhai, Mizoram (Photos 3 and 4); Anantapur, Andhra Pradesh (Photo 5); Tamil Nadu (Photos 6 and 7); Jath, Maharashtra (Photo 8); Mandsaur, Madhya Pradesh (Photo 9); and Karnal, Haryana (Photo 10).

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ICAR-NATIONAL RESEARCH CENTRE FOR GRAPES

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PREFACE

Recent years, unfavourable weather in major grapes growing areas has been an important constrain for Indian table grape industry. Rains within first 50 days of fruit pruning and cold waves during active fruit growth stage has considerably increased the cost of production in most areas. Everyone is aware that thunder storms and hailstorms at the time of harvest caused total destruction of the crop in many vineyards during the last two years. Similarly even light rains at harvesting stage have lead to huge crop losses due to berry cracking and poor post-harvest shelf life. A large number of farmers have suffered due to these and other such problems, which are often not reflected through statistical data on area of production and productivity.

During 2013-14, the production and productivity of grapes in India increased to 25,85,000 MT and 21.8 MT/ha respectively with marginal increase in area of production to 1,18,700 ha (NHB, 2014 data). During 2014-15 season the crop was extraordinarily good in most areas and the advance estimate of NHB, probably recorded in December 2014, indicated record production figure of 26,02,000 MT from 120,000 ha. But rains during January and then hailstorms during February and March have destroyed the crop in main grape growing areas in Nasik, so much so, that we may see record low production this year. Furthermore, during 2013-14 India had recorded all time high of fresh grapes export (192617 MT), worth Rs. 166.65 millions, but this year it may be reduced to half of the figure. Reports from European markets have indicated that Indian grapes are being sold at lower prices due to inferior quality.

The crop that makes good profit, and requires high inputs cannot sustain with uncertainties of weather. Cost effective technology on growing table grapes under plastic cover, developed in Italy and Spain, if adopted properly, could remove uncertainties in grape production as mentioned above. It will also help in extending grape production in northern India where rains at harvest are common. Many progressive grape growers in Maharashtra have already adopted the technology and have got the benefit. However, for systematic adoption and Indianization of the technology adoptive research is required. This Centre was the first to take up research on protected cultivation a few years back and has again initiated field demonstrations. We are hopeful that practical guidelines will soon emerge from our research data before the fruiting season of 2015-16.

Research on development of new varieties resistant to downy mildew by incorporating resistance in Thomson Seedless was started in the Centre almost a decade before. Consistent efforts of the scientists have started showing positive results. Several promising progenies have been identified using suitable markers developed by the Centre and are being evaluated in vineyards. Breeding program on development of self-thinning variety with naturally loose bunches and bold berries, was demanded by the growers. The breeding program has been initiated and six new varieties with such desirable characters have been introduced for their use in such breeding program from USDA collections. Efforts are also on to introduce patented varieties with such traits, with the help of DAC, and APEDA. The guidance and encouragement given by Dr. N. K. Krishnakumar, DDG (HS), and Dr. S. K. Malhotra, Horticulture Commissioner, GoI (formerly ADG, HS) to initiate these programs is highly appreciated. Especially Dr. N. K. Krishnakumar was personally involved in all the stages of development.

A few potential varieties developed at this Centre, namely Medika, A18-3, and KR white were established in three farmer's vineyards in Nasik for multilocational testing.

PREFACE

The varieties were showcased at optimum maturity during a field day arranged at one of the growers field and were seen by more than 500 growers. Salinity and limited availability of water are major constrains faced by the grape growers in Sangli district and adjoining Karnataka. This Centre had developed a technology for improving water use efficiency (WUE), incorporating sub-surface irrigation, mulching and use of anti-transpirents etc. A demonstration of this technology has been set up on a growers vineyard at Jat in collaboration with Maharashtra Rajya Drashka Bagayatdar Sangha (MRDBS). It is hoped that these efforts on extension research will help in increasing WUE in the area. Path breaking techniques such as partial root drying (PRD) are being tried in this area under direct supervision of a RAC member, Dr. G. S. Prakash.

Major commercial cultivation of grapes was so far restricted only in Maharashtra, Karnataka, Tamil Nadu, Telangana and Andhra Pradesh. While in Mizoram (Champai), Madhya Pradesh (Ratlam), and West Bengal (Bankura), the area under grapes is increasing and state departments and SAU's are actively supporting the growth. ICAR-NRCG, powered with only 15 scientists, had so far concentrated its research activities mainly in Maharashtra and adjoining areas of Karnataka. All India Co-ordinated Research Project on Fruit Crops has helped us to increase our reach in Karnataka (Bijapur), Tamil Nadu (Cumbum), Madhya Pradesh (Mandsaur) and Punjab (Ludhiana). The Centre is now trying to test potential new varieties and technology on weather information based crop advisory in these places. Under, NEH and TSP programs ICAR-NRCG is making good efforts in introducing modern nursery techniques, and other production technologies in Champai area in Mizoram. Team of scientists have visited Srinagar and Leh-Ladakh in Jammu and Kashmir, Anathpur in Andhra Pradesh, and Mandsaur and Ratlam in Madhya Pradesh, in close association with state departments and SAU's and tried to document current status of viticulture in these area. In most of these areas, ICAR-NRCG has supplied planting material for research purpose and have conducted discussions with growers.

The guidance and encouragement given by Dr. S. Ayyapan, Secretary DARE and Director General, ICAR and Dr. N. K. Krishnakumar, Deputy Director General, Horticultural Sciences, ICAR are highly appreciated and constantly needed. We also take this opportunity to thank the entire RAC, under the chairmanship of Dr. B.M.C. Reddy, Vice Chancellor, Dr YSR Horticultural University, Andhra Pradesh for valuable guidance all through the year.

Place : Pune
Date : May 2015

(S.D. SAWANT)
Director

कार्यकारी सारांश

भाकृअनुप–राष्ट्रीय अंगूर अनुसंधान केंद्र, पुणे की स्थापना जनवरी 1997 को भारत में अंगूर उत्पादन और प्रसंस्करण की बाधाओं पर मिशन उन्मुख अनुसंधान द्वारा, ध्यान देने के लिए हुई। भारतीय कृषि अनुसंधान परिषद, आरएसी, क्यूआरटी और आईआरसी के मार्गदर्शन में चार व्यापक क्षेत्रों, आनुवांशिक संसाधन और सुधार, उत्पादन तकनीक, पादप स्वास्थ्य प्रबंधन एवं तुड़ाई उपरांत प्रौद्योगिकी, में संस्थागत और बाह्य वित पोषित परियोजनाओं के तहत अनुसंधान किया जा रहा है। केंद्र में अधिदेश के तहत परामर्श सेवा एवं अनुबंधात्मक शोध भी किये जाते हैं। वर्ष 2014-15 की शोध उपलब्धियों को निम्नवत संक्षेप में प्रस्तुत किया जा रहा है।

आनुवांशिक संसाधन और सुधार

इस वर्ष विरल गुच्छों, बड़ी मणि और किशमिश के लिए उपयुक्त किस्मों की खोज करने के लिए श्रीनगर और लेह–लद्दाख क्षेत्र में पर्यवेक्षण किए गए। पर्यवेक्षण के दौरान सत्रह प्रविष्टियाँ एकत्र की गईं। भाकृअनुप–रापाआसंब्यूरो, नई दिल्ली के माध्यम से यूएसडीए, जेनेवा से सोलह प्रविष्टियाँ प्राप्त की गईं । सक्रिय अंगूर जर्मप्लाज्म साइट में उपलब्ध 97 संकर और 51 प्रविष्टियों का पासपोर्ट डेटा संकलित किया गया और उनके लिए आईसी संख्या प्राप्त की गई।

चार आशाजनक किस्मों, मांजरी नवीन, ए18/3, मेडिका और किशमिश रोजाविस व्हाइट, का पुणे और नासिक परिस्थितियों के तहत आंकलन किया गया। हर किस्म के लिए पुणे और नासिक परिस्थितियों के तहत अच्छी गुणवत्ता वाले फल प्राप्त करने के लिए आवश्यक इष्टतम गुच्छा लोड निर्धारित किया गया।

डाउनी मिल्ड्यू के लिए मार्कर असिस्टिड प्रजनन में कैरोलिना ब्लैक रोज x थॉमसन सीडलेस की क्षेत्र में लगी 51 संततियों का पांच माइक्रोसेटेलाइट मार्कर के साथ विश्लेषण किया गया। माइक्रोसेटेलाइट डेटा और रोग रेटिंग का सह पृक्करण के लिए विश्लेषण किया गया था। माइक्रोसेटेलाइट प्राइमर वीवीडीएम5 से प्राप्त 153बीपी एलील की उपस्थिति डाउनी मिल्ड्यू प्रतिरोध के साथ जुड़ी पायी गई।

आरएनए अनुक्रमण आधारित ट्रांसक्रिप्टोम विश्लेषण द्वारा अंगूर लता में लवणता तनाव प्रतिक्रिया के क्रियात्मक विश्लेषण में, तनाव के 6 घंटे और सात दिन बाद, प्रतिलेखन कारक (ट्रांसक्रिप्शन फेक्टर) से जुड़ी जीओ टर्म की बहुतायता पाई गयी। इससे अंगूर में लवणता तनाव प्रतिक्रिया में प्रतिलेखन कारकों की प्रमुख भूमिका का संकेत मिलता है। 370 भिन्नक रूप से अभिवियक्त जीन के क्लस्टर विश्लेषण द्वारा अगेती और पछेती प्रतिक्रियात्मक जीनों की पहचान की गई। 110 जीन की अभिवियक्ति सिर्फ तनाव के 6 घंटे बाद और 169 जीन सिर्फ तनाव के 7 दिन बाद प्रभावित हुईं। जड़ से आरएनए का भी अनुक्रमण किया गया और लवणता तनाव में अंग विशिष्ट प्रतिक्रिया समझने के लिए आंकड़ों का विश्लेषण जारी है। लवणता तनाव प्रतिक्रिया स्वरूप परासरणी संरक्षकों जैसे प्रोलीन, आरजीनीन और ओर्निथीन का संचय मापा गया।

पुष्पक्रम, पुष्प गुच्छ और मणि अवस्था पर जीए प्रतिक्रिया समझने के लिए आरएनए अनुक्रमण आधारित ट्रांसक्रिप्टोम विश्लेषण किया गया। विभिन्न अवस्थाओं पर जीनों की बड़ी संख्या अप–रेगुलेटेड या डाउन–रेगुलेटेड पाई गई। पुष्प क्रम दीर्घीकरण और पुष्प विरलन अवस्थाओं पर जीए की प्रमुख प्रतिक्रिया सूक्ष्मस्तर पर 6 घंटे के अंदर देखी गई। भिन्नक रूप से अभिवियक्त जीन का जैविक प्रक्रिया, आण्विक कार्य और कोशीय घटकों में वर्गीकरण किया गया। 10 परीक्षित प्रत्याशी संदर्भ जीनों में से, पुष्प क्रम दीर्घीकरण अवस्था पर ट्यूबूलिन और ईएफ़1एल्फा तथा पुष्प विरलन और मणि दीर्घीकरण अवस्थाओं पर पीपी2ए और एसएएनडी सर्वाधिक स्थिर संदर्भ जीन पाये गए। इन जीन का चुनी हुई जीन की अभिवियक्ति विश्लेषण के लिए संदर्भ के रूप मे प्रयोग किया जाएगा। समानता जांच के आधार पर अंगूरों में 10 जीए प्रतिक्रियाशील प्रत्याशी जीनों की पहचान की गई। इन जीनों का हॉरमोन उपचारित नमूनों में अभिवियक्ति विश्लेषण किया गया। चार जीन, जीआईडी1बी, एससीएल15, एससीएल28 और एक्सटीएच की अभिव्यक्ति उपचारित नमूनों में अप या

कार्यकारी सारांश

डाउन रेगुलेटेड पाई गई।

कलमित और स्वमूल लताओं में मणि की विभिन्न अवस्थाओं का पूर्ण प्रोटीओम विश्लेषण किया गया। बड़ी संख्या में मूलवृंत द्वारा प्रभावित प्रोटीन की पहचान की गई। प्रोटीन में सर्वाधिक बदलाव विरेजन अवस्था और तत्पश्चात 3-4 मिमी अवस्था पर पाया गया।

उत्पादन प्रौद्योगिकी

कैबर्ने सौवीनों में अच्छी गुणवत्ता के फल प्राप्त करने हेतु, 8x4 फुट के अंतराल को इष्टतम पाया गया। पुणे की परिस्थितियों में, लाल वाइन क़िस्मों में से, कलाडोक, ग्रेनिच, निह्लुसीओ और कैबर्ने सौवीनों जल्दी तैयार हुईं जबकि सफ़ेद वाइन क़िस्मों में सौवीनों ब्लाँ, रिजलिंग तथा गेवर्ट्रेमिनर अगेती थीं। लाल वाइन क़िस्मों में, शिराज तथा पेटिट वर्डोट एवं सफ़ेद वाइन क़िस्मों में रीजलिंग से बनी वाइनों को अधिक पसंद किया गया।

वाइन एवम ताजे अंगूरों की क़िस्मों हेतु मूलवृन्तों के मूल्यांकन में, 110 आर तथा फरकाल पर कलमित कैबर्ने सौवीनों ने उपज तथा टीएसएस के संदर्भ में अच्छा प्रदर्शन किया जबकि डोगरिज पर कलमित फेंटासी सीडलैस को वृद्धि, उपज तथा गुणवत्ता मानकों के विषय में बेहतर पाया गया।

फेंटासी सीडलैस लताओं में सिंचाई अनुसूची, जिसमें बारिश (579 मिमी) के साथ 250.56 मिमी सिंचाई, से अंगूर की उपज अधिकतम उपचार (313.24 मिमी) के बराबर प्राप्त हुई। उपसतहीय उपचार मे निम्नतम सिंचाई जल 169.02 मिमी का उपयोग किया और इसमें सिंचाई जल की जल उपयोग क्षमता अधिकतम (106.20 किग्रा/मिमी) थी इस प्रकार यह तकनीक निम्न सिंचाई जल उपलब्धता में बहुत ही महत्वपूर्ण है।

एफवाईएम के मुक़ाबले कार्बनिक पदार्थ के सस्ते स्रोत के रूप में प्रैसमड कम्पोस्ट का अकेले या एफवाईएम, हरी खाद एवं छंटाई जैव द्रव्यमान के संयोजन में प्रयोग के अध्ययन में, अकेले एफवाईएम के मुक़ाबले प्रैसमड कम्पोस्ट सहित वाले उपचार में महत्वपूर्ण मृदा कार्बनिक कार्बन संचय देखा गया।

जत, सांगली जिले में सूखा प्रवण क्षेत्र में किसान के अंगूर बाग में इस केंद्र द्वारा विकसित तकनीक को प्रदर्शित करने हेतु थॉमसन सीडलैस के क्लोनल चयन माणिक चमन में एक परीक्षण शुरू किया जा चुका है।

क्रीमसन सीडलेस, मंजरी नवीन और फैंटासी सीडलेस में जीए$_3$ @10 पीपीएम और सीपीपीयू @0.5 पीपीएम के अनुप्रयोग से इन किस्मों में मणि आकार और गुणवत्ता में सुधार हुआ।

विभिन्न खरपतवारनाशी में से, ऑक्सीफ्लोरफेन 2.5% + ग्लाइफोसेट 41% एससी और पेराकुएट डाइ क्लोराइड 24% एसएल, अंगूर बगीचे में घास और चौड़े पत्ती वाले खरपतवार के नियंत्रण में प्रभावशाली पाए गए।

वृद्धि की क्रांतिक अवस्थाओं पर नमी की कमी से उत्पादन में होने वाली हानि पर होने वाले प्रश्नों के उत्तरों के लिए, यह पाया गया कि 40 दिनों तक लताओं को अनुसंशित सिंचाई स्तर के 50% सिंचाई तथा इसके बाद आधारीय छंटाई से 105 दिनों तक असिंचित रखने से, अनुसंशित सिंचाई स्तर की तुलना में उपज में 26.2% की कमी आई। इसका अनुसरण फलत छंटाई के दौरान, मणि वृद्धि से तुड़ाई तक अनुसंशित सिंचाए स्तर में 50% की कमी वाले उपचार ने किया जहां उपज में 14.2% हानि थी।

पादप स्वास्थ्य प्रबंधन

डाउनी मिलड्यू व्याधि के रोगजनक *प्लाज्मोपेरा विटीकोला* के प्राकृतिक प्रक्षेत्र आइसोलेट में क्यूओआई फफूंदी नाशकों के प्रति प्रतिरोधिकता का पता लगा। महाराष्ट्र के इन प्रक्षेत्रों में डाउनी मिलड्यू का नियंत्रण असफल था।

पाउडरी मिलड्यू व्याधि के रोगजनक *एरिसिफी निकेटर* के जीव विज्ञान पर मूल अनुसंधान से ज्ञात हुआ कि महाराष्ट्र के आइसोलेट एस्कोस्पोर आनुवांशिक समूह से संबन्धित है। लेकिन सिर्फ एक मेटिंग टाइप ईडीओफोर्म की उपस्थिति के कारण इनमें लैंगिक प्रजनन नहीं होता।

बेसिलस प्रजाति जीवाणु ने अंगूर मणि पर *इन सीटू* बहु अवशेष अवकर्षण की क्षमता दर्शाई जिससे अवशेष प्रबंधन के

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क्षेत्र में रोमांचक संभावनाएं जाग्रत हुई है।

स्वचालित परामर्श देने के लिए कीट और माइट जोखिम आंकलन और परामर्शदात्री प्रणाली का विकास किया गया। मिलीबग *मेकोनेलिकोकस हिर्सुटस* की जीवन अवस्थाओं के लिए तापीय स्थिरता और विकास प्रभाव सीमा निर्धारित की गई। यह सूचना जोखिम आंकलन मॉडल के परिशोधन के लिए उपयोगी होगी।

आकारिकी द्वारा पहचान किए *स्ट्रेमेशियम बार्बेटम* का साइटोक्रोम ओक्सीडेज1 (सीओआई) अनुक्रमण आधारित डीएनए बार कोडिंग द्वारा जाति स्तर तक पहचान की पुष्टि की गई। सीओआई अनुक्रमण एनसीबीआई डेटा बेस में जमा किया गया जो इस प्रजाति के लिए प्रथम प्रस्तुति थी।

मिलीबग प्रबंधन हेतू अंगूर पारितंत्र में प्राप्त दुश्मनों को उनकी सामर्थ्य के लिए आकलन किया गया। मिलीबग परजीवक एनागाइरस *डेक्टाइलोपी* की जीवन आयु 30^0 से. पर सर्वाधिक थी। इस परजीवक ने मीलिबग प्रजाति *मेकोनेलिकोकस हिर्सुटस* के लिए प्राथमिकता दर्शाई और सर्वाधिक परजीवन निंफ की तीसरी इन्स्टार अवस्था और तत्पश्चात वयस्क कीटों पर था।

कीटरोगजनक फफूंदी *वर्टिसिल्यम लिकेनी* ने वयस्क मादा मिलीबग की उत्पादकता और अंडा फोड़नक्षमता को कम किया। *क्राइसोपरला सिलेमि* के तीसरे इन्स्टार लार्वा को शोषक हानिकारक कीटों पर परभक्षी पाया गया। प्रक्षेत्र परीक्षणों में लार्वा निर्मोचन या *क्राइसोपरला* के अंडा कार्ड को लता पर स्टेपल करने से मिलीबग कॉलोनी संख्या में कमी हुई।

क्षेत्र स्तर पर डाइनोफ्यूरण और फ्लोनिकामिड के अपव्यय विश्लेषण में प्रयोग के 60 दिनों के बाद भी इन रसायनों की जड़ता पाई गई। अत: ये रसायन अंगूर की खेती में इस्तेमाल के लिए उपयुक्त नहीं हैं। किशमिश निर्माण के दौरान हेक्सिाथीयाजोक्स और बाइफेनाजेट के लिए क्रमशः 6-9 दिन और 5-6 दिन की अर्ध आयु निर्धारित की गई। किशमिश सुखाने के दौरान हेक्सिाथीयाजोक्स और बाइफेनाजेट के लिए प्रसंस्करण कारक क्रमश: 1.2-1.6 दिन और 0.9-1.1 दिन निर्धारित किया गया। आहार जोखिम की गणना के आधार पर किशमिश उपभोक्ताओं के लिए सुरक्षित पाई गईं। किशमिश में 67 कीटनाशकों का जीसी–एमएस पर विश्लेषण के लिए अनुकूल बहु–अवशेष विधि का विकास और पुष्टीकरण किया। घरेलू अंगूर के 29 नमूनों का जोखिम मूल्यांकन के लिए विश्लेषण किया गया, इनमें से 14 नमूनों ने ही एमआरएल का पालन किया।

इलायची में एलसी–एमएस/एमएस पर 154 कीटनाशकों और जीसी–एमएस/एमएस द्वारा 244 कीटनाशकों के लिए बहुअवशेष विश्लेषण के लिए एक क्यूसीएचईआरएस आधारित निष्कर्षण विधि का मानकीकरण और पुष्टीकरण किया गया। । चिकन मांस में कीटनाशकों और पीसीबी के जी–सी–एमएस/एमएस द्वारा बहुअवशेष विश्लेषण के लिए एक विश्लेषणात्मक विधि विकसित की गई। । इसी तरह, चिकन मांसपेशियों में बहु – अवशेषों और बहु स्तरीय पशु चिकित्सा दवाओं के एलसी–एमएस/एमएस क्यूट्रेप द्वारा विश्लेषण के लिए एक मात्रात्मक जांच पद्धति का विकास और पुष्टीकरण किया गया।

यूरोपीय देशों को निर्यात होने वाले अंगूरों में कृषि रसायन अवशेषों के नियंत्रण के लिए अवशेष निगरानी कार्यक्रम का यह 12वां साल था। 2014-15 फसल में केंद्रीय कीटनाशक मण्डल और रजिस्ट्रेशन समिति से प्राप्त लेबल क्लैम वाले 41 परजीवनाशी (अनुबंध 5) सूची की संस्तुति की और सभी निर्यात नमूनों में 182 परजीवनाशी एवं उनके मेटाबोलाइट (अनुबंध 9) की निगरानी की गई। 917 आंतरिक चेतावनी जारी की गई जो कि कुल नमूनों का 12.2% थी। आरएमपी के अनुछेद 9 में दिये परजीविनाशकों के अवशेष जांच के लिए व्यावसायिक परीक्षण प्रयोगशालाओं के लिए प्रवीणता परीक्षा आयोजित की गई। कुल निर्यात नमूनों में से 5% (करीब 400) नमूनों का एनआरएल में पुष्टि परीक्षण किया गया।

तुड़ाई उपरांत प्रौद्योगिकी

बीटा–ग्लूकोसाइडेज उत्पादन करने वाली यीस्ट की दो उपभेदों की पहचान की गई तथा इनकी वृद्धि के लिए एक माध्यम का मानकीकरण किया गया। अंगूर जूस के किण्वन तथा उच्च स्तर की वाइन बनाने में यह उपभेदें लाभदायक होंगी। वाइन अंगूर गूदे का 20% का संयोजन तथा 145^0

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से. पर 17 मिनट के लिए बेकिंग से कुकीज़ की क्रियाशील गुणवत्ता में वृद्धि हुई। आइस क्रीम में 25 ग्रा/किग्रा की दर से महीन वाइन तलछट को मिलाने से भौतिक, क्रियाशील तथा रियोलॉजिकल गुणवत्ता में वृद्धि हुई। महीन वाइन तलछट को मिलाने से योगहर्ट की गुणवत्ता में वृद्धि पायी गई।

थर्मल डिजोरप्शन गैस क्रोमेटोग्राफी मास स्पेक्ट्रोमीटरी के द्वारा वाइन वाष्पशीलों के विश्लेषण हेतु विधि का निर्धारण किया गया। विभिन्न रासायनिक वर्गों जैसे कि ईस्टर, अल्कोहल, एल्डिहाइड्स, टरपींस, कार्बनिक अम्ल, कीटोन्स, ईथर, फिनोल्स, लेक्टोन्स, मिथोक्सिपाइरेजिंस इत्यादि, की पहचान की गई। शिराज तथा सौवीनों ब्लाँ के किण्वन के दौरान फिनोलिक बदलावों का आकलन किया गया।फ्लेवोनोल्स में धीमी वृद्धि पाई गई तथा फिर रेकिंग के दौरान इनकी सांद्रता में कमी आई तथा स्थिरता देखी गई। रेकिंग के समय नए फिनोल यौगिक उत्पन्न हुए जिनकी सांद्रता में एक स्तर तक वृद्धि हुई तत्पश्चात स्थिरता आई।

उत्तर पूर्व पर्वतीय एवं जनजातीय उप योजना

उत्तर पूर्व पर्वतीय एवं जनजातीय उप योजना के तहत, मिज़ोरम के चंपई जिले में 11 अंगूर बगीचों का सर्वेक्षण किया और किसानों को एक समान स्फुटन के लिए हाइड्रोजन साइनामाइड के प्रयोग पर प्रशिक्षित किया। हाइड्रोजन साइनामाइड के अनुप्रयोग वाले बगीचों में एकसमान स्फुटन और अधिक कली आविर्भाव देखा गया। चंपई में स्थित राज्य बागवानी विभाग के पॉली हाउस में सात वाइन क़िस्मों की कलमों का रोपण किया गया। गुणवत्ता रोपण सामग्री का उत्पादन नामक एक प्रशिक्षण कार्यक्रम का आयोजन किया गया।

गुणवत्ता रोपण सामग्री का उत्पादन

वर्ष के दौरान, अंगूर मूलवृंत और व्यावसायिक तौर पर प्रचलित किस्मों की 42668 कलम या कलमित पौध महाराष्ट्र, कर्नाटक और अन्य अंगूर क्षेत्रों के उत्पादकों को बेची गईं। व्यावसायिक किस्मों में थॉमसन सीडलेस, फैंटासी सीडलेस और क्रिमसन सीडलेस की मांग अधिक थी। मूलवृन्तों में सर्वाधिक डोगरिज बेचा गया।

तकनीकी स्थानांतरण

8 फरवरी 2015 को धोंदगवान, नासिक जिला में अंगूर प्रक्षेत्र दिवस का आयोजन किया गया। रेस्वेराट्रोल और पॉली फीनोल की उच्च मात्रा के कारण औषधीय गुणों वाली संकर जूस किस्म मेडिका के विभव को विशिष्ट रूप से दर्शाने के लिए इस प्रक्षेत्र दिवस का आयोजन किया गया। किस्म प्रदर्शन ब्लॉक में केंद्र में विकसित अन्य संभाव्य संकर और क्लोनल चयन जैसे मंजरी नवीन, किशमिश रोजाविस व्हाइट और ए18/3 को भी उनकी कार्यिकी परिपक्व अवस्थाओं पर दर्शाया गया।

अंगूर उत्पादकों की समस्याओं को सुलझाने के लिए केंद्र के निदेशक और वैज्ञानिकों ने अनेक प्रक्षेत्र दौरे किए। केंद्र ने कर्नाटक, महाराष्ट्र, तमिलनाडु और हरियाणा में आयोजित पाँच विभिन्न प्रदर्शनियों में भाग लिया, जिनमें करीब एक हज़ार लोगों ने केंद्र के स्टॉल का भ्रमण किया और अंगूर पर जानकारी प्राप्त की। सूचना प्रसारण के विभिन्न माध्यमों जैसे प्रशिक्षण कार्यक्रम, प्रक्षेत्र दौरे, अंगूर उत्पादकों/एसोसियशन द्वारा आयोजित सेमिनार, वेब परामर्शदात्री, रेडियो वार्ता, संस्थान में व्यक्तिगत पारस्परिक बातचीत और वेबसाइट पर सूचना प्रदर्शन द्वारा अंगूर उत्पादन के विभिन्न पहलू और तुड़ाई उपरांत प्रौद्योगिकी से संबन्धित सूचना अंगूर उद्योग के विभिन्न हितधारकों तक पहुंचाई जाती है। वर्ष के दौरान करीब ७०० किसानों ने केंद्र में विकसित तकनीकों की जानकारी के लिए संस्थान का दौरा किया।

मानव संसाधन विकास

एक वैज्ञानिक ने सेनफ्रांसिस्को, कैलिफोर्निया, सं रा अमेरिका में आईयूपीएसी द्वारा 10-15 अगस्त 2014 के दौरान आयोजित पेस्टिसाइड कैमिस्ट्रि पर अंतराष्ट्रीय काँग्रेस में भाग लिया और एक वार्ता दी। चार वैज्ञानिक और दो तकनीकी स्टाफ को उनके क्षेत्र में आधुनिक जानकारी लेने के लिए विभिन्न राष्ट्रीय संस्थानो में प्रशिक्षण के लिए भेजा गया।

राजस्व आय

प्रशिक्षण, परामर्श, अनुबंध अनुसंधान और सेवा, पौध सामग्री और प्रक्षेत्र फल विक्रय से रू 57.08 लाख का राजस्व अर्जित किया गया।

EXECUTIVE SUMMARY

ICAR - National Research Centre for Grapes, Pune was established in January 1997 to undertake mission oriented research to address the issues related to grape production and processing in India.

Research is being carried out under four broad areas of genetic resource management and biotechnology, production technologies, plant health management and postharvest technology and value addition. Besides these institutional programs, several externally funded projects are also in progress. The Centre also undertakes consultancy services and contractual researches related to its mandate. The research achievements made during 2014-15 are briefly summarized below.

Genetic Resources Management and Biotechnology

During the year explorations were carried out in Srinagar and Leh-Ladakh region to search for varieties with loose bunches, bold berries and suitable for raisins. Seventeen accessions were collected during the exploration. Sixteen accessions were received from USDA, Geneva through ICAR-NBPGR, New Delhi. Passport data was compiled and IC number was obtained for 97 hybrids and 51 accessions maintained in grape active germplasm site.

Four promising varieties viz. Manjri Naveen, A18-3, Medika and Kishmish Rosavis White were evaluated under Pune and Nasik conditions. A bunch load of 40 bunches/vine under Pune condition and 40-50 bunches/vine under Nasik condition was found to be optimum for Manjari Naveen. For A18/3, 40-60 bunches/vine and 30 bunches/vine was optimum bunch load for Pune and Nashik conditions respectively. Optimum bunch load for Medika was 40-60 bunches/vine for Pune and 40-60 bunches/vine for Nasik conditions. For Kishmish Rosavis White grown for raisin purpose, 80 bunches/vine was found to be optimum both for Pune and Nasik conditions.

Fifty-one field planted progenies of Carolina Black Rose × Thompson Seedless were analysed with five microsatellite markers for downy mildew resistance. Microsatellite data and disease rating data was analysed for cosegregation. Presence of 153 bp allele obtained with microsatellite primer VVDM5 was found to be linked with the downy mildew resistance.

Functional analysis of salinity stress response in grapevine using RNA sequence based transcriptome analysis, indicated over representation of gene ontology (GO) term related to transcription factor activity at 6h as well as 7 days of stress thus suggesting major role of transcription factors in salinity stress response in grape. Cluster analysis of 370 differentially expressed genes identified early and late responsive genes. 110 genes were affected only at 6h of stress and 169 genes at 7 days. RNA from roots was also sequenced and data analysis is in progress to understand the organ specific response to salt stress. Accumulation of organoprotectants like proline, arginine and ornithine was recorded in response to salinity stress.

Transcriptome analysis was carried out to understand the mechanism of GA response at rachis, flower cluster and berry stage. A large number of genes were either up-regulated or down-regulated at different stages. The major response to GA at molecular level during rachis elongation and flower thinning was observed within six hour of application. The differentially expressed genes were functionally categorized into biological processes, molecular function and cellular component. Among 10 candidate reference genes, the most stably expressed reference genes were tubulin and EF1α at rachis elongation and PP2A and SAND at flower thinning and berry elongation stage. These genes will be used as reference during expression analysis of selected genes. Based on homology search, 10 GA responsive candidate genes were identified in grape. Relative expression of these genes was analysed in hormone treated samples. Expression of four genes viz. GID1B, SCL15, SCL28 and XTH was found to be either up or down-regulated in treated samples.

Whole proteome analysis of different

EXECUTIVE SUMMARY

stages of berries of grafted and own rooted vines was performed. Differential expression analysis identified large number of proteins which were affected by rootstock. The maximum change in protein was observed at veraison and 3-4 mm berry stage.

Production Technology

In Cabernet Sauvignon, a spacing of 8 X 4 feet was found to be optimum for obtaining quality fruits for wine making.

Among red wine varieties, Caladoc, Grenache, Niellucio and Cabernet Sauvignon matured early under Pune conditions and required 136 days for harvest, whereas Sauvignon Blanc, Riesling and Gewurztraminer were early maturing white wine varieties with a maturity period of 137 days.

Wines from Shiraz and Petit Verdot among red wine varieties and Riesling among white wine varieties were found to be the most preferred in organoleptic tests.

In evaluation of rootstocks for wine and table varieties, Cabernet Sauvignon grafted on 110R and Fercal rootstock performed better in terms of yield and TSS, where as Fantasy Seedless grafted on Dogridge performed better with respect to growth, yield and quality parameters.

In Fantasy Seedless vines, irrigation schedule with 250.26 mm of applied irrigation along with rainfall (579 mm) produced yield on par with highest treatment (313.24 mm). Further, subsurface treatment utilized least irrigation water of 169.02 mm with highest WUE of 106.20 kg/mm of irrigation water thereby signifying the importance of this technique under low irrigation water availability.

In the studies on use of different sources of organic matter, press mud compost showed significant increase in soil organic carbon, as compared to FYM, green manure and recycled pruned biomass.

A trial was initiated in Jath, a drought prone area in Sangli district on farmers' plot to demonstrate the effectiveness of techniques developed at the Centre for improving water use efficiency in Manik Chaman, a clone of Thompson Seedless vines. The trial includes appropriate use of sub surface irrigation, mulching etc.

The application of GA_3 @10 ppm and CPPU @ 0.5 ppm was found effective in improving the berry size and quality parameters of Crimson Seedless, Manjri Naveen and Fantasy Seedless.

Among different weedicides, application of Oxyfluorfen 2.5%+ Glyphosate 41% SC and Paraquat dichloride 24% SL was found effective to control grassy and broad leaf weeds in grape vineyards.

To answer questions regarding likely production losses due to moisture stress at critical growth stages, it was found that vines irrigated at 50% of the recommended irrigation level up to 40 days followed by no irrigation thereafter till 105 days in foundation pruning season led to yield reduction of 26.2% over recommended irrigation level. Even the soil moisture content was least during this period. This was followed by 14.2% loss where vines were irrigated @50% of recommended irrigation level from berry growth to harvesting stage in fruit pruning season.

Plant Health Management

Resistant to QoI fungicides was detected in natural field isolates of *Plasmopara viticola*, the pathogen of downy mildew disease, from such vineyards in Maharashtra where there was failure of downy mildew control.

Basic studies on biology of *Erysiphe necator* causing powdery mildew disease has shown that the isolates from Maharashtra belong to ascospore genetic group, but the presence of only one mating type idiomorph results in absence of sexual reproduction.

Bacillus species have shown capability of *in situ* multi residue degradation on grape berries raising exciting possibility in field of residue management.

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Pest risk assessment and advisory system was developed to provide automated advisory for the management of insects and mites in vineyards. The use of advisory system was tested in vineyards.

Thermal constant and development threshold were determined for life stages of mealybug *Maconellicoccus hirsutus*. This information will be used for the refinement of risk assessment model.

DNA barcoding of morphologically identified *Stromatium barbatum* with cytochrome oxidase1 (CoI) sequence confirmed its genus level identification. The CoI sequence was submitted to NCBI which was the first submission for this species. Various natural enemies found in grape ecosystem were evaluated for their potential in the management of mealybugs. The longevity of mealybug parasitoid *Anagyrus dactylopii* was found to be highest at 30°C. This parasitoid exhibited preference for mealybug species *Maconellicoccus hirsutus* and maximum parasitization was on third instar of nymphs followed by adults.

The third instar larva of *Chrysoperla zastrowi* sillemi was found to be voracious predator of sucking insect pest. In field trial, release of larvae or stapling egg cards of *Chrysoperla* resulted in reduction in mealy bug colonies after two weeks. Entomopathogenic fungi *Verticillium lecanii* resulted in reduced fecundity of adult female mealybug and significant reduction in egg hatchability.

Dissipation analysis of dinotefuran and flonicamid at field level revealed persistence of these chemicals even after 60 days of application. Thus these chemicals are not appropriate for use in grape cultivation. The half life for hexithiazox and bifenazate during raisin making was estimated to be 6-9 days and 5-6 respectively. The processing factor established for drying were 1.2-1.6 days for hexithiazox, 0.9-1.1 days for bifenazate and 2.3-2.5 days for dinotefuran. The dietary exposure calculated in final raisin indicated safety to the consumers. A multi-residue method was optimized and validated for analysis of 67 pesticides in raisin using GC-single quadrupole mass spectrometry (GC-MS). 29 domestic grape samples were analysed for risk assessment purpose, of which 14 samples were complied with MRL.

A QuEChERS based extraction method was optimized and validated in cardamom for multiresidue analysis of 154 pesticides by LC-MS/MS and 244 pesticides by GC-MS/MS. An analytical method was developed for multiresidue analysis of pesticides and PCBs in chicken meat by GC-MS/MS. Similarly, a quantitative screening method was developed and validated for multi-residue and multi-class veterinary drugs analysis in chicken muscles by using LC-MS/MS Q Trap.

This was the 12th year of the Residue Monitoring Program for controlling agrochemical residues in table grapes for export to the EU countries. In the season, 2014-15, a list of 41 pesticides (Annexure 5), with label claim with CIB and RC were recommended and 182 pesticides (+ their metabolites) (Annexure 9) were monitored in all export samples. 917 internal alerts for the season 2014-15 were issued which accounts for around 12.2% sample failure. A proficiency test (PT) round among the commercial testing laboratories was organized for pesticide residues as per Annexure 9 of RMP in grape. 5% samples (around 400 No.) of the total number of export samples were analyzed for confirmatory testing at NRL.

Post-harvest Technology

Two β-glucosidase producing yeast strains were identified and a medium for their growth was standardized. These strains will be useful for grape juice fermentation to making high quality wines.

A method for analysis of wine volatiles by thermal desorption - gas chromatography mass spectrometry was optimized. A large number of wine volatiles belonging to different chemical classes like esters, alcohols, aldehydes, terpenes, organic acids, ketones, ethers, phenols, lactones, methoxypyrazines, etc. were identified. The phenolic change

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during the wine fermentation was assessed for wine from Shiraz and Sauvignon Blanc. The flavonols was found to increase slowly and further during racking the concentration was decreased and gets stabilized. New phenolic compounds were produced and their concentration increased to a certain level and gets stabilized on racking.

Addition of wine grape pomace 20% and baking at 145°C for 17 min improved the functional properties of cookies. Fine wine lees @ 25 g/kg of ice cream improved physical, functional and rheological properties of ice cream. Addition of fine wine lees also improved the quality of yoghurt.

NEH and TSP program

As part of NEH and TSP, eleven vineyards were surveyed in Champhai district of Mizoram and farmers were educated on the use of hydrogen cynamide for uniform sprouting. Uniform sprouting and higher bud emergence was observed in vineyards where Hydrogen cyanamide was applied. The proposed program on evaluation of wine varieties under Mizoram condition was initiated by planting cuttings of seven wine varieties in the poly house of State department of Horticulture at Champhai. A training program on production of quality planting material in grape was organized and grape growers were educated about the importance of quality planting material and its role in achieving higher yield.

Production of Quality Planting Material

During the year, 42668 rooted cuttings of grape rootstocks and cuttings of commercially popular varieties were sold to grape growers of Maharashtra, Karnataka and other grape growing regions. Among the commercial varieties, Thompson Seedless, Fantasy Seedless and Crimson Seedless were in demand. Among rootstocks, maximum cuttings of Dogridge were sold.

Transfer of Technology

'Grape Field Day' was organized at Dhondgavan, district Nasik on 8th February 2015 to highlight the potential of hybrid 'Medika' as a potential juice variety with pharmaceutical properties due to high content of resveratrol and polyphenols. The other promising hybrids and selections developed by the Centre viz. Manjri Naveen, Kishmish Rosavis White, and A-18/3 were also showcased at their physiological maturity in the varietal demonstration block.

Several field visits were taken up by the Director and scientists of the Centre to address the problems reported by growers. Centre arranged stalls in five different exhibitions organized in Karnataka, Maharashtra, Tamil Nadu and Haryana. About one thousand visitors visited the stall of Centre during these exhibitions.

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 700 farmers visited the Centre to know about viticulture and technologies developed at the Centre.

Human Resource Development

One Scientist participated in 13th IUPAC (International Union of Pure and Applied Chemistry) International Congress on Pesticide Chemistry held in San Francisco, California, USA during 10-15th August 2014 and delivered a lead talk. Four scientists and two technical staff were trained in different national organizations to acquire the knowledge in their respective field of specialization.

Revenue Generation

Revenue of Rs. 57.08 lakhs was generated through training, consultancy, contract research and services, sale of planting material and farm produce.

Introduction

In the eighteen years of its establishment, the ICAR-National Research Centre for Grapes has acquired the technical expertise and state of art equipment 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 was characterized based on phenotypic and molecular characters and a catalogue of germplasm was prepared. The germplasm was also 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. 110R 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 right 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.

The Centre has also initiated trials on evaluating 19 wine varieties for yield, quality of fruits and quality of wine. Similarly 8 rootstocks are being evaluated for growing Cabernet Sauvignon. A fermentation room with small fermenters 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) through the APEDA sponsored National Referral laboratory. This was the 10th year of the Residue Monitoring Plan, initiated by APEDA, Ministry of Commerce, Government of India in 2003-04 in collaboration through the National Referral Laboratory (NRL) setup under this institute. This year more than 23000 farms had 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 Postharvest technology. Based on the guidlines received from council, ongoing 41 research projects were merged into seven research programmes. Besides seven institutional research programmes, and one flagship programme, seven externally funded projects, three 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.

Thrust areas of research

- Eco-region specific technology generation and extension in continuation.
- Enhancement of water productivity and nutrient use efficiency.
- Climate change and management of stresses.
- Value-added product development, food safety and quality assurance.
- Bio-remediation, bio-fertilization, bio-molecules, bio-fortification, bio-safety, bio-security, and biosensors.
- IT-based decision support systems for technology transfer.

The Centre's flagship programme for XII plan is Development of decision support system for enhancing productivity of grapes under abiotic (temperature and moisture) and biotic (insect pests and fungal disease) stress conditions.

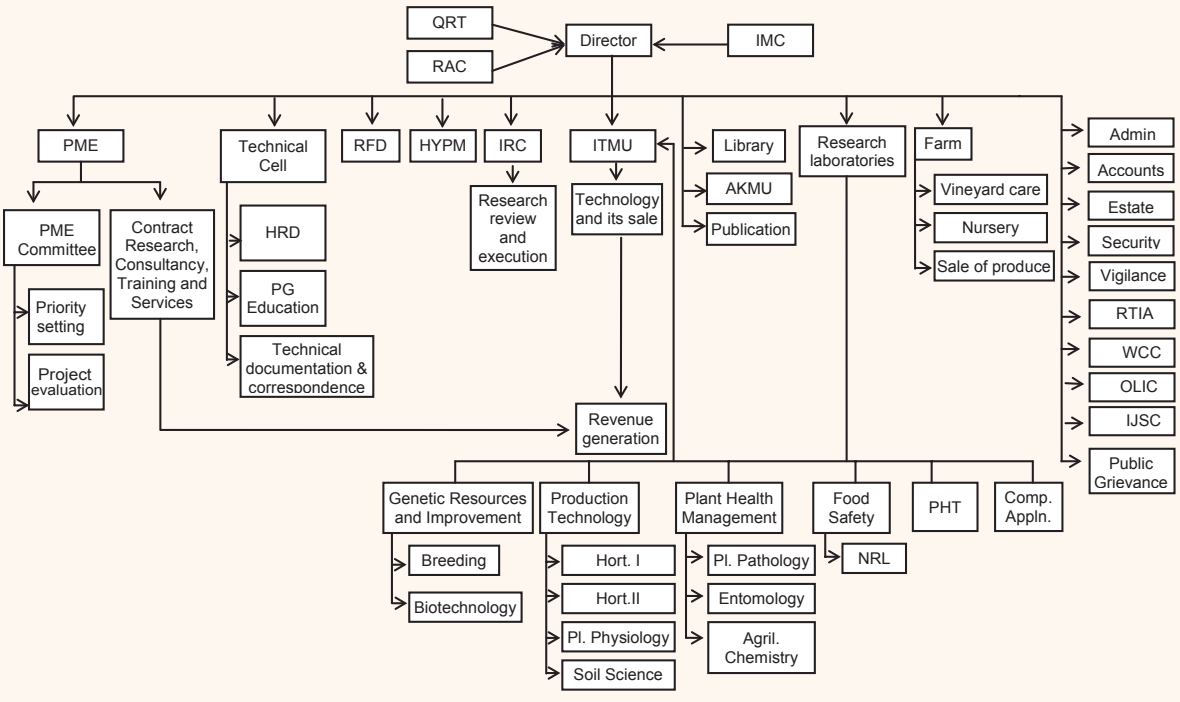
Besides this, several new initiatives will be taken up to meet the demands of the grape industry and strengthen the basic and strategic research. The new initiatives proposed to be undertaken during the XII plan are as follows.

- Exploration of additional germplasm from North East, North West Himalayas and Western Ghats; and their evaluation and

exploitation.

- Basic and strategic research for abiotic stress and introgression of downy mildew resistance in varieties suitable for tropical viticulture.
- Input use efficiency- optimization of nutrient and water requirement of grapevine in different soil regions.
- Evaluation and adoption of modern machines and tools for vineyard operations.
- Geographical indicators for grapes and processed products.
- Validation of technologies developed by the centre through on-farm and farmer participatory research.

Organizational set-up



Financial statement

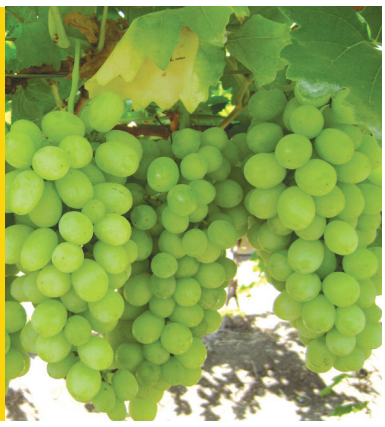
(Rs. in Lakhs)

Sl. No.	Heads	R.E. 2014-15		Expenditure 2014-15		Final Grant		Revenue Generated
		Plan	Non-Plan	Plan	Non-Plan	Plan	Non-Plan	
1.	Estt. Charges	0.00	355.00	0.00	335.00	0.00	335.00	
3.	O.T.A.	0.00	0.00	0.00	0.00	0.00	0.00	
4.	T.A.	10.00	2.00	10.00	2.00	10.00	2.00	
5.	Equipment	44.86	3.0 0	44.86	3.00	44.86	3.00	
6.	IT	14.99	0.00	14.99	0.00	14.99	0.00	
6.	Library books	0.15	0.00	0.15	0.00	0.15	0.00	
5.	Other charges	196.14	160.00	196.14	78.00	196.14	78.00	
6.	Works	4.86	0.00	4.86	0.00	4.86	0.00	
7.	Furniture	0.00	2.00	0.00	2.00	0.00	2.00	
8.	Pension	0.00	20.00	0.00	0.00	0.00	0.00	
	Total	271.00	542.00	271.00	420.00	271.00	420.00	57.08

Staff position

Sl. No.	Post	Number of posts		
		Sanctioned	Filled	Vacant
1.	Research and Management Personnel	1	1	0
2.	Scientific	16	13	3
3.	Technical	8	7	1
4.	Administrative	13	9	4
5.	Supportive	7	7	0
	Total	45	37	8

Research Achievements



Genetic Resources and Improvement

Collection, characterisation and evaluation of grape germplasm

Exploration in Himalayan region for grapes

Exploration was carried out in Srinagar and surrounding areas from 30th July to 5th August, 2014 and in Leh-Ladakh region during 18-26th September, 2014 to search for the grapes with loose bunches, bold berries, disease resistance and black seeded variety for raisin purpose. Total 17 collections were made and cuttings were successfully established in the pots and will be evaluated for desired traits. Area explored during Leh-Ladakh visit were Turtuk, Chalungkha, Pakistan Garari, Biama, Dha, Garkun, Darchik, Hunderman, Sanjak, Cellik Omachik Thang, Thang, Chuthang, Tangte and leh.

Import of varieties from United State Department of Agriculture, USA

Total 56 grape accessions were selected for import from the United State Department of Agriculture, USA. The selection was based on the traits such as loose bunches, bold berries, better shelf life, disease resistance (downy mildew, powdery mildew and anthracnose), drought tolerant, early ripening and suitability for raisin purpose. Out of 56, 16 accessions (Table 1) have been received from USDA, Geneva through ICAR-NBPGR, New Delhi. These cuttings are being raised under controlled conditions.

Allotment of IC numbers to grape accessions

Passport data was compiled and IC numbers were obtained from ICAR-NBPGR, New Delhi for 95 grape hybrids and 51 grape accessions at ICAR-NRC for Grapes, Pune.

Multi-locational performance of short listed potential grape varieties

Based on the information collected during evaluation of different varieties at ICAR-NRC Grapes, Pune during recent years, four varieties were shortlisted for multi locational evaluation. The details of the varieties are given in table 2.

These varieties were established at four different locations in Nasik region in the vineyards of volunteer grape growers and at Centre's farm as detailed in table 3.

During the period of report, first year data from two locations (Dondgavanwadi, Nasik and ICAR-NRCG, Pune) was obtained and is presented below.

Table grapes

The first year data was recorded for two table grape varieties, Manjri Naveen and A18/3, for growth, yield and quality parameters in relation to different bunch load

Manjri Naveen

It is an early maturing variety and needs to be harvested at 16° Brix. At ICAR-NRC Grapes, Pune, four different bunch load of 40, 60, 80 and 100 bunches per vine spaced at 10 X 6 feet distance were maintained whereas at Nasik, 30, 40, 50 and 60 bunches per vine were maintained at a spacing of 8 X 5 feet.

At Pune, retention of 40 bunches per vine was found better in terms of average berry diameter (18.53 mm), average bunch

Table 1.

List of 16 grape varieties imported from USDA, USA

Sr. No.	Name of variety	Traits
1.	Othello	Bold berries and downy mildew resistance
2.	NY 65.556.5	Loose bunches and downy mildew resistance
3.	Tetra	Loose bunches and bold berries
4.	Joyous	Downy mildew resistance and drought tolerance
5.	E.S. 9-2-74	Juice purpose
6.	Mars	Downy mildew, powdery mildew and anthracnose resistance
7.	Blue Boy	Loose bunches and bold berries
8.	Swenson Red	Early ripening
9.	Leon Millot (Kuhlmann 194-2)	Downy mildew resistance and early ripening
10.	Akota	Downy mildew resistance
11.	Fredonia Vinton (33-15-46-48)	Early ripening
12.	Landot 4511	Downy mildew resistance and early ripening
13.	Canandaigua	Loose bunches and better shelf life
14.	Cayuga White (GW 3)	Downy mildew resistance
15.	B 9	Downy mildew resistance
16.	NY 65.565.1	Loose bunches and downy mildew resistance

Table 2.

Details of varieties for multi-locational evaluation

Variety	Type/purpose of grapes	Characters
Manjri Naveen	Table	A selection from Centennial Seedless. Green, seedless, bold berries, loose bunch and early ripening.
A18/3	Table	Black colour, bold berries with good pulp.
Medika	Juice	A hybrid of Pusa Navrang X Flame Seedless. Seeded, black colour, tenturian, excellent juice with higher antioxidant properties.
KR White	Raisin	A selection from Kishmish Rosavis. Green, seedless, good for raisin making.

Table 3.

Sites of multi-locational evaluation of selected varieties

Location	Dondgavanwadi	Vinchur	Vinchur Gavali	Pimpal-gaon	Pune
Name of the grower	Mr. Sahebrao Baste	Mr. Yuvraj Darekar	Mr. Vijay Rikame	Mr. Satish More	ICAR-NRC Grapes
Varieties evaluated	Manjri Naveen, Medika, KR White, A18/3	Manjri Naveen, Medika, KR White, A18/3	Medika and A18/3	Medika,	Manjri Naveen, Medika, KR White, A18/3
Rootstock used	Dogridge	Dogridge	Dogridge	110 R	Dogridge

weight (392.0 g) and days to harvest (115.4) in vines spaced at 10 X 6 feet distance. The preliminary study conducted for the causes for pedicel detachment during late harvest stage revealed that ABA was more in pedicel as compared to berries and whole bunch.

At Nasik, the highest berry diameter

Manjri Naveen

(20 mm) was obtained with 30 bunches per vine followed by 40 bunches (19 mm) and 50 bunches (18 mm). The TSS was 17.02, 16.53 and 16°Brix, respectively with 30, 40 and 50 bunches per vine. Considering that harvesting at 16°Brix is recommended for Manjri Naveen, a bunch load of 40-50 bunches is found to be optimum. At these bunch loads, yield (17.3 and 18.52 kg/vine for 40 and 50 bunch load, respectively) was higher than 30 bunch load (16.47 kg/vine). At 60 bunches per vine, optimum TSS was not achieved.

A18/3

Under Pune conditions, the standardization of bunch load in relation to yield and quality was done on 3-year old vines. The bunch load of 40, 60, 80 and 100 was maintained on a vine spaced at 10 X 6 feet distance. Higher average bunch weight of 355 g and yield per vine of 14.2 kg was recorded at 40-bunch retention treatment. It was followed by 60-bunches per vine with 325.3 g bunch weight and 19.5 kg yield per vine. The berry diameter was higher at 40-bunch load (19.20 mm) than in the 60-bunch treatment (18.51 mm). Considering the berry quality, bunch weight and yield per vine, the retention of 40 to 60 bunches per vine spaced at 10 X 6 feet distance was found to be the optimum.

A18/3

Under Nasik conditions, 30, 40 and 50 bunches per vine were maintained on a vine spaced at 8 X 5 feet distance. Higher average bunch weight of 372.55 g, 50-berry weight of 184.75 g and yield per vine of 10.54 kg with 18.55 mm berry diameter was recorded at 30 bunch load as compared to other bunch retention treatments. The development of uniform black colour was also achieved early in 92.88 days in this treatment.

Juice varieties

Medika

In Medika, under Pune conditions, the trial was conducted with a bunch load of 40, 60, 80 and 100 bunches per vine spaced at 10 X 6 feet distance. It was observed that the average bunch weight reduced from 278.8 g in 40 bunches/vine to 167 g in 100 bunches/vine treatment. Same trend was recorded for

Medika

Kishmish Rosavis White

berry diameter. TSS was found to be higher in bunch load of 40 (19.6 °Brix) followed by 60 bunches (19.3 °Brix) . The acids in juice ranged from 8.36 to 9.10 g/L. The period taken to achieve uniform black colour of the berries was less in 40 bunches/vine (96.8 days) as compared to 100 bunches/vine (103.0 days). Considering the TSS as an important quality parameter, a bunch load of 40-60 bunches per vine seems to be optimum for 10 x 6 feet spaced vines of Medika.

Under Nasik condition, the bunch load was 40, 50, 60 and 70 per vine. Average bunch weight was maximum in 40 bunches per vine (303 g) followed by 50 bunches (260.8 g) while the minimum bunch weight of 220 g was recorded in 70 bunches per vine. Total soluble solids (TSS) ranged from 20.8° Brix in 40 bunch load to 18.34° Brix in 70 bunches per vine. However, considering the TSS as an important juice quality parameter, for 8 x 5 feet spaced vines under Nasik condition, retention of 40 to 50 bunches per vine is optimun for Medika.

Raisin grapes

Kishmish Rosavis White

In Kishmish Rosavis White, under Pune condition, 40, 60 and 80 bunches per vine spaced at 10 X 6 feet were maintained. The average bunch weight varied from 371.13 in 40 g to 302.50 g in 80 bunches. The yield per vine ranged from 14.85 to 24.20 kg/vine. The berry diameter was minimum in 80 bunches per vine (15.01 mm) and maximum in 40 bunches per vine (17.15 mm). The highest TSS (22.01 °Brix) was recorded in minimum bunch load treatment of 40 bunches and the lowest TSS of 20.16 °Brix in 80 bunches/ vine. 25% raisin recovery was obtained with 80 bunches/vine. Hence, 80 bunches per vine load can be considered to the optimum in a vine spaced at 10 X 6 feet distance. Under Nasik region, the variety performed equally good for raisin recovery (25%) at 80 bunches/ vine treatment for vines spaced at 8 x 5 feet.

Clonal selection in grapes

Total nine clones were identified from different area of Maharashtra viz., Solapur, Sangli, Nasik, Akkalkot and Pandharpur. Among these, 7 were originated from Sonaka and two black coloured mutants were originated from Sharad Seedless. During the year, cuttings of these mutants were grafted on the Dogridge rootstock and maintained in the field.

Molecular breeding for introgressing downy mildew resistance in seedless grape

Crossing

Three downy mildew resistant interspecific hybrids were crossed with Thompson Seedless during November-December, 2014. A total of 105 inflorescences were crossed in three different parental combinations (Table 4).

Table 4.

Crossing programme conducted during Nov.-Dec. 2014

Sr. No.	Female Parent	Male Parent	No. of inflorescence crossed
1	SV-12364	Thompson Seedless	40
2	SV-12309	Thompson Seedless	30
3	Seibel 9308	Thompson Seedless	25
Total			95

A total 200 F1 progenies of Carolina Black Rose x Thompson Seedless and 300 progenies of Seyve Villard x Thompson Seedless obtained from crossing conducted during fruiting season 2013-14 were raised in the polybags for six months for hardening and were transferred in the field in the month of February, 2015.

Phenotyping and genotyping of segregating population

70 field established progenies of Carolina Black Rose x Thompson Seedless were phenotyped for their response to downy mildew pathogen using *in vitro* as well as field screening.

Out of 70, 51 progenies were analyzed with five microsatellite markers located in *RPV3* locus. Genotype and phenotype data were analysed for co segregation, using single marker analysis approach. Among five markers, VMC7f2, UDV737 and UDV305 have been reported for their linkage with *RPV* locus in wine grapes, whereas two markers VVDM2 and VVDM5 are new markers developed at this Centre using grape genome sequence of QTL region and were found to be polymorphic between two parents. In this analysis, the earlier reported three markers (VMC7f2, UDV737 and UDV305) were not found to be linked/associated with resistance to downy mildew resistance. However, single marker analysis indicated that 153bp allele obtained with primer VVDM5 has strong association with resistance. The mean rating of progenies in which 153 bp allele was present was 3.36 (*in vitro* rating) and 3.54 (field rating) whereas mean rating was 5.48 (*in vitro* rating) and 6.26 (field rating) for progenies in which this allele was absent. The difference in mean rating was statistically significant at p value 0.01, thus indicating that presence of this allele is significantly associated with resistance to downy mildew. This marker will be validated with larger number of progenies to confirm its use in marker assisted selection.

Breeding for loose bunch and bold berry

This breeding program was initiated this year. Red Globe, a seeded, colored variety with bold berries was crossed with Centennial Seedless (seedless, colorless and loose bunch) and A18/3 (colored, seedless). A total of 173 inflorescences were crossed during fruiting season 2014-15.

Functional analysis of salinity stress response in grapevine

This project was initiated in 2013 with financial assistance from Department of Biotechnology, New Delhi. The objectives of the project are (i) to understand the molecular response of grapevine to salinity stress at transcript and proteome levels, (ii) to understand the physiological mechanism of salt tolerance in grapes and interaction among different cellular responses to salinity stress, (iii) to study the mechanism of stress tolerance in rootstock and its influence on gene expression in scion variety under stress, (iv) to identify promising salinity tolerance genes from grapes and (iv) to develop functional markers for salinity tolerance in grapes. The project involves RNA sequence based transcriptome analysis and proteome analysis.

RNA sequence based transcriptome analysis of salt stressed grapevines of Thompson Seedless identified large number of differentially expressed genes at early as well as late stage of salt stress. The differentially expressed genes were functionally categorized. Among the up-regulated genes at six hour of stress, the main biological processes GO terms (Fig. 1) to which genes belonged were biosynthetic processes, nucleobase containing compound metabolic process, response to stress and transport. Among molecular function related GO terms (Fig. 2), DNA binding and sequence specific DNA binding transcription factor activity were the major terms.

At 7 days of stress, the up-regulated genes belonged to 23 different biological processes GO terms (Fig. 3). The major

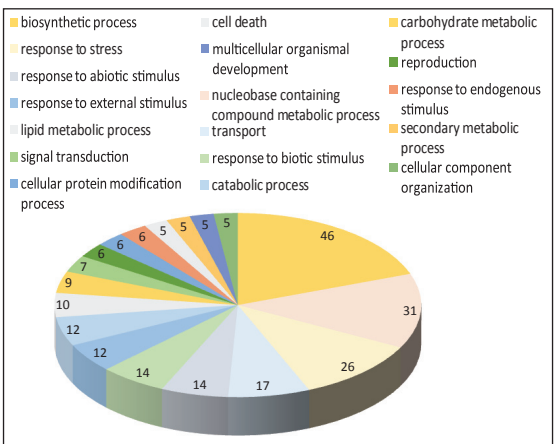


Fig. 1: GO term (biological processes) classification of upregulated genes at 6h

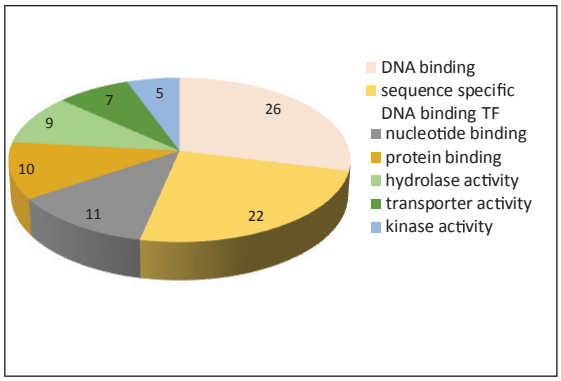


Fig. 2: GO term (Molecular function) classification of upregulated genes at 6h

GO terms were regulation of transcription, oxidation-reduction process and single organism transport. Whereas, DNA binding, transcription factor activity and hydrolase activity were major molecular function GO terms (Fig. 4).

Gene enrichment analysis indicated overrepresentation of GO terms related to transcription factor activity and/or DNA

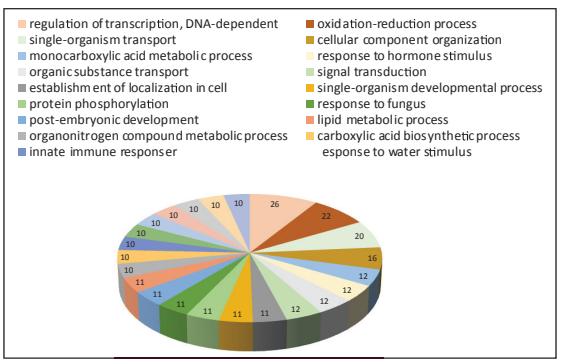


Fig. 3 : Biological process GO terms at 7 days

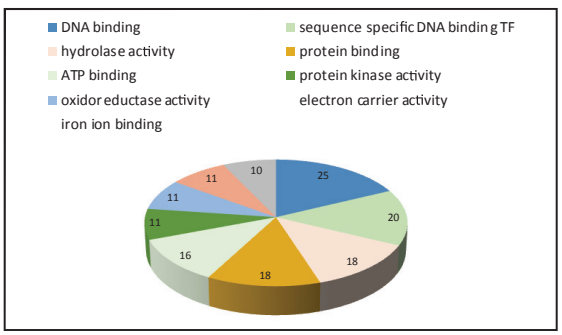


Fig. 4: Molecular function GO terms at 7 days

binding and under representation of GO terms related to metabolic processes at 6 hours of stress. Similarly GO terms related to transcription factors were over represented at 7 days of stress.

Cluster analysis of differentially expressed genes at different time points was used to study gene expression pattern of affected genes. 5 genes were common for three stages of sampling (6h, 24h and 7 days), though their expression pattern varied considerably (Fig. 5). Several genes were stage specific. Expression of 110 genes was changed only at 6h whereas 20 and 169 genes were specific for 24h and 7 days respectively.

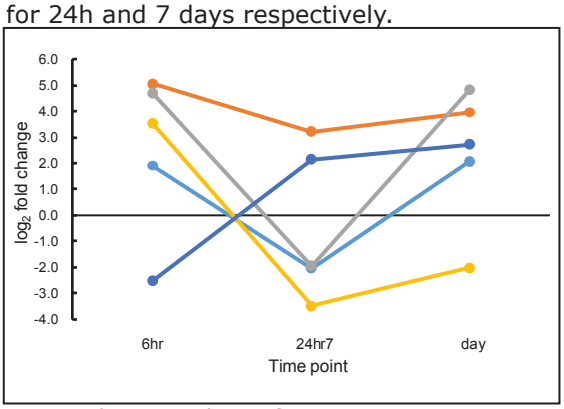


Fig. 5: Cluster analysis of 5 common genes

Identification of stable reference genes

Eight candidate reference genes were selected and their expression was analyzed in treated and control leaf samples of Thompson grafted on 110R as well as own root at different time points. Variation in Cq (Quantification Cycle) values was observed. Cq data was analyzed with different algorithms viz. geNorm, Norm finder, BestKeeper, deltaCT and RefFinder comprehensive ranking to identify most stable gene/s. Different set of stable reference genes were identified for grafted and own root vines. GAPDH and EF1α for grafted and Actin and Tubulin for own root, were identified as the most stable genes under salt stress. Identified reference genes will be used for data normalization during expression analysis of selected salt responsive genes.

Sequencing of Root RNA and analysis

The RNA from roots at different time points of stress (6h, 24h and 7 days) were sequenced using Illumina Hiseq 2000 platform. The sequence data was subjected to *de novo* assembly. The number of assembled transcripts was 1,708,162, of which 415,944 had a length of ≥150 bp. The length of longest transcript was 11,918 bp. The trimmed reads were aligned to the assembled transcriptome (length ≥150bp). Of all filtered reads ~ 76.36% of reads from all

samples were aligned back to their assembled transcriptome respectively. Overall 64,152 unique transcripts were obtained which had expression ≥ 1 FPKM. Differential expression and other analyses of these transcripts are in progress.

Analysis of osmoprotectants

Accumulation of osmoprotectants viz. amino acids, sugar alcohols and proline was studied in grafted and own root grapevine in response to salt stress at different time points. The content of proline was significantly different in salt treated Thompson Seedless/ own root vine at 15 days. However, no significant difference in proline content was recorded in Thompson Seedless/110R. Similarly significant accumulation of arginine and ornithine was observed in salt treated vine of Thompson Seedless/own root only. Among sugar alcohols, accumulation of Myo-inositol was observed upto 7 days followed by decrease in its content. Similarly, content of sorbitol increased in treated vines upto 48 hours followed by its decrease till 30 days.

Understanding rachis and berry elongation in response to GA_3 application in Thompson Seedless grapes through functional genomics

This project initiated in April 2013 involves RNA sequence based transcriptome analysis to understand mechanism of giberrellic acid action at rachis elongation, cluster thinning and berry elongation stages. Besides transcriptome analysis, observations on morphological and metabolic changes in response to GA_3 application were also recorded.

RNA sequence data analysis

RNA sequence data obtained during the first year was analyzed in detail. Differential expression analysis resulted in identification of large number of genes whose expression was changed in response to GA_3 hormone. The details of differentially expressed genes at different stages are given in table 5.

As revealed by the data, response to GA_3 application at molecular level takes place within six hour during rachis elongation and flower thinning, whereas at berry elongation stage, considerable change in gene expression takes place at 24h also. Functional categorization using Blast2GO revealed that at level 3 of GO terms, 76 up-regulated genes at 6h in rachis stage represent 32 biological processes related GO terms mainly different

Table 5.

Details of differentially expressed genes in response to GA_3 application

Sampling time	Criteria: Log_2 (fold change) ≥ 1.2, p ≤ 0.05 and q≤ 0.05	
	Up-regulated	Down-regulated
Rachis 6h	76	50
Rachis 24h	15	5
Flower 6h	17	247
Flower 24h	22	23
Berry 6h	79	95
Berry 24h	112	80

metabolic processes and 17 GO terms related to molecular functions mainly enzymatic activity (fig. 6 a and b). 50 down-regulated genes at 6h represented 24 level 3 GO terms related to biological processes and 7 related to molecular function.

At flower thinning stage, after 6h of GA_3 application, 15 up-regulated genes represented 17 and 8 level 3 GO terms respectively under biological processes and molecular function. 247 down-regulated genes represented wide spectrum of biological processes and functional categorization grouped them into 37 level 3 GO terms. Among 11 GO terms related to molecular function, hydrolase activity and transporter activity were the major terms. At berry elongation stage, modulation of gene expression continued at 24h also. At 6h and 24h, up-regulated genes belonged to several biological processes, among which biosynthetic process, cellular component organization, transport, response to stress were the major processes. Cluster analysis indicated that while expression of some up-regulated genes at 6h remained high at 24h also, expression of large number of genes decreased to insignificant level at 24h (Fig.7). Same trend was observed for down-regulated genes also.

Stable reference genes for qPCR data analysis

A total of 10 candidate reference genes were evaluated for their stability under experimental conditions. Expression of these genes was analyzed with four different algorithms to assess their suitability for qPCR data normalization. Based on the overall

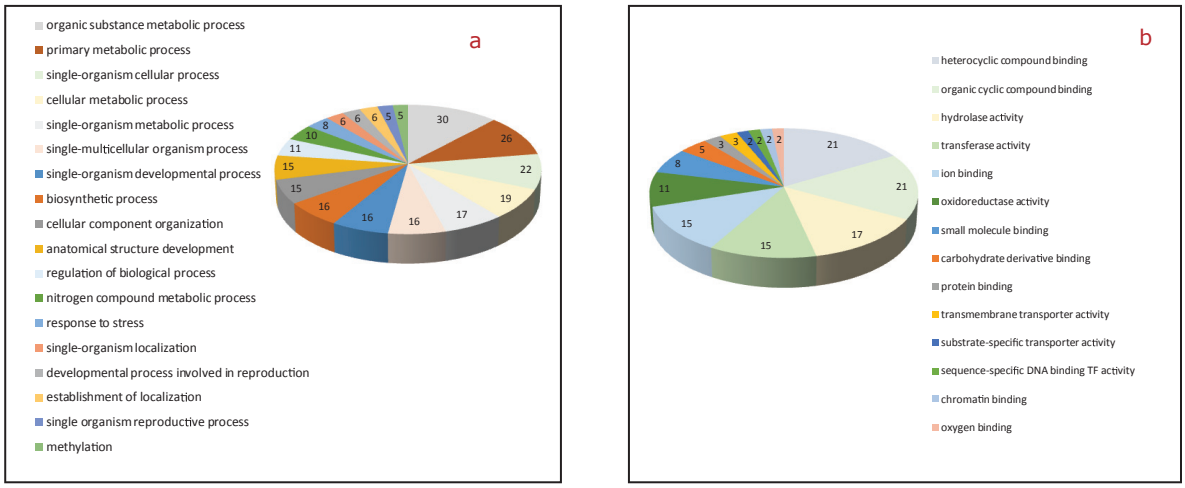


Fig. 6 : Functional categorization of up-regulated genes at 6h in rachis (a) biological processes (b) molecular function

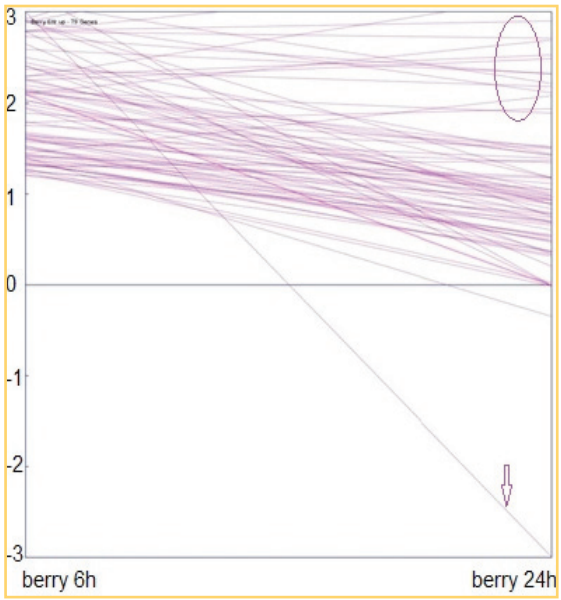


Fig. 7: Cluster analysis of genes up-regulated in berries at 6h

ranking, PP2A, Sutra and SAND were identified as the most stably expressed genes across all samples. When stage wise samples were considered, Tubulin, EF1α and UBC were the most stable genes during rachis elongation; while PP2A, SAND and Sutra were the most suitable genes for data normalization at flower thinning and berry elongation stages.

Identification and analysis of homologous GA responsive candidate genes

Data available in public domain was used to identify GA responsive candidate homologous genes in grape. The selected genes were GAI1, RGL, SCL28, SCL15, GID1B, XTH, SPINDLY and SNAKIN1. Relative expression of these genes was analyzed in hormone treated samples of rachis, flower cluster and berries at different time points. The expression of GID1B was down-regulated in flower cluster and berries after GA application. Expression of SCL15 decreased in flower cluster at 6 and 48h and increased in berries at 6h after GA application. The expression of SCL28 was up-regulated in flower cluster at 6 and 24h and down-regulated in berries at 48h. Expression of XTH and Snakin was also down-regulated in berries at 48h after GA treatment. Expression of remaining candidate GA responsive genes did not change under our experimental conditions.

Analysis of metabolites and endogenous hormone in differentially GA responsive genotypes

Five genotypes viz. Cabernet Sauvignon, Red Globe, Manjari Naveen, Fantasy Seedless and Sauvignon Blanc were selected based on their compactness/looseness. While Cabernet Sauvignon and Sauvignon Blanc are compact bunches, other three genotypes have loose

bunches. Metabolites such as sugars, organic acids and phenolics were estimated in these genotypes at three experimental stages. Varietal and stage wise differences were observed for all the metabolites.

Completed Project

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

The major findings under this project were as follows.

1. A protocol for the extraction of good quality protein from different tissues was standardized. The optimized protocol yielded good quantity of protein suitable for 2D electrophoresis as well as total proteome analysis on LC-MS/MS.
2. Protocols for 2D electrophoresis were standardized.
3. 2D electrophoresis of protein extracted from different tissues of Thompson u.c. Seedless grafted on three rootstocks revealed differential number and pattern of protein profile. At 3-4 mm and 8-10 mm berry stage, maximum protein spots were obtained on Dogridge, whereas, at veraison and harvest stage, number of protein spots was highest in 110R.
4. The starch content of buds reduced from 0 to 9 days after pruning which corresponded with increase in amylase activity. Sharp increase in amylase activity in own root vines upto 6^{th} days was observed indicating fast starch hydrolysis in own root vines.
5. Activity of enzymes PPO and POD on 9^{th} DAP was less in own root and 110R grafted vines indicating early release of bud break.
6. The bud break on 12^{th} DAP was highest in 110R followed by own root and Dogridge.
7. High concentration of proteins and sugars (glucose) in addition to higher concentration of Uracil, Salicylic acid (responsible for fruitfulness) improves fruit bud differentiation, thus increased fruitful canes on TS/OR and TS/110R was obtained.
8. High concentration of GA_3, ABA and reduced Uracil in TS/Dogridge during fruit bud differentiation resulted in reduced fruitfulness.
9. During berry development stage, rootstocks significantly influenced the variation in concentration of metabolites at different stages. For example, at veraison, malic acid was the highest on 110R whereas tartaric acid was at par on Dogridge and own root which was significantly higher than 110R. Both glucose and fructose was significantly less on Dogridge as compared to 110R and own root.
10. IAA concentration was highest at the time of fruit set followed by 3-4 mm berry stage as it is necessary for cell division. The concentration of IAA was not detected after 8-10 mm berry stage on all the stock scion combinations. Highest IAA was recorded on either Dogridge or on 110R at first three stages.
11. The concentration of GA_3 increased from fruit set till 8-10 mm stage of berry development with rapid decrease later on. Highest concentration of GA_3 at 8-10 mm stage was recorded on Dogridge followed by those on 110R rootstock.
12. Highest ABA concentration was recorded at veraison stage and later on it decreased. Among stock scion combinations, after veraison, highest ABA concentration was recorded on 110R rootstock followed by those on Dogridge and own rooted vines.
13. Uracil concentration was highest in all the samples compared to other hormones.
14. None of the cytokinin compounds could be detected in any of the samples.
15. For whole proteome analysis, protein was extracted from three biological replicates for five stages from three stock scion combinations. Whole proteome analysis was completed for five stages on Triple TOF 5600 MS/MS. (out sourced to ABSCiex India Ltd). Data analysis for identifying differentially expressed proteins was performed using software SWATH 2.0 and Protein Pilot 5.0 software.
16. The number of total proteins identified at different stages in each stock scion combination is given in table 6.
17. Differential expression analysis identified large number of proteins which were affected by rootstocks (table 7). The maximum change in proteins was observed at veraison stage followed by 3-4 mm stage.

Table 6.

Number of proteins detected at different stages

Stage	TS/Dogridge	TS/Own rooted	TS/110R
Full bloom	1784	1878	1789
3-4mm	1507	1964	1460
8-10mm	1650	1586	1634
Veraison	1700	1681	1715
Harvest	1664	1570	1592

Table 7.

Differentially expressed proteins at different stages of berry development

	Full bloom		3-4 mm		8-10 mm		Veraison		Harvest	
	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down
Dogridge v/s Own root	7	0	41	27	46	3	4	151	2	16
110R v/s own root	12	19	9	48	8	13	6	120	2	13
Dogridge v/s 110R	17	2	61	13	60	0	5	24	10	21

18. At 3-4 mm stage, most of the up-regulated proteins on Dogridge were involved in coding enzymes involved in metabolic and cellular process. Few proteins also coded for enzymes involved in developmental and multicellular organismal process.
19. In Dogridge, of 181 common proteins identified in five development stages, 78 showed more than 2-fold change ($p \leq 0.05$) in protein expression level in at least one of the development stages and therefore, they were identified as differentially expressed protein (DEPs).
20. 55 differentially expressed protein were down-regulated under at least one development stage, including 3 DEPs at two stages (3-4 mm and Veraison), while 7, 41 and 4 DEPs were down-regulated at 3-4 mm, veraison and harvest stage respectively.
21. Among 15 up-regulated DEPs, 9 and 6 DEPs up-regulated at 3-4 mm and 8-10 mm stage, respectively.
22. 8 DEPs showed up and down regulation in different development stages, 2 DEPs at 3-4 mm (up) and veraison (down), while 6 DEPs at 8-10 (up) and VS (down).
23. Cluster analysis identified five clusters which helped in determining the expression pattern of significantly up- and down-regulated proteins during berry development stages.
24. Fischer's enrichment analysis indicated over-representation of genes belonging to GO term "structural molecule activity" (GO:0005198) in up-regulated list of protein at flowering stage, 3-4 mm, 8-10 mm berry). In contrast, this GO term was down-regulated from Veraison stage onward.
25. Response to abiotic stimulus (GO:0009628) was significantly over-represented in veraison stage down-regulated list of protein ."Nucleic acid binding" (GO:0003676), DNA binding (GO:0003677) was under -represented in veraison down-regulated subset. There was no statistically significant result in other sets.
26. The major pathways affected by rootstocks were Glycolysis and Carbohydrate Metabolism, Energy Metabolism and Photosynthesis, Amino acid metabolism and Antioxidant Enzyme.
27. At veraison, highest number of proteins was detected in vines grafted on 110R rootstock and least was on un-grafted vines. Most of the up-regulated proteins on 110R coded for enzymes involved in

cellular process followed by metabolic process indicating high level of metabolic activities at veraison stage.

28. The highest number of up-regulated proteins coding for enzymes involved in growth process at veraison was recorded on 110R indicating its continuous growth and late ripening compared to other combinations.

Rootstocks considerably affect berry characteristics. Comparison of proteome data of own root and grafted vines at different stages of berry development has helped us to indentify the key genes affected by these rootstocks. This information will be useful for the identification of candidate genes and development of markers for important genes related to berry quality.

Production Technology

Standardization of cultural practices to increase quality wine

Effect of planting density on wine quality in Cabernet Sauvignon variety

The experiment was initiated during 2014-15. Cabernet Sauvignon vines grafted on 110R rootstock were spaced at 8 feet between rows while the spacing between the vines varied from 2 feet, 3 feet and 4 feet thus accommodating 2722, 1815 and 1361 vines per acre. The data was recorded for bud sprout, vegetative growth, bunch and berry quality. The bud sprout was early in 8 x 4 feet spacing (10 days) than the delayed sprouting in closed spacing of 8 x 2 feet (13.52 days). Shoot length was also significantly higher in 8 x 4 feet (85.71 cm) spacing than the lowest (79.79 cm) in the dense spacing of 8 x 2 feet. Significantly higher TSS (23.0 °Brix) and bunch weight (97.71 g) was recorded in 8 x 4 feet spaced vines and the lowest TSS (20.14 °Brix) and bunch weight (94.86 g) in 8 x 2 feet. The number of bunches per vine were less in 8 x 2 feet spacing (14.86) as compared to 22.57 in 8 x 4 feet spacing indicating the reduced fruitfulness under dense canopy. The highest yield per vine (2.21 kg) was recorded in the vine spaced at 8 x 4 feet distance and the lowest of 1.41 kg/vine in 8 x 2 feet distance. Considering bunches per vine and TSS, the spacing of 8 x 4 feet found to be optimum. This was the first year of harvest, the experiment will be continued and wine quality of different treatment will be assessed in subsequent years.

Effect of pruning dates on wine quality in Shiraz variety

The experiment was initiated on Shiraz, a red wine grape variety grafted on 110R rootstock during 2014-15. The vines were trained to mini-Y trellises spaced at 8 x 4 feet distance. The experiment was conducted to study the effect of different pruning time on growth, yield and wine quality. The vines were pruned at three different times (01.10.2014, 10.10.2014 and 20.10.2014). The observations were recorded on vegetative growth parameters, yield and quality parameters. The vines pruned on 20.10.2014 were early to sprout than the other pruning times. Number of bunches per vine were higher in the vines pruned on 10.10.2014. However, the average bunch weight was higher in late pruned vines. This might be due to the higher temperature experienced by the vines during the period of maturity. Yield per vine was higher in 1.10.2014 pruned vines. This was the first year of the harvest, the experiment will be continued and wine quality of different treatment will be assessed in subsequent years.

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

The project was initiated in collaboration with France government during the year 2008-09. Ten red wine and nine white wine grape varieties grafted on 110R rootstock were planted. Each variety was planted in one row accommodating 104 plants. The data recorded on vegetative growth, bunch, yield and wine parameter during the year 2014-15 is presented.

Red wine varieties

Growth and yield parameters

During the year, the red wine varieties statistically showed variation in vegetative growth parameters. The variety Grenache recorded significantly less shoot length of 37.2 cm followed by 39.5 cm in Petit Verdot and

53.4 cm in Merlot. However, maximum shoot length was recorded in Niellucio with 90.7 cm. The variety Petit Verdot also recorded least number of bunches per vine (7.2) followed by Cinsaut (10.1). The highest number of bunches per vine were obtained in Shiraz (43.5). The same trend was observed during the year 2013-14. However, no correlation was observed between vigor and yield in these varieties. The yield in Petit Verdot (0.5 kg), Niellucio (0.8 kg) and Cinsaut (1.1 kg/ vine) was very low indicating their poor performance under Pune condition.

The bunch weight was highest in Shiraz and Cinsaut (110.3 and 110.7 g respectively) while the lowest in Petit Verdot and Caladoc (63.2 g). Significantly higher 100-berry weight (132.0 g) was recorded in Cinsaut and the lowest in Petit Verdot (42.0 g). Number of berries per bunch ranged from 62.0 in Niellucio to 111.0 in Cabernet Sauvignon.

Fruit composition

The fruit composition viz., total soluble solids, acidity and juice pH plays an important role in quality wine preparation. All the red wine varieties varied significantly for TSS. Among the different varieties, TSS ranged from 18.3 °Brix in Cinsaut to 23.7 °Brix in Grenache. Acidity ranged from 6.7 g/L (Temperanillo) to 8.8 g/L (Niellucio). Juice pH ranged from 3.1 in Petit Verdot to 3.6 in Temperanillo.

Maturity period

Among the red wine varieties, days required to harvest bunches at appropriate TSS varied significantly. Based on the time taken for harvest, the varieties viz., Caladoc, Grenache, Niellucio and Cabernet Sauvignon took minimum period of 136 days to harvest. It was followed by Petit Verdot which took 138 days to harvest. These varieties were rated as early varieties. However, the varieties viz., Shiraz, Cinsaut, Temperanillo, Merlot and Cabernet Franc took maximum period of 158 days to harvest and thus were rated as late varieties under Pune condition. Based on the TSS requirement of individual red wine variety, the degree days ranged from 1571.1 to 1871.2. The varieties viz., Caladoc, Grenache, Nieullicio, Petit Verdot and Cabernet Sauvignon required minimum degree days of

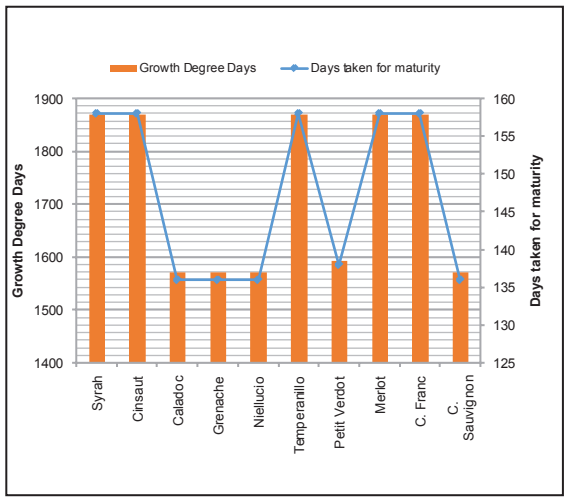


Fig. 8: Degree days requirement and days taken for maturity of red wine varieties

1571.1 for maturity. (Fig. 8).

Biochemical composition of wine grape juice

The phenolic compounds play an important role in flavor and aroma of the wine. The grapes from red wine varieties were collected at harvest and the phenolic compounds were estimated using HPLC. Among the phenolics, higher amount of non-flavonoids hydroxycinnamic acids (Fig. 9) and hydroxybenzoic acids (Fig. 10) were recorded in Cabernet Franc while the least concentrations were recorded in Grenache and Cabernet Sauvignon. Whereas, the highest concentration of flavonoids was recorded in Petit Verdot, followed by Cabernet Franc and the least in Grenache (Fig. 11). The concentration of Stilbenes was highest in Shiraz followed by Caladoc while the least concentration was recorded in Niellucio (Fig. 12). Among the organic acids estimated in red wine varieties, tartaric acid was the major acid recorded. Cabernet Franc recorded the highest amount of tartaric acid followed by Merlot whereas Cinsaut recorded the lowest amount (Fig. 13). Among the sugars, fructose was the major sugar estimated in all the varieties. The Highest amount of fructose was recorded in Merlot followed by Petit Verdot and Temperanillo. Merlot recorded the highest amount of glucose followed by Cinsaut whereas the lowest quantity of glucose was recorded in Caladoc indicating the varietal difference among the red wine varieties.

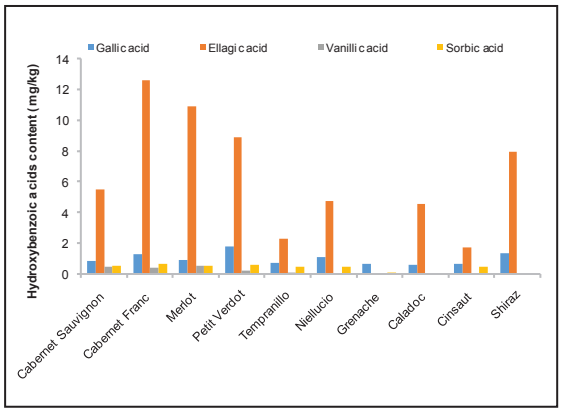


Fig. 9: Non-flavonoids (hydroxybenzoic acid (mg/kg) in juice of red wine grapes.

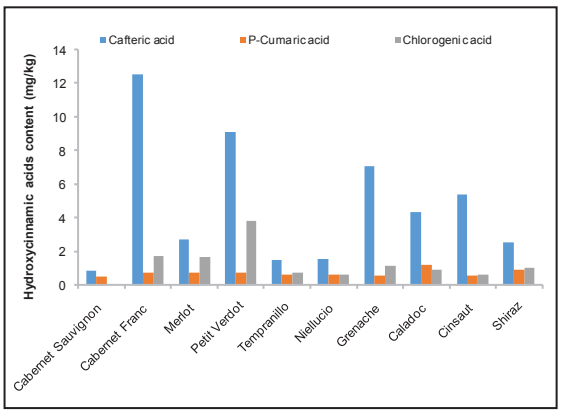


Fig. 10: Non-flavonoids hydroxycinnamic acid (mg/kg) in juice of red wine grapes

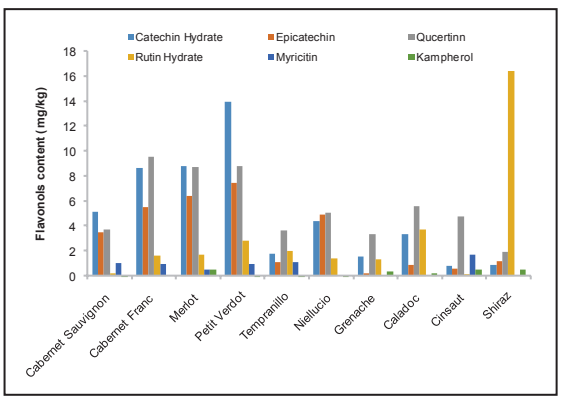


Fig. 11: Flavonoids (flavan-3-ols) (mg/kg) in juice of red wine grapes

Biochemical composition of finished red wines

The concentration for various phenolic compounds in finished wine varied among red wines. The highest total phenol of 4550.19 mg/L was recorded in Petit Verdot followed by Cabernet Sauvignon (2971.48 mg/L) whereas, the variety Shiraz and Cinsaut

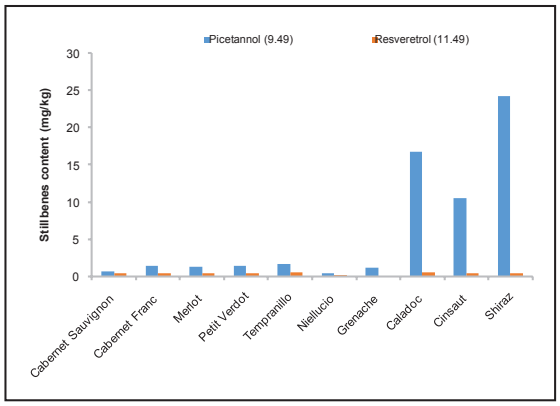


Fig. 12: Stillbene content in juice of red wine grape varieties

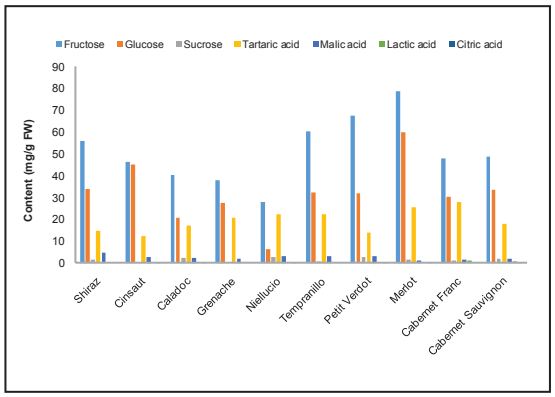


Fig. 13: Organic acids and sugar content of red wine grapes

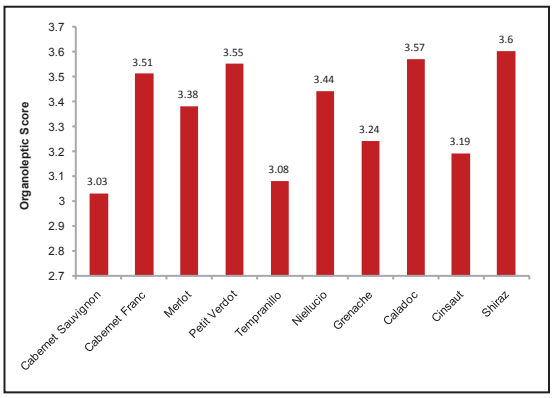


Fig. 14 : Organoleptic scores for red wines

produced least amount of total phenols of 0.02 mg/kg and 26.76 mg/L respectively. Among the individual phenols, Rutin hydrate was abundant in all the red wine varieties. It was highest in Petit Verdot (4295.80 mg/L) followed by Cabernet Sauvignon (2586.37 mg/L) while it was the least in Caladoc (680.47 mg/L). Oenin chloride was found to be the second most abundant individual phenolics in

red wine, while P-coumaric acid and Caffeic acid was recorded in least concentration in red wines.

Organoleptic test

The organoleptic test was conducted to know the preference of different group of people for testing. The wine testing session was organized at ICAR-NRC Grapes, Pune inviting the wine specialists from Sula Winery, Nasik. The orientation on wine testing was given by the expert to the testers. The wine was served to 20 members with the evaluation report card. The wines were rated on a scale of 0 to 5, five being the most preferred. Shiraz wine received higher rating of 3.60 followed by Caladoc (3.57) and Petit Verdot (3.55). The wine from Cabernet Sauvignon was rated to be the lowest (3.03) (Fig. 14). Thus, under Pune conditions, Shiraz and Petit Verdot are suitable varieties for producing better quality wines.

White wine varieties

Growth parameters

Among the white wine varieties, shoot growth was minimum in Viognier with 29.83 cm and Muscat White with 30.62 cm while the highest shoot length was recorded in Colombard with 93.44 cm. The variety Gros Meseng recorded very less bunches per vine (3.33). The same performance was exhibited by this variety during the last year. The reduction in number of bunches per vine was also reflected in yield per vine among these varieties. The yield ranged from 0.33 kg in Gros Meseng to 2.95 kg in Sauvignon Blanc. Average bunch weight ranged from 70.30 g (Vignoir) to 126.40 g (Vermentino). Hundred berry weig ht was the lowest in Vignoir (49.0 g) and the highest in Sauvignon Blanc (131.67 g). Considering the fruitfulness, it can be concluded that Pune condition are not suitable for the variety Gros Meseng.

Fruit composition

Among the different varieties studied, Gewurztraminer recorded highest TSS of 27.30 °Brix whereas the lowest TSS was in Viognier (20.57 °Brix). The acid in fruit ranged from 5.50 g/L in Muscat White to 7.72 g/L in Gros Meseng. The juice pH ranged from 3.31 in Vignoir while the lowest amount was recorded in Sauvignon Blanc.

Maturity period

Among the different varieties, Sauvignon Blanc, Riesling and Gewurztraminer matured early and were harvested in 137 days as compared to all other varieties which were harvested in 157 days. The early maturing varieties took 1571.1 degree days for maturity while later varieties required 1871.2 degree days (Fig. 15)

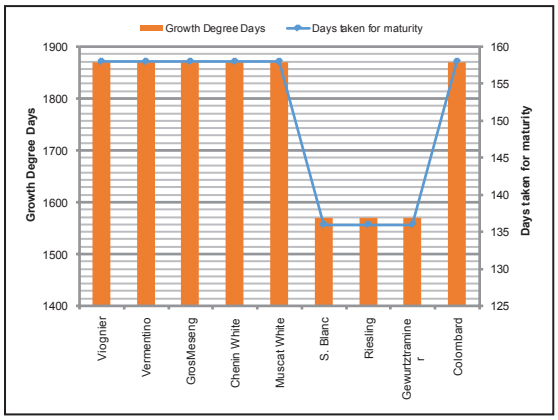


Fig. 15: Degree days requirement and days taken for maturity for white wine varieties

Biohemical composition of finished wines

Among the white wines, highest total phenolics was recorded in Vermentino (2726.35 mg/L) followed by Viognier (920.11 mg/L) while, it was lowest in Chenin (4.28 mg/L). The individual phenolics from finished wines in Gewrtztraminer variety recorded negligible amount. Among the individual phenolics, rutin hydrate was recorded in highest concentration (3206.04 mg/L) followed by Oenin chloride (182.83 mg/L) and Caftaric acid (180.69 mg/L) whereas, Caffeic acid was recorded in small quantity of 0.114 mg/L. The differences for individual phenolics in finished wine of red and white varieties might be due to the genetic differences among the varieties that might have influenced the phenolic content.

Organoleptic test

Among the different white wines, the wine made from Colombard was rated high with 3.28 score on a 5.0 point scale and was followed by Riesling (3.24). The wine from Chenin and Vermentino were the least preferred (Fig. 16).

Based on maturity and organoleptic test, Riesling was found to be a better white wine variety under Pune conditions.

Performance of Cabernet Sauvignon grafted on different rootstocks

The project was initiated during the year 2008-09 in collaboration with France

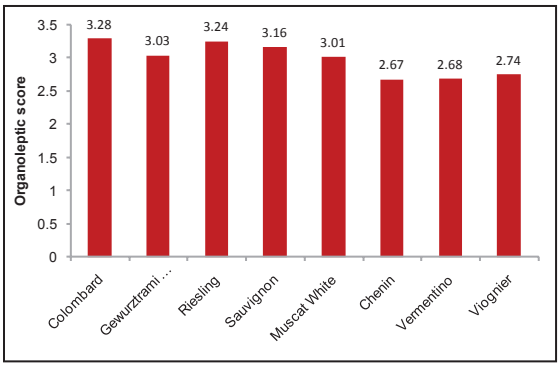


Fig. 16: Organoleptic score for white wine

government. Cabernet Sauvignon, a red wine variety grafted on different rootstocks (110R, 101.14MGT, SO4, Grevesac, Fercal, 1103P and Dogridge) was evaluated for growth, yield, quality parameters and nutrient status. Significant differences were recorded for the bunch and yield parameters in vines grafted on different rootstocks. Maximum bunch weight was recorded in Fercal grafted vines (147.5 g) followed by 110R (145.75 g) rootstock while it was least on Grevesac rootstock (65.00 g) grafted vines. The highest number of berries per bunch was recorded on vines grafted on 110R while the least was on Grevesac grafted vines. Rootstocks significantly increased the yield per vine. The maximum yield per vine was recorded in the vines grafted on 110R (6.66 kg) followed by Fercal (4.97 kg), while the least yield was recorded on 101.14 Mgt (2.32 kg). Highest TSS was recorded on 110R (23.97 °B) followed by Grevesac (23.40 °B) grafted vines, while it was the least on 101.14 MGT (21.45 °B) and Dogridge (21.47 °B).

Influence of rootstocks on juice composition was recorded. The vines grafted on Fercal rootstock showed highest juice K (1350 ppm) followed by SO4 (1300 ppm) while least juice K (885) was recorded on 110R grafted vines. Similar trends were obtained for juice Na on grafted vines. The rootstock influenced the petiole nutrient content of Cabernet Sauvignon vines significantly. Maximum nitrogen content was recorded on 110R grafted vines (1.08%), while the least content was recorded with 101.14 MGT (0.78%). Similar trend was observed for P content. The 110R grafted vines showed highest K contents while Fercal showed the least. The results obtained in the present study showed that the vines grafted on 110R and Fercal increased bunch weight, number of berries per bunch, yield per vine, total soluble solids and juice K and juice Na compared with other rootstocks studied.

Thus, Cabernet Sauvignon grafted on 110R and Fercal rootstock performed better in terms of yield and TSS.

Performance of Sauvignon Blanc grafted on different rootstocks

The experiment was initiated during the year 2014-15. Sauvignon Blanc, a white wine grape variety grafted on different rootstocks (110R, Fercal, 1103P, 140Ru, SO4, Dogridge and Salt Creek) was evaluated for growth, yield and fruit composition. The significant variations were recorded for vegetative parameters of Sauvignon Blanc grafted on different rootstocks. The highest shoot length (89.5 cm) was recorded in the vines grafted on Fercal rootstocks, while 1103P grafted vines recorded minimum shoot length of 67.25 cm. The maximum shoot diameter (6.57 mm) was recorded on Dogridge grafted vines, while least was observed on 1103P and 140Ru (5.3 mm).

The maximum bunch weight, number of berries per bunch, 100 berry weight and yield per vine was recorded on SO4 grafted vines, while least was recorded on 1103P grafted vines (Table 10). Total soluble solids were highest in vines grafted on 140Ru, while least was on Salt Creek. Lowest juice pH was recorded on 1103P (3.36), while it was highest on 140Ru (3.68). Thus grafting on SO4 increased yield and yield parameters of Sauvignon Blanc while 1103P resulted in decrease in parameters. Since, this is the first year data, no conclusion can be drawn.

Performance of Fantasy Seedless grafted on different rootstocks

The project was initiated during 2014-15. The vines of Fantasy Seedless grafted on three rootstocks (140Ru, Dogridge and 110R) were evaluated alongwith own rooted vines for growth, yield and quality parameters. Significant differences were recorded for various vegetative parameters of Fantasy Seedless grafted on different rootstocks. Maximum pruning weight was recorded on Dogridge rootstocks, while it was least on Own rooted vines. Own rooted vine sprouted early after 9.2 days, but growth showed low vigor recording minimum shoot length (63.71 cm), shoot diameter (8.25 mm), lowest number of bunches per vine (21.74). The vines on Dogridge sprouted late (13.06 days) but showed best vigor and recorded maximum shoot length (82.83 cm), shoot

Table 8.

Effect of different rootstock on yield and fruit quality parameters of Cabernet Sauvignon

Rootstocks	Av. Bunch wt. (g)	No. of berries / bunch	100-berry wt (g)	Yield kg/vine	TSS (°B)	Acidity (g/L)	Juice pH
110R	145.75	155.75	94.25	6.66	23.97	6.33	3.75
101.14Mgt	112.25	125.00	90.63	2.32	21.45	7.08	3.66
140Ru	77.75	82.5	96.25	2.79	23.25	5.63	3.88
Dogridge	82.65	87.5	95.75	3.13	21.47	6.70	3.69
SO4	118.75	139	86.70	4.91	21.75	6.35	3.75
Gravesac	65.00	72.75	91.25	2.05	23.40	6.13	3.84
Fercal	147.50	93.25	144.50	4.97	22.25	6.63	3.71
1103P	68.63	76.75	91.08	2.72	22.27	6.60	3.69
CV%	3.64	3.66	4.963	11.462	1.461	2.02	0.93
CD (p=0.05)	5.47	5.61	7.211	0.623	0.48	0.19	0.05

Table 9.

Effect of different rootstocks on juice and petiole nutrient contents of Cabernet Sauvignon

Rootstocks	Juice		Petiole					
	K (ppm)	Na (ppm)	N %	P %	K %	Ca %	Mg %	Na (ppm)
110R	885	56	1.08	0.65	1.20	1.55	0.95	256.25
101. 14Mgt	895	89	0.91	0.56	1.05	1.46	0.63	265.25
140Ru	945	62	0.78	0.42	1.02	1.58	0.95	282.25
SO4	1300	88	0.84	0.60	0.81	1.09	0.66	281.25
Gravesac	1140	70	1.04	0.53	1.20	1.86	1.22	287.75
Fercal	1350	71	1.06	0.37	1.23	2.25	1.01	296.50
1103P	1175	88	0.96	0.46	0.79	1.35	0.96	224.00
S. Em ±	58	5	0.03	0.01	0.05	0.09	0.04	20.18
CD (p=0.05)	121	10	0.06	0.01	0.10	0.19	0.09	42.39

diameter (9.20 mm). Dogridge rootstock showed highest yield and average bunch weight, 50-berry weight, TSS indicating its superiority. The rootstock 140 Ru grafted vines showed highest number of bunches (32.80) as compared to other rootstock grafted vines. The results obtained in the present investigation indicated that Dogridge rootstock grafted vines performed better with respect to growth, yield and quality parameters. However, being the first year observations, consistency in growth performance and yield contributing parameters needs to be studied for another 2-3 years.

Performance of Red Globe grafted on different rootstocks

The project was initiated during 2014-15. The vines of Red Globe grafted on 140Ru, Salt Creek, 110R and Dogridge were evaluated for growth, yield and quality parameters and compared with own rooted vines of Red Globe. The trend with respect to sprouting, time, vigor were similar as that in case of Fantasy Seedless, except that maximum number of bunches and total yield per vine were better in 110R. On Dogridge rootstock, 140.2 days were required to achieve uniform

Table 10.

Effect of different rootstock on bunch and berry characters and quality parameters of Sauvignon Blanc

Root-stocks	Av. Bunch wt. (g)	No. of berries / bunch	100-berry wt (g)	Yield/ vine (kg)	TSS	Acidity	Juice pH
110R	91.50	91.50	107.25	1.23	21.28	5.90	3.54
Fercal	73.25	59.50	120.50	1.04	20.43	6.10	3.60
1103P	67.25	56.00	116.75	0.76	21.23	5.50	3.40
140Ru	90.75	74.75	118.00	1.75	22.13	5.89	3.70
SO4	124.75	106.75	160.50	1.86	21.28	5.52	3.60
Dogridge	91.50	72.00	122.25	1.17	18.83	5.90	3.50
Salt Creek	91.00	74.50	120.25	0.70	18.73	6.20	3.50
CV%	4.78	2.17	1.32	21.00	2.78	6.70	1.30
LSD at 5%	6.39	2.46	2.43	0.38	0.85	0.58	0.07

Table 11.

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

Growth Stage		Treatments *				
	Expected duration (days after pruning)	T1	T2	T3	T4 (subsurface irrigation)	T5 (PRD)
Foundation 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
121days - fruit pruning *	121 -	15	15	0	0	0
Fruit 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

colour as against 121.6 days in own rooted vines. However, being the first season data, the experiment needs to be continued for next year.

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

The experiment on standardizing irrigation schedule for Fantasy Seedless vines raised on 110R rootstock was initiated in 2013-14. Five treatments (irrigation schedule based on crop growth stage and recorded open pan evaporation) given in table 11 on vines raised under uniform management conditions were imposed. The treatments (T1, T2 and T3) was 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 and treatment T5 comprised of Partial rootzone drying (PRD) technique. Total pan evaporation and rainfall recorded during the period was 1531 mm and 579 mm respectively. The vines were not irrigated for 85 days during the period due to rains.

Treatment with 250.26 mm of applied irrigation (T2) along with rainfall (579 mm) produced yield (17.86 t/ha) on par with the highest treatment (313.24 mm) with WUE of 71.93 kg/mm of irrigation water (Table 12). The treatment T2 was significantly superior over treatments with lower irrigation water application. Between treatments T4 (SS) and T5 (PRD), no significant difference in yield was observed. Treatment T4 (SS) utilised least irrigation water of 169.02 mm with highest WUE of 106.20 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 bunches. The total irrigation water utilised was 203.22 mm which was comparable to T5 (PRD) and higher than T4 (SS). The photosynthetic and transpiration rates recorded up to 90 days after pruning were significantly lower in the T3 treatment compared to other treatments during Foundation pruning season. However, no significant differences were observed among the treatments during the fruit pruning season after 30 days of pruning. This difference could be due to intermittent rains, similar schedules at flowering stage and lower temperature necessitating less application of irrigation water. This could be understood from the leaf water potential results which also did not differ between the treatments during fruit pruning season up to 90 days. However, at 120 DAP and harvest, vines under T4 (SS) treatment recorded lowest leaf water potential implying that the vines were stressed as compared to other treatments as they had not been irrigated from the ripening stage onwards. The leaf water potential during foundation and fruit pruning season was highest in T1 treatment and followed trend similar to the quantum of irrigation water applied (Table 12). The petiole N, P and K content of the vines at the

Table 12.

Effect of irrigation treatments on yield and yield parameters of Fantasy Seedless vines

Treatments	Yield (t/ha)	Bunch wt. (g)	Bunch no.	TSS (°B)	Acidity (g/L)	Irrigation applied (mm)*	WUE (kg/mm of irrigation applied)
T1	18.04	46.25	217.50	19.3	6.4	313.24	57.46
T2	17.86	46.30	215.51	18.6	6.6	250.26	71.93
T3	15.37	43.55	197.02	17.5	6.7	203.22	88.57
T4	16.27	46.05	197.05	17.8	6.8	169.02	106.50
T5	16.16	44.95	200.49	18.7	6.5	203.22	88.57
SEm±	0.38	1.27	4.06	0.36	0.24		
CD (p=0.05)	0.82	NS	8.86	0.79	0.53		

fruit bud differentiation stage was significantly lower in T3 treatment as compared to other treatments. At full bloom stage, petiole N, P and K content were marginally lower in T3 treatment compared to other treatments.

Leaf proline contents were significantly higher in treatments T3, T4 and T5 where less irrigation water was applied compared to T1 and T2 at 30 and 45 DAP during foundation pruning season, there upon no significant differences were recorded as the schedules were uniform across the treatments. However, total phenols in leaf tissue showed significantly higher contents in treatments T3, T4 and T5 compared to T1 and T2. The leaf proline and total phenols were highest in T3 treatment compared to any other treatment thereby clearly showing the moisture stress during foundation pruning season. During fruit pruning season, leaf proline content was significantly higher at 30 DAP in T3 treatment over other treatments. The T1 followed by T2 treatment continued to have the lowest leaf phenol and proline content compared to other treatments. In general, there is a tendency of osmoprotectants like proline and phenols to accumulate under moisture stress conditions. Berry proline content increased till harvest across all the treatments whereas total phenols in the berries declined with time. Significantly highest berry phenol and proline content was recorded at 120 DAP and harvest in T4 treatment where irrigation was stopped from ripening stage onwards. The berry proline and phenol content continued to remain lower in T1 treatment followed by T2.

Comparison of different sources of organic matter in grapevines including recycling of pruned biomass

Farm yard manure was a most common source of manure in the Indian agriculture. Grape vineyards were no exception. However, during the recent years its cost has increased due to less availability in the grape growing regions. An experiment was initiated during 2013-14 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 in different treatment combinations. The treatment details are given in table 13.

There was no significant difference amongst different treatments in terms of yield and yield related parameters though

Table 13.

Treatment details

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

Table 14.

Effect of treatments on yield and yield related parameters

Treatments	Yield (t/ha)	Bunch no.	Bunch weight (g)	TSS (°B)	Acidity (g/L)
T1: Control	16.98	75.50	126.03	22.20	7.23
T2: FYM	18.23	74.25	137.52	21.05	7.00
T3: Press mud	18.82	74.75	140.35	19.80	7.00
T4: FYM + press mud	17.87	77.50	131.23	19.78	7.00
T5: FYM + press mud + pruned biomass + GM	18.27	74.25	137.19	21.63	7.23
SEm±	1.19	4.72	11.78	0.70	0.12
CD (p=0.05)	NS	NS	NS	NS	NS

highest yield was recorded in treatment T3 (Press mud compost) (Table 14). Other quality parameters like TSS and acidity also did not differ significantly between the treatments. Treatments T3, T4 and T5 increased potassium concentration in petioles significantly at fruit bud differentiation and petiole N and K content at flowering stage over other treatments (Table 15). The soil organic carbon accumulated significantly in the treatments where organic sources have been added (Fig.17). Between the organic sources, press mud compost alone or in combination has significantly improved organic carbon over FYM treatment. These results indicated that press mud compost alone or in combination can be used as a cheaper source of organic matter as well as nutrients. The experiment is being continued.

Table 15.

Effect of treatments on petiole nutrient content at Full bloom stage

Treatments	Fruit Bud Differentiation stage			Flowering stage		
	N %	P %	K %	N %	P %	K %
T1: Control	0.87	0.69	1.88	0.90	0.32	2.52
T2: FYM	0.89	0.63	1.83	0.94	0.31	2.50
T3: Press mud	0.87	0.70	2.05	0.97	0.32	2.67
T4: FYM + press mud	0.95	0.64	2.07	0.92	0.34	2.73
T5: FYM + press mud + pruned biomass + green manuring	0.88	0.63	2.18	0.94	0.35	2.92
SEm±	0.03	0.03	0.05	0.01	0.01	0.07
CD (p=0.05)	0.06	NS	0.12	0.03	0.01	0.16

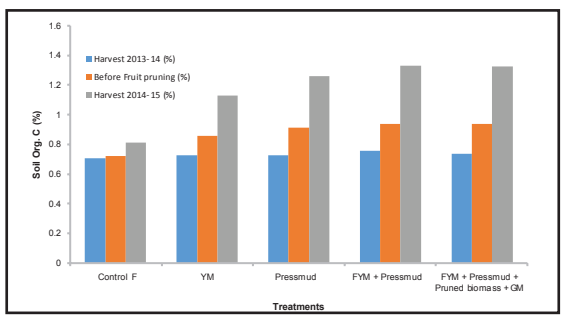


Fig. 17: Accumulation of soil organic carbon

Demonstration - Techniques to improve water use efficiency in Thompson Seedless vines

A trial was initiated in November, 2014 to demonstrate the effectiveness of the techniques developed at ICAR- NRC Grapes for improving water use efficiency in Thompson Seedless vines. The demonstration was started in farmer's field at Jath in Sangli district. This experiment is financially supported by Maharashtra Rajya Draksh Bagayatdaar Sangh (MRDBS). The objective of the experiment are as follows.

1. Demonstration of the techniques developed at the Centre to improve water use efficiency in Thompson Seedless vines.
2. To study the effect of partial root zone drying technique and mid row irrigation (buried subsurface drip irrigation) along with surface drip irrigation on yield and quality of grapes.

The experiment has been laid out on Manik Chaman, a clone of Thompson Seedless vines. The experimental design is RBD with 4 replications. The vine spacing is 8' x 5'. The treatment details are given in table 16. Vines are being irrigated with water having EC = 2.77 dS/m; pH = 7.16; Ca^{2+} =178 ppm; Mg^{2+} = 111 ppm; Na^{+} = 123 ppm; HCO_3^{2-} = 6 meq/L. The initial soil samples analysed had average pH of 7.8; N = 112 ppm, P = 55.7 ppm; K = 403.6 ppm; Ca = 0.8%; Mg = 0.3%, Cl = 72.1 ppm and Na = 190 ppm.

The leaf water potential recorded at flowering, veraison and harvest stage did not differ significantly between the treatments. This clearly showed that the treatments intended for increasing water use efficiency through 25% reduction in irrigation water did not show any stress as compared to recommended irrigation level. Similarly,

Table 16.

Treatment details

Treatment	Description
T1	Recommended surface drip irrigation (based upon pan evaporation and crop growth stage)
T2	Subsurface irrigation at 75% of the T1 with buried subsurface irrigation line double line.
T3	Subsurface irrigation at 75% of the T1– PVC pipes
T4	Recommended Surface drip irrigation at 75% of the T1 + mulch + anti-stress (biodegradable acrylic polymer)
T5	Recommended surface drip irrigation with buried subsurface drip line in the middle of two rows
T6	Partial root zone drying

the petiole nutrient content (N, P and K) at flowering stage also did not differ significantly between the treatments. The treatments also did not differ significantly in terms of yield, TSS and acidity. The yield ranged from 19.9 MT to 24.7 MT/ha under various treatments.

Standardization of bioregulators schedule for improving quality and yield of table and wine grapes

The following varieties were evaluated for dose standardization of bioregulators to see the effect in terms of increase in the berry size, quality parameters and yield parameters,

Crimson Seedless

The dose of bioregulators (GA_3 and CPPU) was standardized to improve the berry size and yield of Crimson Seedless grapes since it has potential for export. Among the schedule, application of GA_3 (10 ppm) and CPPU (0.5 ppm) at 3-4 mm berry size and 6-7 mm berry size was found effective in improving the berry size and quality parameters.

Red Globe

The schedule to improve the quality and production of Red Globe was standardized. The data recorded at harvest indicates that the application of higher doses of GA_3 (20 ppm) and CPPU (2 ppm) at 3-4 mm berry size and 6-7 mm berry size were effective in increasing the size of the berries and also the quality of berries.

Manjri Naveen

Similarly the schedule of the bioregulators like GA_3 and CPPU was standardized for production of better quality grapes of Manjri Naveen variety. Among the different schedules, application of GA_3 (10 ppm) and CPPU (0.5 ppm) at 3-4 mm berry size and 6-7 mm berry size seems to be effective in increasing berry size as well as quality of this variety.

Fantasy Seedless

This is export oriented important variety. An experiment was conducted to standardize the schedule for production of very good quality grapes of this variety. The data recorded at harvest indicates that the application of GA_3 (10 ppm) and CPPU (0.5 ppm) at 3-4 mm berry size and 6-7 mm berry size were effective in increasing the size of the berries and also the quality of berries.

Medika, KR-White and A18/3

The schedule to improve the berry size, quality and yield production of Medika, KR-White and A18/3 varieties were standardized. The data recorded at harvest indicates that the application of lower doses of GA_3 (10 ppm) and CPPU (0.5 ppm) at 3-4 mm berry size were effective in increasing the size of the berries and also the quality of berries for Medika, KR-White and A18/3 varieties.

Physiological disorders and their management in grapes

Effect of foliar application of Boron and Zinc on Berry Cracking

Results of the study concluded that maximum reduction (15.23%) of berry cracking occurred with the foliar application of Zinc @ 2 g/L + Boron @ 2 g/L as compared to control (27.48%).

Effect of different chemicals on Berry Cracking

Results of this study indicate that there was highest reduction (18.49%) in berry cracking with the application of CCC @ 500 ppm in grapes over control (30.42%). Skin thickness (0.17 µm) of berry was also found best in the treatment of Agrocharger (1 ml/L and 2 ml/L) and CCC (500 ppm). Hence,

CCC @ 500 ppm was found to be superior in comparison to other treatments.

New chemicals/ botanicals for improving bud break and grape quality

Evaluation of Physiological effects of (Metiram 55% + Pyraclostrobin 5%) 60%WG in Thompson Seedless grapes

Two sprays of (Metiram 55% + Pyraclostrobibn 5%) 60%WG @ 600 g/acre at 75 days and 85 days after fruit pruning showed increase in berry length, berry diameter, bunch wt, leaf size, leaf thickness and yield per vine at harvest as compared to control (no spray).

Studies on bio-efficacy, physiology and phytotoxicity of Homobrassinoloide 0.03% in Thompson Seedless grapes

Formulation of Homobrassinoloide 0.03% a new generation plant growth promoter containing naturally occurring brassinolides was evaluated for its effect on bunches after dipping treatments. The berry length, diameter and skin thickness were increased significantly when the formulation was used at 1.0 ml/L as compared to other treatments.

Studies on bio-efficacy of Sea weed extract in Thompson Seedless grapes

Formulation containing Sea weed extract (Plantozyme) applied as a spray, drench and drip irrigation were evaluated for their effect on growth in Thompson Seedless grapes. Application of Sea weed extract formulation as a spray (2.5 ml/L) significantly influenced all the berry parameters while the application as drip (2.5 ml/L) recorded significantly higher bunch weight, berry length, berry diameter and yield in Thompson Seedless grapes.

Evaluation of weedicides on grassy and broad leaf weeds in Tas-A-ganesh grapes

Application of (Oxyfluorfen 2.5%+ Glyphosate 41%) 43.5% SC at dose 3.125 L/ha and Paraquat dichloride 24% SL at dose 2.5 a.i. lit/ha showed best results in terms of weed control over control (no spray) at post emergence stage of application.

Plant Health Management

ICAR-AMAAS Sub-Project on "Development of microbial formulations for biological control of grape diseases"

Control of powdery mildew in field by microorganisms

Trichoderma

Based on previous year's studies, two isolates of *Trichoderma* were selected as most promising for control of grape powdery mildew caused by *Erysiphe necator.* The aqueous suspensions of these isolates were evaluated in a field trial on Thompson Seedless vines after foundation pruning (April-October) 2014. Results are presented in table 17. Both isolates were effective in controlling powdery mildew. *T. koningii* - NAIMCC-01938 and *T. harzianum* - NAIMCC-01965 reduced the 'area under disease progress curve' (AUDPC) to 774.57 and 849.99 respectively as compared to control which recorded 1375.09 AUDPC. The total phenol contents, which is an indication of disease severity in the susceptible variety was also lower in *T. koningii* isolate as compared to *T. harzianum* isolate. These bio-control isolates will be formulated and the formulations will be tested in large scale field trials, either alone or in combination with safe fungicide(s).

Bacillus

Four most promising isolates of *Bacillus* spp. were selected for field trials based on previous year's studies for control of powdery mildew on Thompson Seedless vines in a field trial after foundation pruning (April-October 2014). The aqueous suspensions of these isolates were evaluated alone and in combination of two compatible isolates. The area under disease progress curve (AUDPC) in all *Bacillus* treatments was significantly lower than control, though higher than those observed in treatment with sulphur. *Bacillus* isolates TL-171 and DR-38+TS-204 were most

Table 17.

Effect of treatments on petiole nutrient content at Full bloom stage

Treatment	PDI of powdery mildew on leaves					AUDPC	Ratings on 50 leaves / replicate	Total phenols (mg/g)	*Trichoderma cfu* / cm² (×10⁵)
	PDI - 1	PDI - 2	PDI - 3	PDI - 4	PDI - 5				
T. harzianum	1.69 (7.01)^{b}	17.38 (25.48)^{b}	22.44 (28.83)^{b}	44.36 (41.69)^{b}	58.69 (51.07)^{c}	849.99^{c}	3.76^{c}	8.41^{c}	3.23^{a}
T. koningii	1.18 (6.22)^{b}	16.96 (24.29)^{b}	21.33 (27.50)^{b}	41.44 (40.07)^{b}	52.89 (46.66)^{b}	774.57^{b}	2.90^{b}	6.34^{b}	5.06^{a}
Sulphur (2.5 g L-1)	1.16 (6.16)^{b}	8.31 (16.69)^{a}	13.49 (21.53)^{a}	32.62 (34.83)^{a}	36.40 (37.10)^{a}	526.60^{a}	2.04^{a}	4.00^{a}	0.00^{b}
Control	0.67 (4.62)^{a}	36.29 (37.03)^{c}	44.89 (42.06)^{c}	67.98 (55.57)^{c}	78.07 (62.08)^{d}	1375.09^{d}	4.06^{d}	13.42^{d}	0.00^{b}
CD (P=0.05)	1.09	2.69	1.58	2.67	1.34	46.73	0.24	0.41	2.03

Four foliar applications were done at 1 x 10^{6} spores/ml concentrations at 7-10 day intervals. Figures in parentheses are arcsine transformed values

Table 18.

Evaluation of Bacillus isolates for control of powdery mildew on Thompson Seedless grapevines

B. subtilis strain	Percent Disease Index (PDI)				AUDPC
	1	2	3	4	
DR-38	30.1 (38.6)^{a}	47.3 (43.4)^{c}	65.4 (54.0)^{d}	71.5 (57.6)^{bc}	1358.91^{bc}
DR-39	35.5 (40.8)^{ab}	46.7 (43.0)^{bc}	67.3 (55.0)^{d}	71.7 (57.8)^{bc}	1394.03^{c}
TL-171	44.1 (44.0)^{cd}	47.0 (43.2)^{bc}	57.8 (49.6)^{b}	68.1 (55.6)^{b}	1343.30^{b}
TS-204	47.6 (46.0)^{de}	46.8 (43.0)^{bc}	61.8 (52.0)^{c}	68.9 (56.2)^{bc}	1393.26^{c}
DR-39+TL-171	46.6 (46.0)^{de}	46.5 (43.0)^{bc}	67.4 (55.0)^{d}	70.1 (57.0)^{bc}	1436.32^{d}
DR-38+TS-204	47.2 (46.2)^{de}	45.6 (42.4)^{b}	55.5 (48.2)^{b}	72.4 (58.4)^{c}	1346.42^{b}
Sulphur	36.7 (43.0)^{bc}	28.5 (32.2)^{a}	44.9 (42.2)^{a}	36.3 (37.0)^{a}	916.00^{a}
Control	48.3 (47.0)^{e}	56.4 (48.8)^{d}	70.3 (57.0)^{e}	85.2 (67.2)^{d}	1614.18^{e}
CD (0.05)	2.70	0.99	1.99	2.25	37.32

Four foliar applications were done at 1 x 10^{8} cells/ml concentrations at 7-8 day intervals. Figures in parentheses are arcsine transformed values

effective in reducing AUDPC to 1343.30 and 1346.42 respectively from 1614.18 AUDPC in control. The efficient bio-control isolates will be formulated and the formulations will be tested in large scale field trials, either alone or with safe fungicide(s).

Effect of microorganisms on shelf-life of Thompson Seedless at Pune

Foliar sprays

Aqueous suspensions of *Trichoderma* and *Bacillus* strains on shelf-life of Thompson

Seedless grapes was studied in a field trial at ICAR-NRCG vineyard. Three *Trichoderma* strains, two *Bacillus* strains and a mixture of these two *Bacillus* strains were applied twice as a spray at flowering stage and again twice at 15 and 7 days before harvesting. *Trichoderma* and *Bacillus* were 15 day and 72 h old respectively and were applied at the concentration of 5×10^6 spores/ml and 1×10^8 cfu/ml respectively. Full coverage of foliage and bunch was ensured. *T. harzianum* 5R and *Bacillus* DR-38, TL-171 and mixture of these two isolates gave less decay even after 10 days on shelf at ambient temperature. All microbes reduced loss in weight increasing shelf-life by 1 day (<5% moisture loss)

Soil drenching

The effect of weekly soil drenching with two *Bacillus* strains at 1×10^8 cfu/ml and with two *Trichoderma* strains at 5×10^6 spores/ml on shelf-life of disease free Thompson Seedless vines at ICAR-NRC Grapes was studied in a field trial. Aqueous suspensions were applied at 1L/vine. *Bacillus* and *Trichoderma* cultures were 72 h and 15 day old respectively. *T. harzianum* 5R and *Bacillus* TS-45 and DR-92 reduced decay during storage. All microbes minimized loss in weight as compared to untreated control in the order, *Trichoderma viride* strain, followed by *Bacillus* TS-45, *T. harzianum* 5R and *Bacillus* DR-92. The two *Trichoderma* strains increased TSS slightly.

Potential of biocontrol agents under Nasik condition

Control of downy mildew

The effect of soil drenching with 2 ISR strains each of *Bacillus* / *Trichoderma* in control of downy mildew was studied in a private vineyard of Thompson Seedless at Nashik. Aqueous suspensions of *Trichoderma* and *Bacillus* at the concentration of 5×10^6 spores/ml and 1×10^8 cfu/ml respectively were applied at 1 L/vine. The vines under these treatments were given 12 fungicide sprays at high risk period of downy mildew. The control (farmer's practice) received 20 fungicide sprays for control of downy mildew during the season. The two *Bacillus* treatments and *Trichoderma* 5R significantly reduced PDI on leaves as compared to control with 20 fungicide sprays (Table 19). All microbial treatments also significantly reduced inflorescence decay and increased number of bunched per vine which resulted in higher yield per vine.

Improving shelf-life of grapes

The grapes harvested from the above treatments were also studied for any possible improvement in shelf-life. *T. viride* strain significantly reduced weight loss as seen on 4th day on shelf. The number of decayed berries was least in berries harvested from vines drenched with *Trichoderma* 5R.

Production of extracellular lytic enzymes by promising biocontrol agents

Trichoderma

The activities (U/ml/min) and specific activities (U/mg protein) of extracellular lytic enzymes, viz. cellulase, chitinase, β,1-3 glucanase, protease, amylase and lipase enzymes by 10 promising bio-control isolates of *Trichoderma* was studied *in vitro* using enzyme specific substrates. The activities in U/ml/min ranged from 63.68 - 396.42 for cellulase; 0.165 – 0.804 for chitinase; 34.42

Table 19.

Evaluation of microorganisms for control of downy mildew under Nasik condition

Treatment	DM PDI on leaves	DM PDI on bunches	Bunch/ vine (No)	Yield / vine (kg)	TSS (°B)	Berry diam. (mm)
	after 15 days of last drenching					
TS-45	3.25(10.36)^{ab}	1.25 (4.55)	31.90^{b}	11.60^{b}	18.93^{ab}	18.34^{ab}
DR-92	2.88 (9.70)^{ab}	0.00 (0.00)	30.40^{b}	11.49^{b}	18.13^{ab}	17.81^{ab}
Tricho -33	3.88 (11.33)^{bc}	1.25 (4.53)	37.90^{a}	13.88^{a}	19.28^{a}	17.75^{ab}
Tricho-5R	2.75 (9.44)^{a}	0.00 (0.00)	32.90^{b}	12.16^{b}	18.43^{ab}	18.80^{a}
Farmer's practice	4.75 (12.54)^{c}	0.63 (2.28)	22.70^{c}	8.24^{c}	17.03^{b}	17.18^{b}
CD (p=0.05)	1.87	NS	4.09	13.85	2.24	1.37

Three soil applications were done at concentration of 1 x 10^6 spores/ ml for Trichoderma and 1 x 10^8 cells/ ml for Bacillus at 17-8 days intervals. Inoculum was applied at 1L per vine.

– 78.28 for β,1-3 glucanase; 51.97 – 136.09 for protease;27.57 – 45.08 for amylase; and 0.15 – 3.06 for lipase (table 20).

Bacillus

The activities (U/ml/min) and specific activities (U/mg protein) of extracellular lytic enzymes, viz. cellulase, chitinase, β,1-3 glucanase, protease, amylase and lipase enzymes by 5 promising bio-control isolates of *Bacillus* was also studied in *vitro* using enzyme specific substrates. The activities in U/ml/min ranged from 227.46 – 279.71 for cellulase; 0.059 – 0.248 for chitinase; 57.31 – 70.19 for β,1-3 glucanase; 23.86 – 54.32 for protease; 09.00 – 48.99 for amylase; and 0.60 – 1.35 for lipase (table 21).

Use of biocontrol agents for biodegradation

Flusilazole

Biodegradation of flusilazole by 5 isolates of *Bacillus* viz. DR-38, DR-39, CS-126, TL-171, and TS-204 was studied in liquid culture and on grape berries. Strains DR-39 and CS-126 minimized the half-life of flusilazole from 8.4 days to 5.3 - 5.8 days in liquid culture. In grapes sprayed with flusilazole at a field dose

Table 20.

Enzyme activity of 10 promising Trichoderma isolates

Trichoderma isolate (NRCG No)	Chitinase	Cellulase	β,1-3 Glucanase	Protease	Amylase	Lipase
	U/ml/min	U/ml/min	U/ml/min	U/ml/min	U/ml/min	U/ml/min
1	0.188^{e}	373.48^{b}	54.48^{d}	65.26^{f}	45.08^{a}	1.46^{e}
3	0.195^{e}	396.42^{a}	52.53^{e}	96.43^{c}	27.57^{h}	1.67^{d}
10	0.451^{d}	196.00^{e}	51.27^{f}	94.28^{c}	40.11^{d}	2.50^{b}
17	0.781^{a}	313.08^{c}	78.28^{a}	136.09^{a}	37.42^{f}	1.39^{e}
19	0.804^{a}	243.96^{d}	60.52^{c}	102.97^{b}	40.45^{d}	2.52^{b}
24	0.228^{e}	130.58^{g}	69.72^{b}	61.37^{g}	37.55^{f}	1.36^{f}
31	0.540^{b}	63.68^{i}	48.33^{g}	58.92^{g}	43.10^{b}	1.37^{f}
32	0.510^{b}	173.51^{f}	41.57^{h}	91.52^{d}	41.05^{c}	3.06^{a}
33	0.406^{d}	85.58^{h}	39.82^{I}	51.97^{h}	39.29^{e}	0.15^{g}
34	0.165^{e}	173.65^{f}	34.42^{j}	74.25^{e}	36.81^{g}	2.38^{c}
CD(p=0.05)	0.068	2.97	0.60	2.94	0.56	0.14

Table 21.

Enzyme activity of 5 promising Bacillus isolates

Bacillus isolate	Chitinase	Cellulase	β,1-3 Gluanase	Protease	Amylase	Lipase
	U/ml/min	U/ml/min	U/ml/min	U/ml/min	U/ml/min	U/ml/min
DR-38	0.248^{a}	276.15^{b}	70.19^{a}	23.86^{e}	14.40^{d}	1.35^{a}
DR-39	0.126^{b}	251.07^{d}	61.85^{d}	29.28^{d}	40.94^{b}	0.75^{b}
CS-126	0.060^{c}	263.50^{c}	68.34^{b}	41.96^{c}	25.73^{c}	0.69^{bc}
TL-171	0.087^{c}	227.46^{e}	66.93^{c}	45.94^{b}	09.00^{e}	0.65^{bc}
TS-204	0.059^{c}	279.71^{a}	57.31^{e}	54.32^{a}	48.99^{a}	0.60^{c}
CD(p=0.05)	0.03	2.74	0.77	1.58	0.62	0.11

of 0.125 ml/L the residue on grapes in control was 1.15 mg/kg after 20 days of application, where as in grapes treated with strains CS-126 and DR-39 the residues had decreased to 0.35 and 0.60 mg/kg respectively.

Mixture of pesticide i.e. carbendazim, tetraconazole and profenofos

Biodegradation of a mixture of pesticide i.e. carbendazim, tetraconazole and profenofos which belong to 3 different chemical groups, by the same five *Bacillus* strains viz.DR-38, DR-39, CS-126, TL-171, and TS-204 was also studied. Each of five strains enhanced the degradation of pesticide mixture on grape berries. Strain TL-171 minimized the half-life of carbendazim from 8.1 days to 5.5 days. Strain DR-39 minimized the half-life of tetraconazole from 8.9 days to 5.8 days. The half-life of profenofos is minimized by strain CS-126 from 2.5 days to 1.6 days.

Table 22.

Kinetics of flusilazole degradation on grape following linear and non-linear models

B. subtilis strain	Linear first order model				Nonlinear first+first order model			
	R^2	K_1 (d^{-1})	K_2 (d^{-1})	DT_{50} (day)	R^2	K_1 (d^{-1})	K_2 (d^{-1})	DT_{50} (day)
DR-38	0.93	2.61	NA	6.7	0.93	0.12	0.50	6.6
DR-39	0.92	2.44	NA	7.6	0.96	0.60	1.84	5.3
CS-126	0.97	2.08	NA	6.4	0.99	0.60	1.67	5.3
TL-171	0.98	2.30	NA	8.5	0.99	0.13	0.78	7.6
TS-204	0.97	2.37	NA	5.8	0.97	0.12	1.19	5.8
Control	0.93	2.31	NA	21.3	0.98	2.38	2.20	18.9

Table 23.

Kinetics of pesticide degradation on grape following nonlinear first+first order model

B. subtilis strain	DT_{50} (days)		
	Carbendazim	Tetraconazole	Profenofos
DR-38	5.8	6.7	2.1
DR-39	7.1	5.8	2.0
CS-126	6.9	6.1	1.6
TL-171	5.5	6.2	2.0
TS-204	5.9	5.8	2.2
No *Bacillus* control	8.1	8.9	2.5

These and earlier studies show that these selected superior strains have capability to control grape diseases as well as degrade pesticides belonging to different chemical groups and will be useful in viticulture to minimize pesticide use and their residues at harvest.

Bioefficacy of new formulations in control of grape diseases

During fruiting season 2014-15 in field trials bio-efficacy of different formulations of fungicides and bio-control agents were tested. Effective doses of the formulations for different diseases have been listed below.

Sr. No.	Fungicide formulation	Dose ml or g/L	Disease controlled
1.	Amisulbrome 20% SC (Kirari)	0.3	Downy mildew
2.	Potassium salt of phosphorous acid (Privi Nutrifight)	4	Downy mildew
3.	Potassium salt of phosphorous acid (Privi nutrifight) + Mancozeb 75%	2.0 + 2.0	Downy mildew
4.	*Bacillus subtilis* (Taegro)	0.37	Downy mildew Powdery mildew
5.	Azoxystrobin 11% + Tebuconazole 18.3% SC (Custudia)	0.5 - 0.75	Powdery mildew
6.	Fluxapyroxad 75 g/L + Difenoconazole 50 g/L SC	0.6 – 0.8	Powdery mildew
7.	Cyflufenamid 5% EW	0.4 - 0.5	Powdery mildew
8.	Chitosan 10% (Kitosan)	2 – 3	Powdery mildew
9.	Proquinazid 20 % EC	0.2 – 0.25	Powdery mildew
10.	Flutriafol 250 g/L SC (CHA 1322)	0.5	Powdery mildew
11.	PIF 320 5% SC	0.8 – 1.2	Powdery mildew

Studies on biology of fungal pathogens

Downy mildew

Fungicide resistance in field isolates of *Plasmopara viticola*

Natural field isolates of *P. viticola* collected from twelve locations in Pune, Sangli, Nasik and Mizoram, were analysed by biological assays for detecting their sensitivity to Azoxystrobin and Kresoxy methyl, two fungicides belonging to QOI group. Nine single lesion isolates had EC_{50} values ranging from 50 ppm to > 1000 ppm and were considered as resistant to the fungicides. Three isolates had EC_{50} values below 4.0 ppm and were considered as sensitive. Molecular analysis of these and another 23 isolates from the same locations revealed that 29 out of 35 isolates were resistant to QOI group.

Sexual reproduction in *Plasmopara viticola*

P. viticola generally reproduces sexually at the end of season and forms oospores which help it to survive from one season to next. Systematic microscopic observations of 220 leaf samples, drawn from 8 vineyards in Pune, Nasik, Sangli and Solapur regions indicated absence of oospores in the leaf tissues. As oospores are abundantly formed and easily observed, our results indicate absence or rarity of sexual reproduction in grape growing areas in Maharashtra. A possible reason could be presence of only one mating type thallus, as seen in case of *E. necator* which needs further investigations.

Powdery mildew

Mating types of *Erysiphe necator*

Analysis of previously recorded weather data showed that temperature and humidity remain in favorable range for sexual reproduction in *Erysiphe necator* and chasmothecia (earlier called as cleistothecia) formation.

Confirmation of absence of MAT1-1 mating type idiomorph of *E. necator* in Maharashtra and Karnataka was done by molecular analysis of 70 additional samples. The presence of both MAT1-1 and MAT1-2 mating type idiomorphs in 1 out of 20 samples collected from Srinagar, Kashmir was confirmed using mating type specific primers. This will explain absence of chasmothecia from vineyards in Maharashtra and its occasional sighting in Kashmir.

Genetic groups of *Erysiphe necator* in India

Molecular analysis of 70 *E. necator* samples collected from diverse regions in India showed that all the isolates belonged to ascospore genetic group and none belonged to the flag-shoot genetic group. This observation supports the non-sighting of flag shoot infections (arising out of infected buds) in Maharashtra.

The above two observations raise questions on how the pathogen is over summering in Maharashtra, if it is not surviving in shoot primordial (dormant buds) or as chasmothecia (earlier known as cleistothecia) which are formed as a result of sexual reproduction.

Leaf spot

Isolations from anthracnose samples from Srinagar, Kashmir and Champhai, Mizoram

All 38 samples from leaf lesions and another 38 samples from lesions on fruits gave only *Colletotrichum* spp. No sample gave *E. ampelina.* Growth of two randomly selected isolates was not completely inhibited even at 1000 ppm carbendazim.

One *Colletotrichum* spp. and 1 unidentified fungus were isolated from anthracnose infected leaf samples from Champhai, Mizoram. Both the isolates were inhibited at 100 ppm carbendazim.

Multi-pronged strategy for the management of mealybug in grapes

Population risk assessment and advisory system

Insect and mite pest risk assessment and advisory system was developed on PHP/MySQL based interactive-web-platform to provide automated advisory based on calculated pest risk-level, phenology, and actual/forecast weather conditions, previous sprays given and actual pest level for thrips, mealybugs, flea beetle, leafhoppers, caterpillars and red spider mites (Fig. 18). The field implementation of this advisory system was done during fruiting season 2014-15 for calibration and refinement. Advisory plots were compared with the farmers' practice. Advisory plot was at par with farmers' practice for incidence level of mites and leaf damage due to caterpillars (Fig.19). However, advisory plot had higher

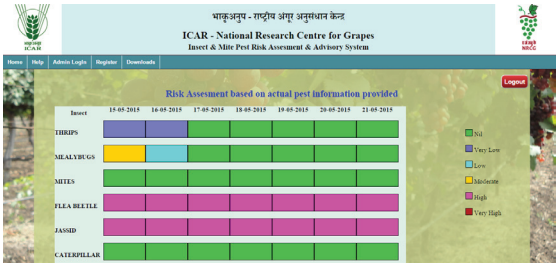


Fig. 18: Insect and mite pest risk assessment and advisory system

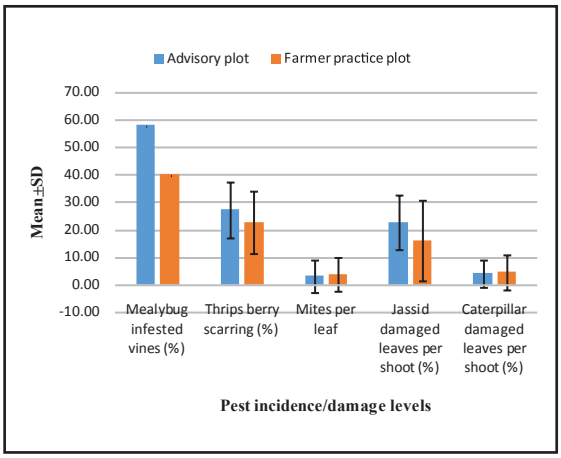


Fig. 19: Comparison between advisory and farmer practice plots for pest incidence levels

percentage of mealy infested vines and berries scarring due to thrips. Advisory plot received a total of 12 insecticide applicaions as compared to 17 in farmers' practice plot (Table 24).

Table 24.

Comparison between advisory and farmer practice plots for total number of sprays

Name of the pest	No. of sprays	
	Advisory	Farmer practice
Jassid+ thrips	6	8
Mealybug	3	6
Mites	3	3
Total	12	17

Determination of thermal constant and development threshold for pink mealybug

Thermal constants were quantified for all stages of pink mealybug, *Maconellicoccus hirsutus* (except adult male) as 107.52 for egg, 119.04 for crawler, 131.57 for second instar nymph, 131.58 for third instar female and 188.67 for adult female. The mean number of days required to complete developmental stages were determined for temperatures at 20, 25, 27, 30, 32 and 35 °C. This information will be utilized for refinement of risk assessment model as build-up of mealybug population in the vineyard also depends upon initial population level.

Management of stem borer in grapes

Identification and documentation of species of stem borer and their biology

DNA barcoding using mitochondrial cytochrome oxidase 1 sequence was done for morphologically identified *Stromatium barbatum* (Fab.) and was put to test. The COI sequence showed 86 per cent match with closely related species *S. longicorne* and in Neighbour Joining (NJ) tree analysis, it formed monophyletic clade with *S. longicorne* suggesting correct genus level identification(Fig. 20). *S. barbatum* adult female was first morphologically identified by an expert taxonomist and COI sequence was submitted to NCBI which was the first submission for this species (Accession No KM921770).

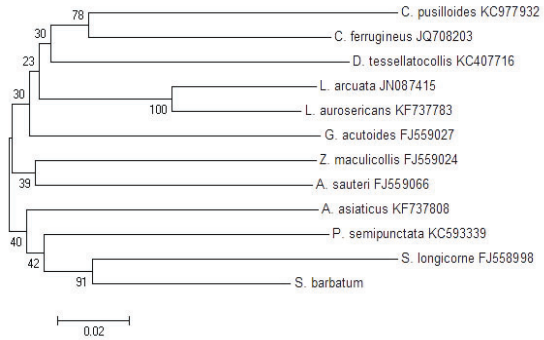


Fig. 20: NJ clustering analysis of *Stromatium barbatum* based on COI gene using MEGA 6

Pictorial illustrations of important morphological features of *S. barbatum* as per Gahan (1906) (Fig. 21) and various life stages were documented for future reference. The COI sequences from adults of different sizes (which were identified morphologically as same species) showed only ≤2.5 per cent divergence confirming size polymorphism. It was also confirmed by the results of interbreeding method (biological species concept) to delimit the species. The mating experiments revealed that egg laying took place in Normal Female × Small Male, Small Female × Small Male and Normal Female × Normal Male combinations concluding that the morphologically identical (for taxonomic features) individuals of different sizes belong to same species. The mating bioassays also revealed that size of both male and female *S. barbatum* govern fecundity.

Development of laboratory rearing method for stem borer

Both stem borer species, viz., *Celosterna scabrator* and *S. barbatum,* once removed from the stem in field do not feed on stem in the laboratory and do not survive. *S. barbatum* was found to survive when an artificial hole was made in the stem and the grub was inserted in. But, it did not work for *C. scabrator* which made laboratory experiments on *C. scabrator* impossible. An artificial food source was identified on which *C. scabrator* grub was able to complete life cycle with success rate of 75.0 per cent during 2013-14 and 87.5 per cent during 2014-15. For *S. barbatum*, ground (crushed) grapevine stem was found effective for rearing grubs. Both these methods made i*n vitro* experiments a possibility where non-destructive real-time observations can be taken.

Behavioural bioassays on attraction towards food sources

Attraction of *S. barbatum* adults towards various food sources such as dry wood, wet wood, green shoots and sugar solution was studied through behavioural bioassays as food preference for this specie is not known yet. It was found that 48.33% females were attracted towards wet wood followed by 33.33% towards dry wood (Fig. 22). However, 59.17% males showed attractiveness towards dry wood. When only green leaves were given as food in no-choice experiments, none of the adults fed on green plant tissues. When observations in vineyards were taken on presence of adults on vines, it was found that majority of adults were found on cordons followed by main trunk. This information is useful in targeting the insecticides towards main trunk and cordons for the management of adults which is the only weak link in the life cycle of this species.

Evaluation of potential insecticides against stem borer adults

Among nine insecticides evaluated, Fipronil 80 WG @ 0.05 g/L and lambda cyhalothrin 5 SG @ 0.5 ml/L resulted in maximum mortality of 100 and 96.3% respectively when applied at the rate of 200 microliter per adult *S. barbatum* during *in vitro* experiments.

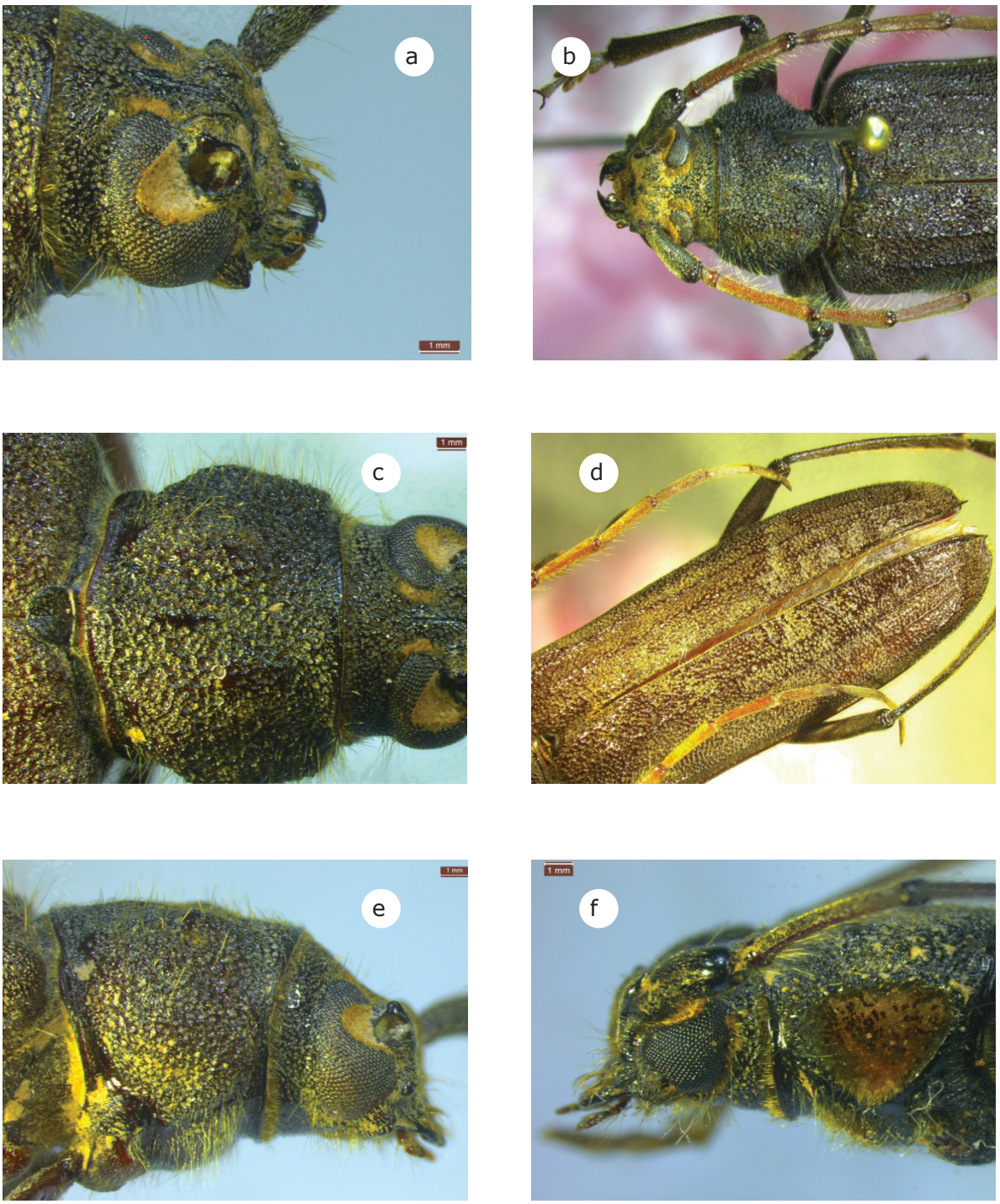


Fig. 21: Morphological features of *S. barbatum* as per Gahan (1906): (a) Eyes emarginated with large lower lobe, (b) Antennae third joint longest, fourth lightly shorter than the fifth, ciliate beneath, (c) Prothorax very densely punctured, the disc with five slightly raised tubercles, (d) Elytra densely punctured; each with two tolerably distinct dorsal and one or two short lateral costae, short sutural tooth at apex, (e) Prothorax sides broadly and obtusely protuberant except near the base in female, (f) Prothorax sides straighter and marked each with a large tomentose depression, extending along greater part of its length in male

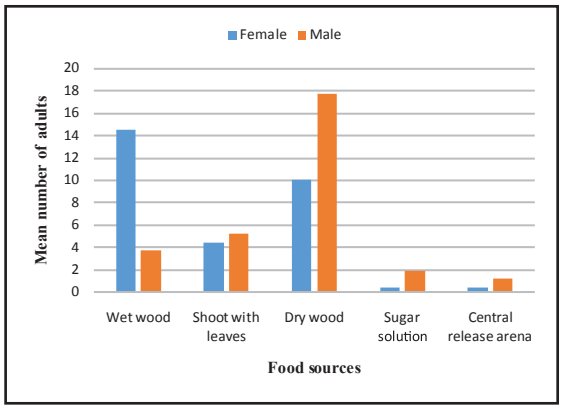


Fig. 22: Attraction of *S. barbatum* adults towards various food sources

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

Evaluation of potential natural enemies against major insect pests of grapes

Studies on longevity of mealy bug parasitoid, *Anagyrus dactylopii* at different temperatures

The longevity (time taken from emergence to death of adult parasitoid) of the mealy bug parasitoid, *Anagyrus dactylopii* was studied under five different temperatures viz., 20, 25, 30, 35 and 40°C in the laboratory. There was a steady decline in the longevity of the parasitoid with increase in the temperature. The mean longevity of the adult parasitoid was 7.00, 8.75, 12.75, 3.50 and 2.00 days at 20, 25, 30, 35 and 40°C respectively.

Host and host stage preference studies of mealy bug parasitoid, *A. dactylopii*

Three species of mealybug viz., *Maconellicoccus hirsutus, Nipeacoccus viridis* and *Planococcus citri* were exposed to the parasitoid for 24 hours and the percent parasitization was observed. The mean percent parasitization of *M. hirsutus, N. viridis* and *P. citri* by *A. dactylopii* was 84, 60, and 41.33 respectively. The host stage preference of *A. dactylopii* over *M. hirsutus, P. citri* and *N. viridis* was studied by exposing fifteen individuals of first, second and third instar nymphs of mealybugs to the adult parasitoids for 24-48 hours. The parasitoid showed higher preference towards the third instar nymphs (64%) followed by adults (33.40%) and second instar nymphs (8.0%) of mealy bug.

Studies on flowering plants to enhance the activity of *A. dactylopii*

Flowering plants viz., Coriander, Cumin and Mustard was planted in the intra rows of the vineyards to enhance the population of parasitoid, *Anagyrus dactylopii* in the vineyards (Fig. 23). The percent parasitization of mealy bug by the parasitoid, *A. dactylopii* in the rows planted with each flowering crop was recorded. The mean parasitization of mealy bugs was 27.53, 13.65, 5.16, and 3.47 percent in the vines whose rows planted with mustard, cumin, coriander and control respectively.

Fig. 23: Mustard crop grown in the intra rows of vineyard to increase the activity of natural enemies

Effect of entomopathogenic fungi on mealy bugs and stem borer

Entomopathogenic fungi were evaluated for their lethal reproductive effects on mealybug. The mean fecundity of adult female mealybug treated with *Verticillium lecanii* was lower (54.20 eggs/female) with a significant reduction in hatchability of the eggs (25.2% egg hatchability). Adult females treated with *Beauveria bassiana* recorded a mean fecundity of 108.80 eggs/female followed by *Metarhizium anisopliae* (194.40 eggs/female).

Stem washing with *Metarhizium anisopliae* at fortnightly interval with a dose of 2000 ml/ha (2.0 ml/L) during second fortnight of June-July coinciding with peak emergence of adult stem borer was found effective in reducing the oviposition (0.61 eggs/vine) and egg hatchability (5.56%) of the eggs of stem borer compared to untreated control (4.99 eggs/vine and 91.85% egg hatchability) (Fig. 24).

Fig. 24: Mycosis of stem borer eggs treated with *Metarhizium anisopliae*

Evaluation of *Chrysoperla zastrowi sillemi* in lab and field conditions

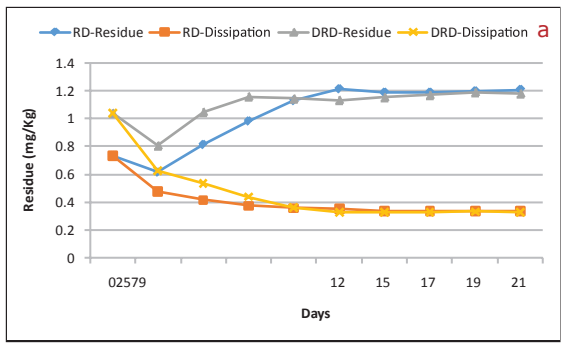
The feeding potential of the different larval instars of this predator on host insects infesting grapevine viz., mealybug *Maconellicoccus hirsutus,* two-spotted spider mites *Tetranychus urticae,* and aphids *Aphis craccivora* and one factitious host eggs of *Corcyra cephalonica* were studied. A single larva of the predator was confined to a glass vial supplied with the nymphs of four insect hosts at the rate of 50 nymphs per day. The number of prey consumed till the completion of each larval instar of the predator was recorded. The third instar larvae of neuropteran predator, *Chrysoperla zastrowi* sillemi was found to be the voracious predator of sucking insect pests infesting grapevine. The third instar larvae of *C. z. sillemi* consumed 201.60 eggs of rice moth *Corcyra cephalonica,* 190.80 crawlers of pink mealybug *Maconellicoccus hirsutus,* 148.60 aphids *Aphis craccivora* and 116.60 mites *Tetranychus urticae* respectively under laboratory conditions.

The efficacy of *Chrysoperla zastrowi sillemi* against mealy bugs was evaluated under field conditions. Four treatments viz., release of larvae of *Chrysoperla* @ 30 grubs per vine (T1), Stappling egg cards of *Chrysoperla* @ 30 eggs/card/vine (T2), Buprofezin 25 SC @ 1.25 ml/L (T3) and untreated control (T4) were evaluated for the management of mealybug. The pre-treatment count of mealybug were 18.83, 18.50, 19.50, 21.17 colonies per vine in T1, T2, T3 and T4 respectively. The number of mealy bug were 9.67, 8.50, 4.67 colonies per vine with a bunch infestation of 16.46, 24.54, 1.45 and 44.49 percent in T1, T2, T3 and T4 two weeks after treatment.

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

Dissipation, safety evaluation and generation of processing factor (PF) for insecticides during raisin preparation

A field dissipation study was conducted to evaluate processing factor (PF) for hexithiazox, bifenazate and dinotefuran during raisin making process at recommended dose (RD) and double the recommended dose (DRD). For all the chemicals, 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 6-9 days for hexithiazox and 5-6 for bifenazate. The residues of dinotefuran remains stabilized after 12 days of sampling and hence the half-life could not be established (Fig. 25). The



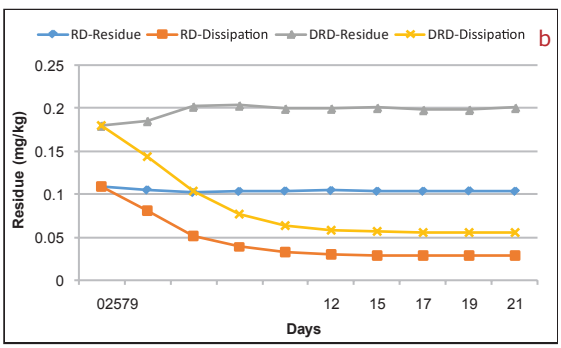


Fig. 25: Dissipation of hexithiazox (a) and bifenazate (b) during raisin preparation

PFs established for drying were 1.2-1.6 days for hexithiazox, 0.9-1.1 days for bifenazate and 2.3-2.5 days for dinotefuran. A PF value of >1 indicates concentration of the residues during drying process. The dietary exposure calculated in final raisin was less than the respective maximum permissible intake both

at RD and DRD for all the three pesticides, which indicate safety to the consumers. The residues of these pesticides in market samples of raisins were well below the EU-MRL and were also devoid of any risk of acute toxicity related to dietary exposure.

Dissipation of dinotefuran and flonicamid in grape

A field dissipation study was conducted to evaluate dissipation kinetics and pre-harvest interval for dinotefuran and flonicamid in grapes at recommended dose (RD) and double dose (DRD). The residues of both the chemicals persist for long in grapes and follow a $1^{st}+1^{st}$ order kinetics. The residues persist at above the MRL level for both the chemicals even after 60 days of sampling (Fig. 26), hence the PHI could not be established. Since these insecticides are highly persistent nature, it will be highly risky to recommend these in grapes.

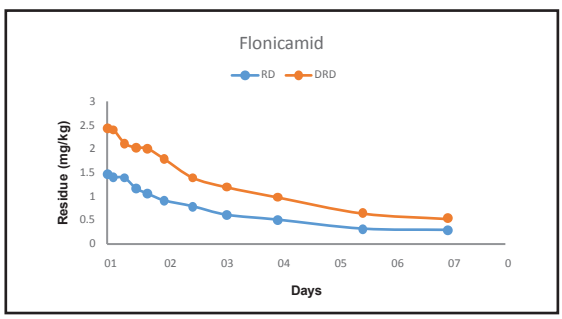


Fig. 26: Dissipation of flonicamid and dinotefuran in grapes

Monitoring of agrochemical residues in grape and grape produce

Validation of a GC-MS method for the estimation of multi residue pesticides in raisins by GC-MS

A multi-residue method was optimized and validated for analysis of 67 pesticides in raisin using GC-single quadrupole mass spectrometry (GC-MS). Prior to extraction, the sample was homogenized with 1:1 sample water ratio. For extraction, to 10 g sample, 10 ml ethyl acetate and 10 g sodium sulphate was added, homogenize for 2 min. followed by centrifugation at 5000 rpm for 5 min. 3 ml aliquot was taken in test tube and 25 mg PSA was added for cleanup followed by centrifugation and analysis in GC-MS. The method performance was validated as per DG-SANCO guideline. Recovery for all tested compounds at 5, 12.5 and 50 ng/g was in 71-109 % range with % RSD of ≤ 13. The LOQ values for all the test compounds were ≤ 10 ng/g. The method was successfully applied for monitoring of pesticides in the market samples of raisins collected from Sangli.

Monitoring of pesticide residue in domestic grapes

For risk assessment purpose, the grape samples for domestic market were analysed. Sample for residue analysis were collected by ICAR-NRCG trained staff of MRDBS. Total 29 grape samples mostly from Nasik district were analysed for pesticide residues out of which 14 samples were complied with MRL. Residues above EU-MRL were found in the remaining 15 grape samples. The failed 15 grape samples contained Chlormequat (CCC), Flusilazole, Spiromesifen, Acephate, Carbendazim, Flonicamid, Dichlorovos, Methomyl, Profenophos, 4-bromo-2-chloro phenol, Dicofol and Hexaconazole residues.

Analysis and safety evaluation of agrochemical residues and contaminants in agricultural commodities and processed products

Development of multi-residue method for pesticide residues in cardamom powder using LC-MS/MS

A QuEChERS based extraction method was optimized and validated as per the guidelines of DG SANCO for multiresidue analysis of 154 pesticides in small cardamom using liquid chromatography mass spectrometry (LC-MS/MS). Proposed method includes 2 g of dried cardamom powder followed by soaking in 8 ml distilled water for 30 min and extraction using acetonitrile.

Quantitative screening of multi-residue and multi-class veterinary drugs in chicken muscles by LC-MS/MS Q Trap

A simple and straightforward acetonitrile based extraction method was optimized for

75 multi-class, multi-residue veterinary drug residue analysis in chicken muscles using LC-MS/MS Q Trap. All the major classes of veterinary drugs were included.

A Q Trap based library for the test analytes was created and used for the confirmation for the analytes having low qualifier (<10 %) ion. The method was validated as per European Commission Decision 2002/657/EC criteria.

Development of multi-residue method for pesticide residues in cardamom powder using GC-MS/MS

A new and rapid method for analysis of 244 pesticides in cardamom matrix by gas chromatography coupled to triple quadrupole tandem mass spectrometer (GC-MS/MS) was standardized.

Development of multiresidue method of pesticides and PCBs in chicken meat

An analytical method was developed for multiresidue analysis in chicken meat with a special focus on Indian Food Safety Act (FSSR) and EU legislation. Sample preparation method involved extraction of analytes with acetonitrile (1% acetic acid) in presence of $MgSO_4$ and NaCl followed by an optimised clean-up with PSA and C18. A freezing step was incorporated in clean-up procedure for effective removal of complex fat matrices.

Postharvest Technology

Identification and evaluation of β-glucosidase producing yeast strains and its impact on wine quality

Collection of yeast strains

In addition to 7 yeast strains in the collection of ICAR-NRCG, 10 strains were collected from VSI, Pune and 10 strains were collected from PHT division of ICAR-IIHR, Bangalore during the period under report. Total of 27 yeast cultures are being maintained.

Standardization of test protocol

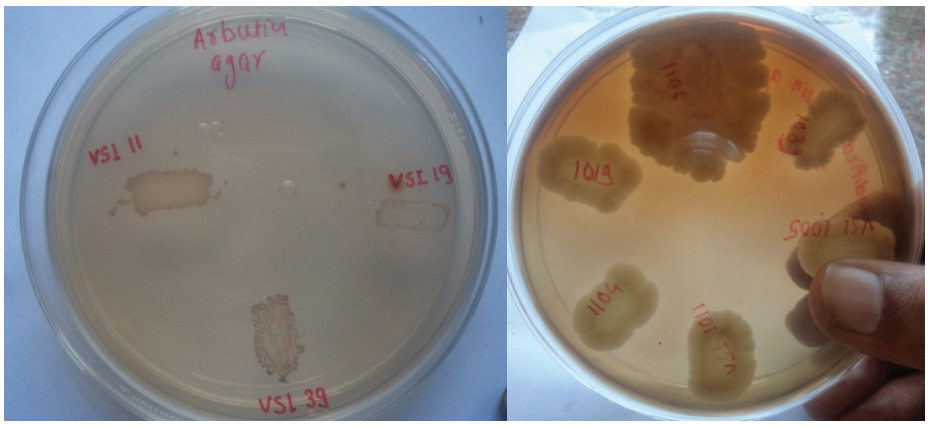
In presence of arbutin in medium, β-glucosidase positive strain give brown colour. The commonly used medium (M1) didn't show positive reaction to any strain in initial tests, hence, tests were conducted by modifying composition of media M2 and M3 as given in table 25. The pH of modified media was raised from 5 to 6.5, peptone, yeast extract and dextrose were added along with ferric ammonium citrate or ferric chloride.

A total of 17 yeast strains were evaluated for β-glucosidase response on all three media. Strains SPR, VSI 1106 showed positive response in both M2 and M3 media within 3 days of incubation, except that in M2 medium strain VSI 1106 showed colour development after 8 days (Fig. 27).

Winery by-products utilization for value addition in food products

Use of Wine grape pomace powder

Wine grape pomace was collected after fermentation of Cabernet Sauvignon grapes



No response on M1 Response on M3

Fig. 27. Growth of yeast strains on different media

Table 25.

Composition of media for screening of yeast strains for β-glucosidase activity

Components	Media		
	M1 (5.0 pH)	M2 (6.5 pH)	M3 (6.5pH)
Peptone	0.0 g	2.0 g	2.0 g
Yeast extract	0.0 g	1.0 g	1.0 g
Dextrose	0.0 g	2.0 g	2.0 g
Arbutin	0.5 g	0.5 g	0.5 g
Agar	2 .0 g	2.0 g	2.0 g
YNB	0.67 g	0.0 g	0.0 g
Ferric Ammo. citrate	0.0 ml	2 ml	0.0 ml
$FeCl_3$	0.0 g	0.0 g	0.03 g

and separation of wine from seed and skin. The collected pomace was dried in oven at 50°C. After drying the seeds were separated and material was grinded to powdery form. The composition of wine grape pomace powder (WGPP) is given in table 26.

Table 26.

Important constituents of WGPP

Constituent	Value
Moisture (%)	6.25
Ash (%)	5.28
Total Carbohydrate (%)	63.33
Protein (%)	13.14
Fat (%)	5.20
Anthocyanin (mg/kg)	0.54
Phenols (GAE mg/g)	2.29
Antioxidant activity (FRAP) (mg/g)	243.96
Tannins (TAE mg/g)	3.25
Colour intensity	12.93

Enrichment of cookies

All dry ingredients were sieved to remove foreign material if any. Mixing of all ingredients was done by two stage method. Creaming of shortening and sugar were done using churner. After creaming all dry ingredients were added to cream mixture. WGPP at a rate of 5% (T2), 10% (T3), 15% (T4) and 20% (T5) was added with dry ingredients to replace the refined wheat flour. In case of control (T1) WGPP was not added. Mixing and kneading were done to form dough. After dough formation, it was kept for 30 - 40 min. Round shape was given to cookies using cutter. Cookies were baked at 150°C for 20- 30 min, packed in air tight plastic bags and stored at lower temperature for further physico-chemical and sensory analysis. The addition of wine grape pomace powder increased antioxidant properties comprising ferric reducing antioxidant power, total phenol content, flavonoid and anthocyanins (Table 27).

Wine grape pomace powder impart brown colour to cookies as compare to control. The colour intensity was increased with increasing concentration of wine grape pomace powder in cookies and maximum colour intensity was observed in cookies obtained from T5. Addition of 5 per cent of wine grape pomace powder (T2) obtained maximum score in the organoleptic testing.

To improve the acceptance of cookies containing more than 5% of WGPP baking processing was changed and it was found that 20% WGPP contained cookies were also acceptable with better crispiness. These cookies were baked at 145°C for 17 minutes. Functional properties of these cookies are presented in Table 28.

Enriched cookies

Table 27.

Impact of functional and physical properties on enriched cookies

Treatments	Physical properties			Functional properties				
	WAC (g H_2O /g)	Ash (%)	Colour intensity	Anthocyanins (mg/g)	Total phenolics (mg GAE /g)	Flavonoids (mg CTE /g)	Antioxidant activity FRAP (mg/g)	Tannins (TAE mg/g)
T1	3.593^{E}	2.641^{E}	0.356^{E}	0.163^{E}	0.041^{E}	0.320^{E}	4.625^{E}	0.160^{E}
T2	3.946^{D}	2.864^{D}	0.510^{D}	2.033^{D}	0.095^{D}	0.627^{D}	11.651^{D}	0.213^{D}
T3	4.061^{C}	3.147^{C}	0.623^{C}	2.864^{C}	0.213^{C}	0.887^{C}	29.669^{C}	0.720^{C}
T4	4.130^{B}	3.422^{B}	0.853^{B}	3.311^{B}	0.305^{B}	1.347^{A}	51.862^{B}	1.171^{B}
T5	4.333^{A}	3.865^{A}	1.130^{A}	3.512^{A}	0.460^{A}	1.133^{B}	75.976^{A}	1.766^{A}
CD (p=0.05)	0.0263	0.0218	0.0731	0.0085	0.0012	0.091	2.7079	0.0318

Table 28.

Improvement in Functional properties of cookies

S. No.	Pomace concentration in product (%)	Crude fibre (%)	Total phenolics (µg/g)	Antioxidant Activity (% inhibition)
1.	Control	0.89	2.25	68.17
2.	15	2.18	58.15	90.05
3.	20	3.18	60.45	93.06
4.	25	5.80	68.70	90.80
5.	30	10.18	97.15	82.81

Use of fine wine lees

Sugar fee ice cream

Sugar free ice cream was made by replacing sugar with sodium saccharin. Processed fine wine lees from Cabernet Sauvignon wine was added during ice cream making as 5 g/kg, 15 g/kg, 25 g/kg and 35 g/kg while in control fine wine lees was not added. T5 was recorded with maximum content of antioxidants, phenols, anthocyanins, tannins and protein as compared to other treatments (Table 29). With the increasing wine lees; pH, specific gravity and overrun were decreased; however viscosity, acidity, colour intensity and fat destabilization index increased (Table 30). Ice creams enriched with addition of fine wine lees were found with reduction in melting of ice cream (Fig. 28). The prepared ice creams were subjected to sensory evaluation using 9 point hedonic scale and T4 with the wine lees concentration of 25 g/kg ice cream was most acceptable.

Table 29.

Effect of fine wine lees on physical and functional properties of ice cream

Treatments	Physical properties			Functional properties						
	pH	Acidity (%)	Colour intensity (AU)	Anthocyanins (mg/L)	Total Phenols (mg/g)	Flavonoid (µg CE/ 100 mg EY)	Flavonol (mg RE/ 100 mg EY)	Antioxidant activity (µg BHT/ mg EY)	Antioxidant activity (scavenging effect in %)	Tannins (mg TAE/ g EY)
T1: Control	7.00	0.31	1.40	8.27	0.03	28.3	0.03	17.88	22.18	0.03
T2: 5 g/kg	6.49	0.54	2.60	27.35	0.05	146.5	0.63	25.36	39.31	0.94
T3: 15 g/kg	6.05	0.74	3.20	38.16	0.09	182.6	1.03	57.97	58.62	1.45
T4: 25 g/kg	5.22	1.05	3.80	52.15	0.17	272.1	1.32	69.33	71.80	1.94
T5: 35 g/kg	4.72	1.50	4.90	61.05	0.23	330.8	1.68	149.64	86.70	2.45
CD (p=0.05)	0.048	0.008	0.03	4.11	0.0003	1.617	0.011	0.772	0.767	0.002

Table 30.

Impact of FWL on rheological properties of ice cream

Treatments	Rheological properties				
	Specific gravity	Overrun (%)	Fat destabilization index (%)	Viscosity (cP)	Weight of melted ice cream in next 10 min (g)
T1	0.96	60.6	23.3	11.0	7.3
T2	0.89	56.7	27.6	13.5	6.4
T3	0.86	55.9	31.6	19.8	4.1
T4	0.80	54.6	36.6	25.6	1.4
T5	0.77	53.4	41.6	29.2	0.2
CD (p=0.05)	0.013	0.512	0.587	0.124	0.004

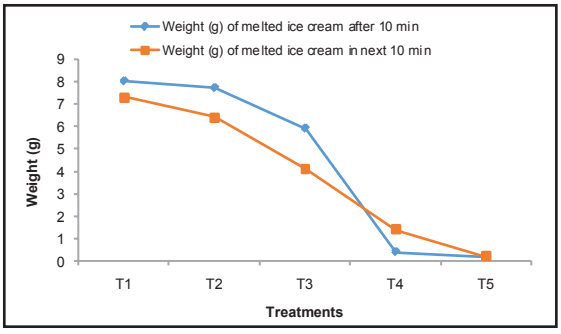


Fig. 28: Ice cream melting in relation to fine wine lees content

Enriched yoghurt

A specially prepared fine wine lees was added at specific stage of yoghurt making. To enhance the effect of fine wine lees, the yoghurt was prepared having three different durations of absorbance. The addition of fine wine lees improved the quality of yoghurt in terms of sensory properties, functional properties, rheological activities and acceptability. Increased absorbance duration was registered with improved quality and sensory acceptance.

Profiling of Grape Varieties Shiraz and Sauvignon Blanc for its Phenolic and Aroma Compounds from Grape to Wine

Optimization of a method of analysis for wine volatiles

This study reports the optimization of thermal desorption (TD) GC-MS (gas chromatography mass spectrometry) parameters for identification and quantification of volatile aroma compounds from wine matrices. The volatile compounds were adsorbed on a preconditioned SPE-tD (solid phase extraction-thermal desorption) cartridge, and inserted into an empty TD tube placed in an auto sampler for analyses. The extraction conditions and TD-GC-MS parameters, such as desorption time and trap desorption temperature, were optimized with a model wine spiked with 64 aroma compounds (certified reference standards) ensuring their confirmatory identifications. The method performance was evaluated by analyzing two different wine types using targeted deconvolution. The time taken for data processing was 15 minutes. A large number of wine volatiles belonging to different chemical classes like esters, alcohols, aldehydes, terpenes, organic acids, ketones, ethers, phenols, lactones, methoxypyrazines, etc. were identified and their concentrations were estimated either against the response of the corresponding reference standards or against 3-octanol, considering its peak area at 150 ng/mL as 100%.

Assessment of change in wine phenolics during fermentation

The phenolic changes during the wine fermentation was assessed for the varieties Shiraz and Sauvignon Blanc. It was observed that during fermentation, the flavonol (Quercetin-3-glucoside) was slowly increased from 8 to 17 days (4.45-8.23 mg/kg) and further during racking the concentration was decrease and gets stabilized (Fig. 29). After 9 days of fermentation, new phenolic compounds ((+)-catechin hydrate, procynidin B1, catechin, (-)-epicatechin, procynidin B2, procynidin C1 etc.) were produced and their concentration increase to a certain level and gets stabilized. This increase in concentration is due to hydrolysis of glycosidic bond by yeast fermentation. In initial days of fermentation process, resveratrol was totally absent, after 8 days it was produced and concentration increased up to completion of fermentation and get stabilized to a level of 1.06 mg/L.

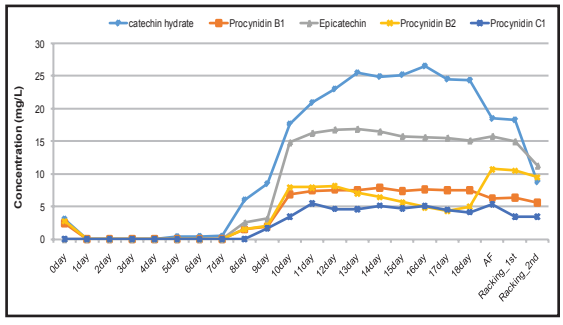


Fig. 29: Concentration profile of different flavanols during wine fermentation

Information Technology

Identification of spatial distribution of climatic suitability for grape cultivation using GIS

This project has been initiated with the objectives to identify spatial distribution of climatic suitability for grape cultivation using GIS tools and to develop geo-spatial model to assess climatic suitability for grape cultivation and to delineate regions having climatic constraints, biotic and abiotic risks. The output will be useful in exploration of potential viticultural zones and regions with constraints. Thematic maps on climatic suitability of a region for grape growing will be useful in identification of potential areas and delineation of areas not suitable for grape cultivation with respect to climate. ARCGIS Desktop 10.2.2 software and has been procured for the study. Also daily district wise normals of meteorological parameters viz. temperature, rainfall and humidity have been procured from IMD, Pune. The compilation of data in a specific format on different parameters for entry into the database has been initiated. The broad climatic factors needed for grape cultivation has been compiled.

Completed project

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

The project was undertaken with the objectives to develop a computerized database of grapevine diseases and insect pests under Indian agro-climatic conditions and to develop a user-friendly diagnosis and management system for grapevine diseases and insect pests under Indian agro-climatic conditions. Following were the achievements under the project

- Information on grapevine diseases was compiled and a database was developed on eight important grapevine diseases and nine postharvest grape diseases. The compiled information was presented in the digital form titled as 'Grapevine Diseases in India', a ready reckoner for diagnosis and management of grapevine diseases in India.
- Information on grapevine insect pest was compiled and a database was developed on 16 grapevine insect pests with information on different species affecting grapevine. The compiled information was presented in the digital form titled as 'Diagnostics and management of pests of table grapes'.
- An online web based 'Grapevine disease and pest diagnosis system for India' has been developed that will assist grower in self-diagnosis of disease and pest problems based on symptoms. A software architecture has been developed that can be populated with data required for symptomatic diagnosis of grapevine problems in India and subsequently can be used to assist grape growers to diagnose other grapevine problems based on signs and symptoms.

Collaborative, Externally Funded, Contract Research and Consultancy Projects

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

This was the 12th year of the Residue Monitoring Program for controlling agrochemical residues in table grapes for export to the EU countries. The guidelines for residue monitoring programme, 2014-15 for export of table grapes to the EU countries was updated. In this season, a list of 41 pesticides (Annexure 5), with label claim with CIB&RC was recommended and 182 pesticides (+ their metabolites and isomers of toxicological significance) (Annexure 9) were monitored in all export samples. SOPs were harmonized for all the nominated laboratories on grape for multiresidue and single residue analysis of pesticides and other contaminants. A total of 30351 farms were registered in Maharashtra, Karnataka and Andhra Pradesh for export to EU as per record on GRAPENET. A total of 985 Internal Alerts on the basis of the reports on the MRL exceedances reported in the context of export to European Union Countries. Out of this, on the basis of re-sampling results and MRL compliance, around 68 internal alerts were revoked. Hence the effective internal alerts for the season 2014-15 was 917 which accounts for around 12.2% sample failure.

Proficiency test (PT) programs on Grape

A proficiency test (PT) round was organized on 15th November, 2014 for pesticide residues as per Annexure 9 of RMP in grapes. The number assigned for this PT was NRCG-PT/FV/01. The test material was distributed to the representatives of 22 individual laboratories including National Referral Laboratory, ICAR-NRC Grapes, Pune. The results were received from 21 of the participating laboratories within the time-scale demanded. The homogenized grape material was spiked with six compounds.

Out of the 21 laboratories who submitted results, two laboratories could not detect chlormequat chloride (CCC), one laboratory could not detect chlorpyriphos and two labs could not detect λ-cyhalothrin. Z scores of 18 out of 19 laboratories for chlormequat chloride and lambda cyhalothrin were within the satisfactory range of -2 to +2. Z scores of 19 out of 20 laboratories for chlorpyriphos and 20 out of 21 laboratories for dimethomorph and myclobutanil were within the satisfactory range. For penconazole, all the 21 z-scores were within the satisfactory range of -2 to +2.

Assessment of nominated laboratories

Inspection and assessment of the nominated laboratories was carried out during the season. The following labs i.e. Microchem Silikar Pvt Ltd, Mumbai; Geochem Pvt. Ltd, Mumbai; SGS India Pvt Ltd. Chennai; TUV NORD India Pvt Ltd, Pune; NCMSL, Hyderabad; Envirocare Laboratories, Mumbai; First Source, Hyderabad; CFT BVDU, Pune; Interfield Laboratory, Chochin; NHRDF, Nasik; TUV SUD India Pvt. Ltd, Bangalore and Bureau Veritas, Chennai 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.

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

5% samples of the total no. of samples analysed (around 400 No.) through GrapeNet, consisting of samples from pack-houses, farms and nominated laboratories were analyzed for confirmatory testing at NRL. The results of all the samples tested at NRL were similar to corresponding laboratory results.

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

During the year, about 61 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. In addition to this, in the institute's germplasm block, about 17 morpho – phenological characters and 10 fruit characters for the selected 61 varieties were recorded to validate the shortlisted DUS characters.

Further, grape growers were guided for filling the applications for registration of grape varieties. Total five applicants were guided for farmers' variety registration. Among these four were Maruti Seedless, Nana Saheb Purple, New Sonaka and Sarita Seedless. At present, these applications are at internal scrutiny stage at PPV&FR, New Delhi. Also the institute is in process of registration of the grape variety Medika.

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 ICAR- 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.

Moisture and temperature effects on plant growth and yield

Moisture stress

To fulfil the knowledge gaps to improve decision making based on yield loss under different moisture stress scenarios in a heavy black cotton type soil, an experiment was conducted to quantify the effects of moisture stress at different crop growth stages (Fig. 30).

Treatments	Foundation pruning		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. 30: Experimental treatment details

This was the second year of the experiment. Total pan evaporation and rainfall recorded during the period was 1531 mm and 510 mm respectively. The vines were not irrigated for 85 days during the period due to rains. The monsoon was delayed till July, 2014. The highest yield was recorded in T7 where recommended irrigation was provided and it was significantly superior over other treatments where yield loss was more than 8% (Table 31). In T3 and T6, the treatments could not be imposed during shoot growth stage due to rains. The yield loss was significant in different moisture stress scenarios and ranged from 6.4% to as high as 26.2%. The yield reduction (26.2%) was the highest in T2 where vines were irrigated @ 50% of the recommended level up to 40 days followed by without irrigation till 105 days after foundation pruning. This was followed by T5 (14.2% loss) where vines were irrigated @ 50% of the recommended irrigation level from berry growth to harvesting stage. During the foundation pruning season, the canopy under T2 was least as compared to other treatments (Fig. 31). The bunch number was significantly

Table 31.

Effect of moisture stress on yield and quality

Treat-ments	Yield (t/ha)	% Yield reduc-tion	Irriga-tion water applied (mm)	WUE (kg/mm of ir-rigation water)	Bunch No.	Bunch weight (g)	TSS (°B)	Acidity (g/L)
T1	20.32	6.9	264.4	76.86	53.67	211.33	20.57	6.80
T2	16.11	26.2	209.0	77.07	48.33	185.67	20.83	6.60
T3	20.15	7.7	296.4	67.99	56.67	198.33	21.27	6.77
T4	20.08	8.0	287.5	69.84	61.67	181.33	20.73	6.60
T5	18.73	14.2	266.8	70.21	58.67	178.00	20.73	7.30
T6	20.42	6.4	241.4	84.59	56.67	200.67	20.94	6.30
T7	21.82	0	319.4	68.34	59.67	204.00	21.30	6.73
SEm±	1.35	-	-	-	2.83	7.48	0.34	0.21
CD (p=0.05)	2.95	-	-	-	6.17	16.31	NS	0.46

less in T2 as compared to other treatments. The treatments where moisture stress (@ 50% of the recommended level) was imposed after berry growth stage had significantly lower bunch weight. However, it was on par with T2 treatment which was severely affected by moisture stress. TSS did not differ significantly between the treatments; however, acidity was high in T5 treatment where moisture stress treatment was imposed from berry growth to harvesting stage. These results will be useful in answering farmer's queries on the expected yield loss under moisture deficit at different stages and decision making process.

T-7: No moisture stress

T1: 50% irrigation at shoot growth stage

T2: 50% irrigation at shoot growth + no irrigation afterwards

Fig.31. Growth during foundation pruning season

The leaf transpiration and assimilation rates were significantly lower till 60 days after foundation pruning (DAP) in T1, T2 and T6 treatments where moisture stress was imposed during foundation pruning season. After 60 days of pruning, transpiration and assimilation rates in T1 and T6 improved over T2 treatment after recommended irrigation was applied (Fig. 32). Treatment T2 continued to have significantly lower leaf transpiration and assimilation rates. Similar trend was observed in case of leaf water potential. Leaf phenol and proline content were significantly higher in the treatments T1, T2 and T6 till 45 DAP, thereafter it declined in T1 and T6 as recommended irrigation level was applied (Fig. 33). However, in T6 phenol and proline continued to rise till 105 DAP after which rains started.

After fruit pruning, T2 continued to have significantly lower transpiration and assimilation rates up to 45 DAP, showing the impact of moisture stress during foundation pruning season (Fig. 34). In T4 and T5 where

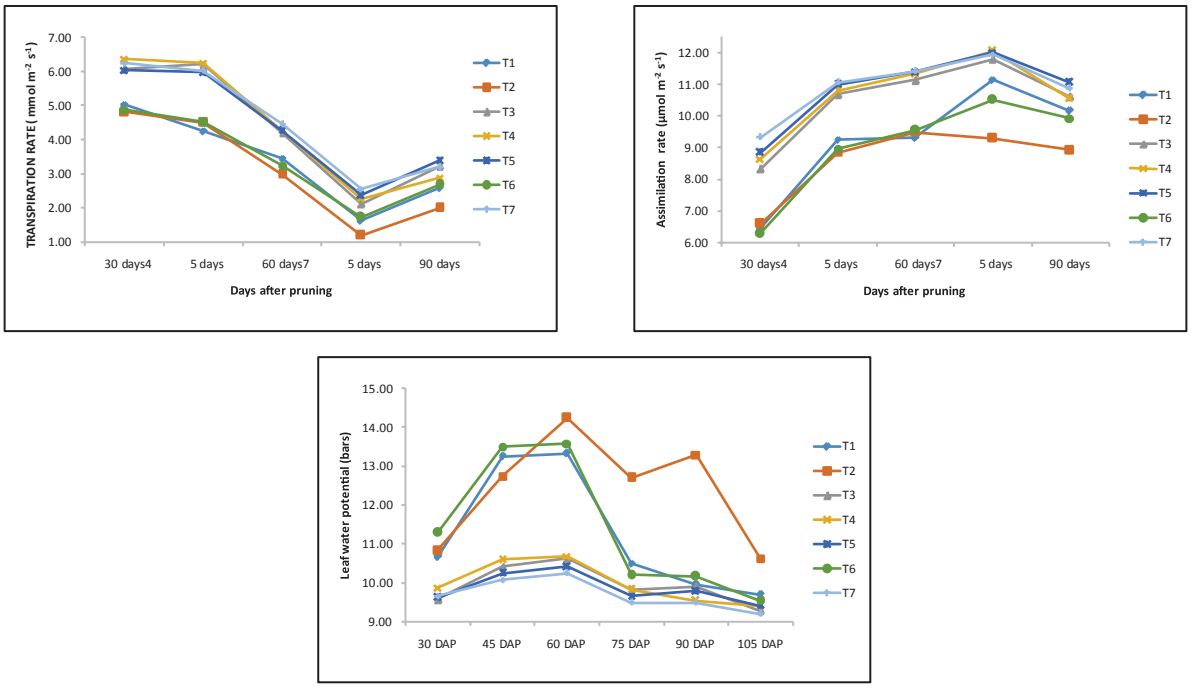


Fig. 32: Assimilation rate, transpiration rate and leaf water potential during foundation pruning season

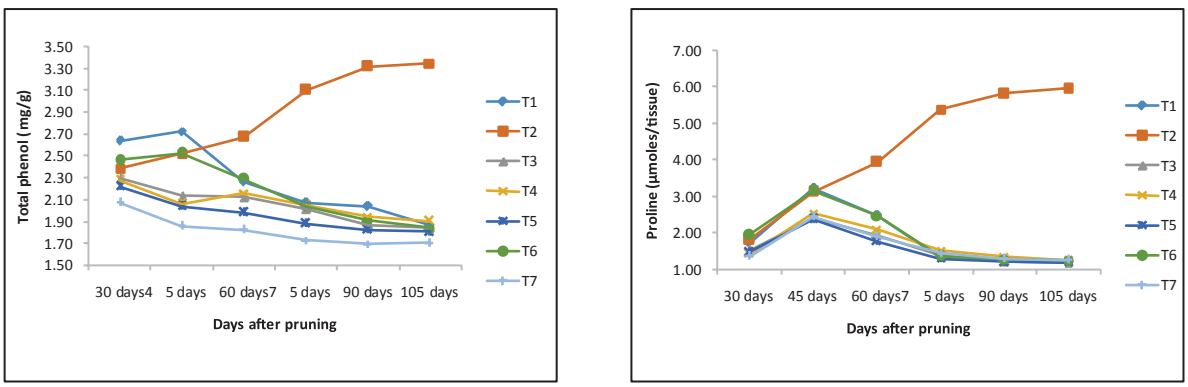


Fig. 33. Proline and total phenol during foundation pruning season

moisture stress were imposed after berry growth stage, there was significant decline in the leaf assimilation and transpiration rate. The leaf water potential from 60 DAP till 105 DAP was the least in T4 and T5 and thereafter it was the least in T5 (Fig.34).

The leaf proline and total phenol was significantly higher in T3 and T6 where moisture treatment was imposed during shoot growth stage (Fig. 35). From berry growth till harvest, the leaf proline and phenol content in T4 and T5 followed similar trend as leaf water potential. The berry proline content in T4 and T5 was significantly higher than other treatments from berry growth to ripening and there upon highest proline content was in T5.

The soil moisture content in the profile also varied as per the treatments (Fig. 36). Throughout the seasons, observed soil moisture content in T7 (recommended irrigation level) was higher compared to other treatments. Soil moisture content in T2 was the least in the foundation pruning season as no irrigation was applied after 40DAP. During fruit pruning season, least values were recorded in T5 from berry growth stage to harvest.

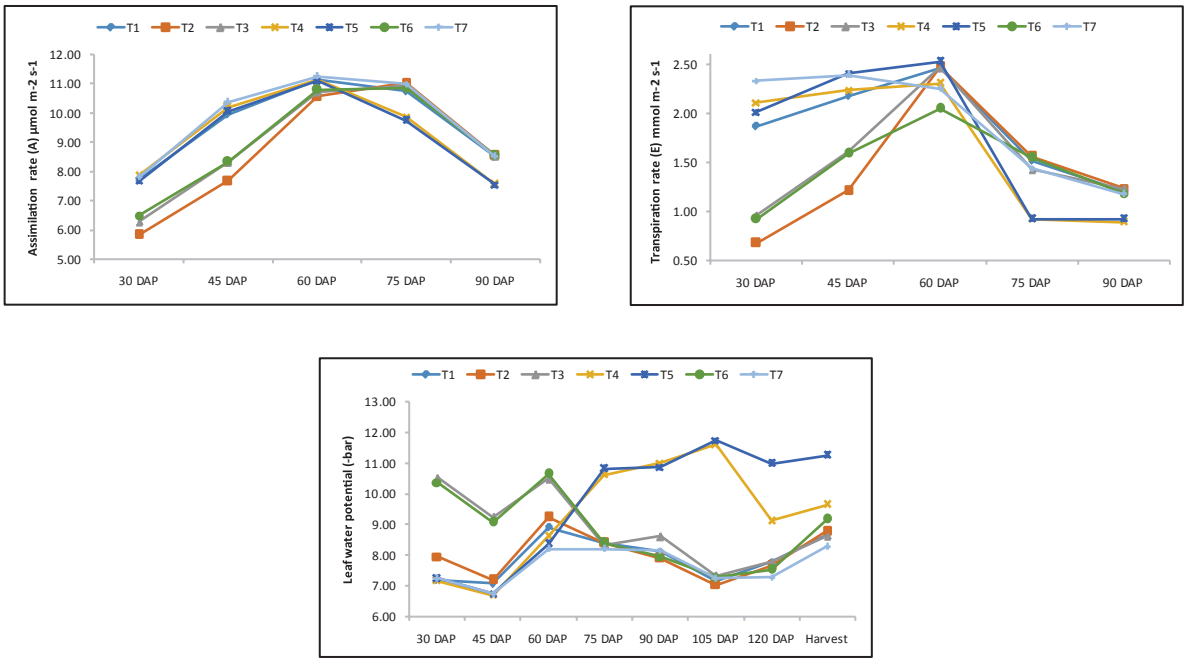


Fig. 34 : Assimilation rate, transpiration rate and leaf water potential during fruit pruning season

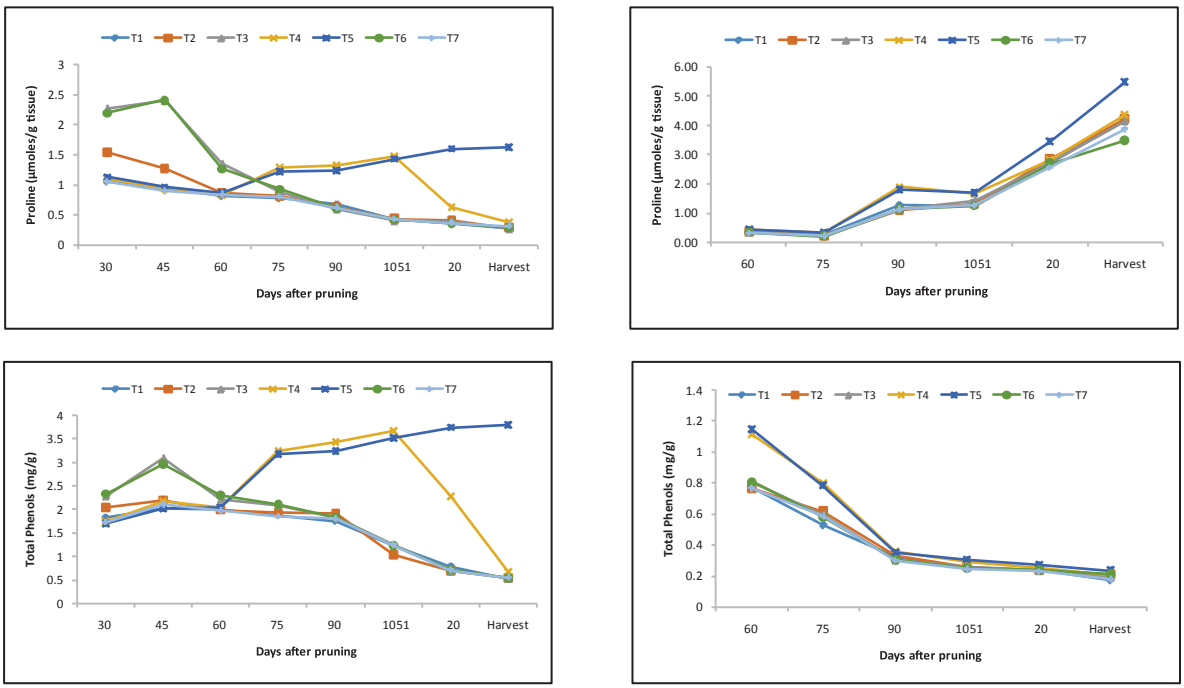


Fig. 35: Proline and total phenol content in the leaf (left panel) and berry (right panel) during fruit pruning season

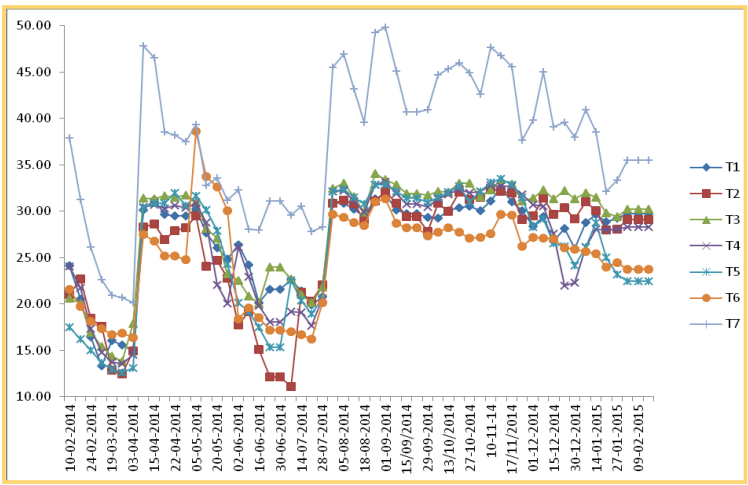


Fig. 36. Changes in soil moisture content

Temperature stress

To establish relationship between temperature and phenology of grapevine, the whole block of Thompson Seedless vines were 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 32.

Table 32.

Treatments for temperature stress

Pruning treat-ments	Foundation Pruning date	Fruit Pruning date
P1	1st April, 2014	30th September, 2014
P2	1st April, 2014	14th October, 2014
P3	1st May, 2014	1st November, 2014
P4	1st May, 2014	15th November, 2014

The vines pruned on 1st May, sprouted earlier (12 days) as compared to the vines pruned on 1st April (16 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 (Table 33). 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 TSS in berries was achieved. The accumulated growing degree days ranged from 1360 to 1541 in different pruning dates. However, the number of days taken to accumulate the growing degree days ranged from 112 to 134 under different pruning treatments (Fig. 37). The heat units accumulated to reach different phenological stages are given in fig. 38.

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

Report presented at page 9.

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

Report presented at page 11.

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

During the year, the following activities were taken up for management, transfer and commercialisation of technologies developed at the Centre.

- Copyright registration 'SW-8145/2014' was obtained on the work 'Information system for management of microsatellite data for grape Germplasm in India'.
- A Memorandum of Understanding (MoU) was signed between ICAR-NRCG and

Table 33.

Effect of temperature and humidity on sprouting behaviour of differentially pruned vines of Thompson Seedless

Date	April pruned vines			Date	May pruned vines		
	Duration in hours				Duration in hours		
	Above 35°C	Above 38°C	< 20 % RH		Above 35°C	Above 38°C	< 20 % RH
4/1/14	7	1	8	5/1/14	8	6	5
4/2/14	5	0	9	5/2/14	9	6	6
4/3/14	7	1	9	5/3/14	6	2	0
4/4/14	8	4	6	5/4/14	8	4	5
4/5/14	9	4	9	5/5/14	9	3	9
4/6/14	7	1	3	5/6/14	8	4	5
4/7/14	8	4	7	5/7/14	7	2	0
4/8/14	6	0	2	5/8/14	2	0	0
4/9/14	6	1	6	5/9/14	6	1	0
4/10/14	7	1	6	5/10/14	5	0	2
4/11/14	7	1	9	5/11/14	6	0	4
4/12/14	7	0	10	5/12/14	6	0	2
4/13/14	6	3	8	Total	80	28	38
4/14/14	7	4	8				
4/15/14	8	5	6				
4/16/14	8	5	3				
Total	113	35	109.0				

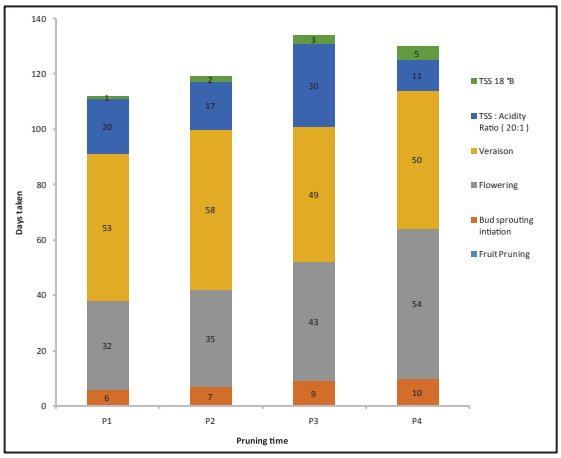


Fig. 37: Days taken at different phenological stages under different pruning treatments

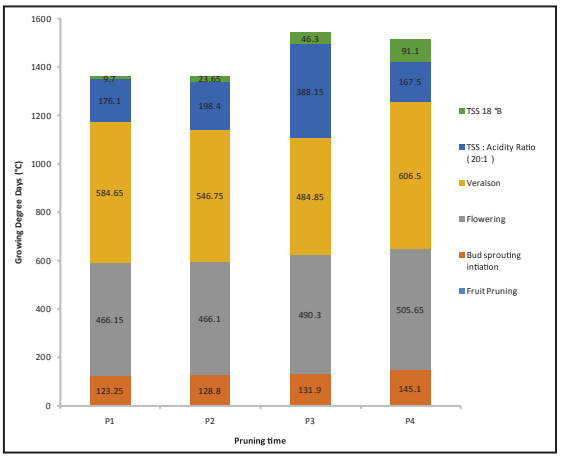


Fig. 38: Growing degree days taken at different phonological stages

'Horticulture Department of Karnataka State' for sale of technology on 'Weather based grape advisory' and consultancy.

- A Memorandum of Agreement (MoA) was signed between ICAR-NRCG and M/s Deepsagar Agro Enviro Services Private Limited for developing model for grape disease advisory system (downy mildew and powdery mildew).
- A Memorandum of Understanding (MoU) was signed between ICAR-NRCG and Spices Board India, Cochin for developing multi residue method for analysis of pesticide residues in three spice matrix viz, cardamom, chilli and cumin. As per MoU, Spices Board will pay Rs. 21 Lakhs (Rs. 7 Lakhs per spice) to ICAR-NRCG for developing and implementing the optimized method at laboratories of Spice Board India.
- A Memorandum of Agreement (MoA) was signed between ICAR-NRCG, Pune and ICAR-Central Institute of Fisheries Technology, Cochin, Kerala for collaborative research work on Chitin and Chitosan and its derivatives
- A meeting of Institute Technology Management Committee (ITMC) of ICAR-NRC Grapes, Pune was convened on 3rd December 2014 under the Chairmanship of Dr. S. D. Sawant, Director for decisions related to IP protection and technology transfer.

Programme for NEH and TSP

The NEH and TSP programme was initiated in 2013-14 in Mizoram state which has emerged as new area of wine grape cultivation. During the course of the discussion following objectives were identified for developing grape industry in Mizoram state:

1. Survey of the grape growing tracts in Mizoram to identify production related constraints.
2. Development of package of practices for grape cultivation in Mizoram
3. Introduction and evaluation of short duration and rain resistance grape varieties suitable for the area.
4. Upgradation of the technological and knowledge base of grape growers and resource persons.
5. Development of nursery for quality planting material under Tribal Sub Plan
6. Training the nurserymen for the production of disease free planting material.

The following activities were carried out during 2014-15

Survey of the vineyards and recording observations on bud sprouting and bunch emergence

Eleven vineyards were surveyed in 2014-15 to record observations on bud sprouting and bunch emergence with respect to the usage of hydrogen cyanamide vis-a- vis control plots where it was not applied. In the vineyards where the bud breaking chemical was applied, uniform sprouting was observed in contrast to erratic sprouting where it was not applied. The bunch emergence was higher under hydrogen cyanamide application. The data on the above aspect is given in table 34. However, in few vineyards, in spite of the application of the hydrogen cyanamide uniform sprouting was not observed. This was due to early pruning (1st week of February) when the prevailing temperature was low and the concentration used could be less. In another case, vineyards experienced rainfall

Observations on sprouting in vineyards treated with Hydrogen cyanamide (RHS) and without Hydrogen cyanamide treatment (LHS)

Table 34.

Effect of hydrogen cynamide application on sprouting and bunch emergence in vineyards of Champhai

Sr. No.	Name of farmers	Name of Village	Location of garden	Approx. area	Date of pruning	No. of shoots (range)	No. of Bunches (range)	Remarks
List of farmers who applied Hydrogen cynamide								
1	C. Lalawmpuia	Veng-sang	Thlangtlak	2.5 acre	2nd week of Feb.	60-85	84-148	Mealy bug infestation was observed. Training not proper
2	HKL.Thanga	Veng-sang	Thlangtlak	1 acre	17th Feb.	11-23	18-52	Rained immediately after application. Did not apply again. Erratic sprouting. Training not proper
3	R.Chalhlira	Veng-sang	Thlangtlak	0.25 acre	Ist week of Feb.	18-31	33-54	Low temperature. Application of hydrogen cynamide inadequate to induce bud breaking
4	J. Ralkulhtawna	Veng-sang	Thlangtlak	2.5 acre	10th Feb.	58-116	139-176	Training not proper
List of farmers who did not apply Hydrogen Cynamide								
1	C. Chalthanga	Veng-sang	Thlangtlak	1 acre	Ist week of Feb.	10-20	10-67	Erratic sprouting Training not proper
2	R. Lallawmzuala	Veng-sang	Thlangtlak	1 acre	3rd week of Feb.	10-20	10-91	Erratic sprouting Training not proper
3	C. Zohmingthanga	Veng-sang	Thlangtlak	0.75 acre	Last week of Feb.	10-18	10-25	Erratic sprouting Training not proper
4	Ramdina	Veng-sang	Hmunhuan	5 acre	20-28th of Feb.	10-20	15-40	Erratic sprouting Training not proper
5	C. Zatluanga	Kahrawt	DC.Road	0.5 acre	Middle of March	3-8	8-10	Erratic sprouting Training not proper
6	HK. Lungmuana	Veng-sang	Hmunhuan	1.5 acre	Last week of Jan. – Ist week of Feb.	12-20	15-32	Erratic sprouting Training not proper

within few hours of the application of hydrogen cyanamide. Based upon the observations, it was decided to take up a study on different pruning dates with varying concentrations of hydrogen cyanamide during next pruning cycle.

It was also observed that the training practices in all the vineyards were not proper. On enquiry with regard to the fertilizer application, it was observed that the farmers applied fertilizers twice in a year – March and November. The fertilizer namely urea, DAP and MOP is being procured by the Growers Society. These fertilizers are then mixed and 500g of the mixture is being applied per vine during March and another 500g per vine during November. Their application schedule needs to be changed as per the crop growth stage and its requirement. A proper training needs to be devised to educate the farmers.

Installation of Automated Weather Station

An Automated Weather Station was installed in the vineyard of Mr. C. Lalawmpuia in Vengsang (Champhai). The farmer had grape plantation on 1.5 hectare area with Bangalore Blue variety.

Installation of weather station in Vengsang Village

Collection of insect specimens

During the visit to vineyards, few vines showed insect damages due to caterpillars, flea beetle and leafhoppers. The farmers were made aware about the use of recommended chemicals to manage these insect pests. Specimens of insects viz. leafhoppers, flea beetle, caterpillars and thrips infesting grapevines were collected for identification purpose from all the vineyards visited.

Establishing Bangalore Blue vineyard as mother block to provide quality planting material

A progressive farmer, C. Lalawmpuia, from Vengsang village was identified for the purpose of establishing mother block. Necessary infrastructure needs to be created for the purpose. Incidentally, weather station is also located in his vineyard. Cuttings from three uniform vines were taken for virus screening at ICAR-NRC Grapes. The farmer was educated regarding the procedure to be followed in raising the mother vines.

Performance of wine grape varieties in Mizoram conditions

As per the proposed program on "Evaluation of wine varieties under Mizoram condition", the cuttings of seven wine varieties (Sauvignon Blanc, Chardonnay, Riesling, Cabernet Franc, Cabernet Sauvignon, Bangalore Blue and Bangalore Purple) were taken from ICAR-NRC Grapes, Pune. The cuttings were then treated in 1500 ppm IBA solution and planted in the poly bags and kept in the Poly house of State department of Horticulture at Champhai. It was decided to plant these cuttings after rooting into a larger polybag of 15-20 kg capacity. The cuttings will then be transferred into the pits in next year Feb. end or early March 2016. Two sites for planting of the rooted cuttings of above cited varieties were selected; one each in Vensang and Mualkawi area.

Training programme

A training programme was organized on 10th September 2014 at Horticulture Department, Champhai. Mr. Mapuia, Sub-divisional Horticulture Officer was the Chief Guest of the programme and Mr. Sanga, Horticulture Extension Officer assisted in translation to local language. Training on 'Production of quality planting material in grape' was given by Dr. R. G. Somkuwar, Principal Scientist (Horticulture). During the training programme, importance of quality planting material and its role in achieving higher yield was explained to the participants. A demonstration of grafting and budding on rootstock was also given. A lecture on 'Identification and management of insect pests and diseases in grapes' under Mizoram conditions was also delivered by Dr. D.S. Yadav, Scientist (Entomology). The participants were shown pictures of various insect and diseases

of grapes and were asked to identify the ones occurring in their vineyards. The farmers reported that symptoms of damage by stem girdler, stem borer, thrips, leafhoppers, flea beetle and caterpillars were seen in their vineyards. However, the level of incidence was not high (Table 35) . The farmers also reported presence of symptoms of downy mildew in their vineyards. Cycle of downy mildew incidence and favourable weather conditions for its development were explained during the programme. A demonstration on use of weather forecasting for decision support for the management of insect pests and diseases was also given.

During the training programme, questionnaire was circulated among trainees.

Training programme for farmers being conducted at Champhai

Table 35.

Status of disease and pest incidence in vineyards

Name of disease/ Pest	Number of farmers reporting					Number of farmers reporting
	Very high	High	Medium	Low	Nil	
Downy mildew	0.00	3.85	65.38	26.92	3.85	26
Anthracnose	0.00	0.00	0.00	0.00	100.00	23
Mealybug	4.35	4.35	0.00	65.22	26.09	23
Thrips	0.00	0.00	7.14	78.57	14.29	14
Stem borer	0.00	0.00	0.00	100.00	0.00	18

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. Weather information based, location specific advisory on disease management

Grape Field Day

'Grape Field Day' was organized at Dhondgavan, district Nasik on 8th February 2015 to highlight the potential of hybrid 'Medika' as a potential juice variety with pharmaceutical properties due to its high content of resveratrol and polyphenols. The other promising hybrids and selections developed by the Centre viz. Manjri Naveen, Kishmish Rozavis White, and A18/3 and introduced grape varieties like Autumn Royal and Fantasy Seedless were also showcased at their physiological maturity in the varietal demonstration block. Six hundred and sixty two grape growers from Maharashtra participated in the Field Day. Grape growers in groups first visited block to see the varieties in fruiting along with the scientists of ICAR-NRCG and discussed various good characters of the varieties. During post-lunch technical session, ICAR-NRCG scientists presented technical information about the varieties and procedure and economics of juice making during the technical session. At the end, question-answer session helped to clarify various doubts of the growers.

Web advisories

During the year, 51 weekly advisories were issued to give weather based disease and pest risk assessment for different grape growing regions and recommended spray schedule based on risk assessment. Advisories also included recommended horticultural practices for hailstorm and heavy rainfall affected vineyards, pesticide residue alerts for export grapes etc. An easily accessible link is provided on the website of the institute to access these advisories.

Field visits to address the problems reported by the growers

- Dr. S.D. Ramteke and Dr A.K. Sharma surveyed the vineyards and cold storage units at Junnar on 10th April 2014 for estimation of post-harvest losses of grapes at farmers and cold storage level. During survey a loss of 7% and 5% was estimated at field and cold storage level, respectively.
- Dr. S.D. Ramteke visited the vineyards affected by chemical injury at Narayangaon, Pune on 19th November 2014 and suggested the strategies to overcome this problem. The grower was advised against indiscriminate use of chemicals and to follow the package of practice recommended by the Centre.
- Dr. S.D. Ramteke visited the vineyards affected by berry cracking, a physiological disorders at Baramati and Bori on 22nd January 2015. Growers were advised against excess irrigation to minimize the incidence of berry cracking.
- Director and a team of scientists visited Nashik region to guide grape growers to manage rain and hailstorm affected vineyards, as per the request from the President, MRDBS, Pune during March 24-25, 2015. Three villages around Niphad were affected due to hailstorm, where 100% vineyards got 100% losses due to hail damage. Guidelines for back pruning of hail damaged vineyard were discussed in farmers meeting arranged in the area.

Participation in charchasatra and seminars organised by MRDBS

Every year Maharshtra Rajya Draksh Bagaitdar Sangh (MRDBS) organizes "Charcha Satra" in all major grape growing areas in Maharashtra. These charcha Satra are organized twice in a year, once to discuss practices after foundation pruning in April-May and then in September to discuss practices after fruit pruning. Team of scientists of the Centre imparts latest information to the grape growers. About 500-3000 growers attend these sessions in different areas. The details are following.

Charcha Satra for foundation pruning were held at Sangli (11th April), Junnar Dist. Pune (25th April), Nasik (26th April), Satana (3rd July). The following topics were discussed by the scientists.

- DR S.D. Sawant – Disease management after April Pruning
- Dr R.G. Somkuwar – Cultural practices for fruit bud differentiation
- Dr A.K. Upadhyay - Nutrient and water management in grapes after April pruning
- Dr S.D. Ramteke - Physiological requirements of formation of fruitfulness in grapes
- Dr D.S. Yadav – Management startegies for insect pests in grape

Similarly Charchasatra were organised to educate the farmers about practices to be followed after fruit pruning, which were held at Baramati, Sangli, Nasik, and Solapur on 22nd, 23rd, 25th and 29th September 2014 respectively. Dr. S.D. Sawant, Dr. R.G. Somkuwar, Dr. A.K. Upadhyay, Dr. S.D. Ramteke, and Dr. D.S. Yadav participated in these charchasatra and educated grape growers on above mentioned with reference to practices for fruiting season. Each event was attended by 400-500 grape growers.

- Dr. S.D. Sawant, Dr. R.G. Somkuwar, Dr. A.K. Upadhyay, Dr. S.D. Ramteke, and Dr. D.S. Yadav participated and delivered lectures on disease management, Canopy management, Nutrient and water management, use of bioregulators and insect pest respectively during Annual Seminar of MRDBS at Pune during 24-26th August 2014.
- Dr. S.D. Sawant, Dr. A.K. Upadhyay and Dr. D.S. Yadav advised about 250 grape growers in Sangli on 11th July 2014 during special farmers' meeting organised by regarding insect pests and disease risks and their management during less rainfall scenario.
- Dr. R.G. Somkuwar and Dr. A.K. Upadhyay delivered lecture on 'Canopy management for quality grape production' and 'Nutrient and water management in grapes' respectively at Jalna in growers seminar organised by KVK, Jalna on 5th March 2015.

Participation in Krishi Vigyan Mela / Exhibitions

ICAR-NRC for Grapes arranged stalls in different events organized in Karnataka, Maharashtra, Tamil Nadu and Haryana. Developed technologies were displayed in the form of posters, live samples of grapes, raisins, juice etc. Important publications of the institute were made available for sale. About one thousand people visited institute's stall during the following exhibitions.

Participation in Exhibition

- Bruhut Udyana Mela at UHS, Bagalkot during 12-15, December, 2014.
- Agribusiness Exhibition organized by State Agricultural Universities of Maharashtra at Pune during 15-16th Dec, 2014.
- Agriculture Technology Week Programme organized by KVK, Narayangaon during 5-7th January, 2015.
- ASC India Expo at NDRI, Karnal (Haryana) during 2-6th February, 2015.
- National Farmers Meet: Farmers, Traders and Researchers Interface which was organized on 14th March, 2015 at Regional Research Station, Paiyur, Dharmapuri district (Tamil Nadu).

Radio Talk broadcasted by Aakashvani, Pune

Dr S.D. Sawant: Management of diseases after foundation pruning without use of systemic fungicides as a strategy for fungicide resistance management.

Dr R.G. Somkuwar: 'Importance of nutrient management and training of grapevines for cane maturity' and 'Canopy management for effective fruit bud differentiation'.

Dr S.D. Ramteke: Use of Bioregulators in grape

Survey of potential areas for commercial viticulture in different states

In an attempt to explore the possibilities of extending commercial grape cultivation in non traditional areas in the country, survey was conducted in a few areas of different States.

Jammu and Kashmir

Survey was conducted in near by areas of Srinagar during 30th July – 5th August 2014 by Drs Indu S. Sawant, Anuradha Upadhyay and Roshni Samarth and in Leh-Ladakh during 18th -25th September 2014 by Drs R.G. Somkuwar and Roshni Samarth.

In Srinagar, the main area under grape cultivation was confined to villages of 'Ganderbal' district. A state horticulture department farm with grape vineyard was also located in this area. The soil is fine textured and varied from clay to silty clay loam. The holdings were small, and on hill slopes. Hussaini, a natural loose bunch variety and Sahebi are the commercially grown varieties.

Vines were trained to bower system and the roofs were very high due to the slope of land. The planting distance was 15 ft. x 15 ft. The practice of burying the shoots under soil before snowfall, allowing it to root, and then reemerging as a new tree is followed. The native grape cultivar "Armani" was planted in

some of the areas such as Ganderbal, Rapora, Kralla Baug. The vines are pruned in the month of Feb-March and the crop is ready for harvest in the month of August-September. Fruitfulness was very less.

Symptoms of Hen and chicken disorder were observed in all vineyards of variety Sahebi. However, the causes for the same were not known to the growers and they were concerned about this problem. Among diseases, rare infections of anthracnose

Bunch having Hen and Chicken disorder

and powdery mildew were seen. Among the insects, mites and thrips were prevalent.

In most cases vines are allowed to grow without proper training and pruning and application of growth regulators was not done. Training programmes on these aspects in collaboration with State Departments or State Agriculture University will be useful to improve grape cultivation in the area.

In Leh and Kargil districts of Ladakh were explored. Dr Saleem Mir, Associate Director, Research, Sher E Kashmir University of Agricultural Sciences and Technology collaborated during the exploration. Khaltsi Thang, Sanjak, Biama, Garkon, Hanu Thang villages in Leh; Hunderman, Cellik Omachik Thang villages in Kargil and Turtuk, Chalungkha and Pakistan Garari villages in Numbra valley were explored. In these regions no commercial cultivation was found, however one or two vines are maintained in backyards by the villagers. Farmers followed no cultural practice like training, pruning, application of growth regulators and plant protection measures resulting in low fruitfulness and poor quality of the fruit. Heavy incidences of powdery mildew, mites and thrips were observed.

Help from scientists of CITH, Srinagar and Sher E Kashmir University of Agricultural Sciences and Technology during exploration in these areas is highly appreciated.

Andhra Pradesh

Dr. S.D. Sawant and Dr. A.K. Upadhyay accompanied by officials of Department of Horticulture, Andhra Pradesh and Scientsists from Horticulture Resarch Centre, surveyed vineyards in Anantpur district during 19-21st August 2014. Grape vineyards were surveyed in Anantapur Rural Mandal, Kuderu Mandal and Dharamavarm Mandal. Presently, a total of 600 acre area is under grape cultivation. The soil is mainly Red sandy loam soil with mixed red and black soil appearing in between. The soils belong to order Alfisols and series Vayalpadu. The soils are shallow in depth with average depth of 15-20 cm, pH of 6.5 to 7.8, low organic matter and normally have good drainage. In general, the ground water is saline with the salinity level declining as we move towards Karnataka area. There is inadequate availability of irrigation water in these areas. Major variety grown is Dilkush. Though some vineyards had Sonaka raised on Dogridge, where planting material reportedly was supplied from the Centre. The soils being well drained are good for growing grapes. There is need to shift from own rooted cultivation to Rootstocks like Dogridge / 110R as the crop faces moisture / salinity stress. Diversification from present variety Dilkush (a bud-sprout of Anab-e-Shahi) to Thompson Seedless and its clones especially for raisin making, use of weather data based disease and pest forecasting as a tool to give need based spray to the vineyards are some of the suggestions for future development.

Madhya Pradesh

Dr S.D. Sawant and Dr R.G. Somkuwar, Principal Scientist (Horticulture) surveyed grape growing areas in Ratlam District of Madhya Pradesh in March 2015. Both table and wine grapes are grown in this district. Among the table grapes, Thompson Seedless is the major table grape variety and Dogridge is the

preferred rootstock. The package of practices is same as used in Nasik, Maharashtra. However, farmers lack in the knowledge of plant growth regulator required for producing quality grapes. The results obtained in Riyawan Vineyards of Mr. Gopalji Dhakad at Kalukheda near Ratlam were encouraging. Mr. Dhakad is in contact with this Centre for last ten years and is aware of good agricultural practices

in grape standardized at the Centre. In this farm six year old vines of Thompson Seedless grafted on Dogridge rootstock have produced 8 MT/ acre yield which was sold @ Rs. 80 per kg. The grape cultivation in this area can be increased through extensive extension activity to educate grape growers on package of practices developed at ICAR-NRCG.

Among the wine grapes, red wine varieties viz., Shiraz, Cabernet Sauvignon and Zinfandel are grown. To cater the need of the wine industry in Madhya Pradesh, a group of 18 farmers have established a small winery called 'AMBY WINES 'with 50,000 litre capacity. Few farmers, whose farms were visited, reported economical production but occasional frost in some areas destroys the crop.

The experimental plot of AICRP under College of Horticulture, Mandsaur was also visited. ICAR-NRCG team was accompanied by Dr. Hari Patidar, Dean, Dr S.N Mishra, Principal Scientist, Dr R. S. Chundawat, Senior Scientist and Dr. Shailendra K. Dwivedi, Officer Incharge, AICRP - Fruits (Grapes) of College of Horticulture, Mandsaur, MP. The trial on Evaluation of table varieties (seeded and seedless), Evaluation of varieties for wine (red and white wine), and juice purpose; and evaluation of different rootstock for table and wine grape varieties is under progress. The Centre has given 51 varieties and three rootstocks (Dogridge, Salt Creek and 110R) for evaluation under AICRP. Most of the varieties had good harvestable yield, indicating that the grapes can be successfully grown in this area.

Training and Capacity Building

Deputation Abroad

- Dr. K. Banerjee participated in 13th IUPAC (International Union of Pure and Applied Chemistry) International Congress on Pesticide Chemistry held in San Francisco, California, USA during 10-15th August 2014. He delivered a lead talk on 'Utilization of advanced analytical tools for targeted and non-targeted screening of pesticide residue'.

Training Acquired

- Dr. A.K. Sharma attended refresher course on 'Agricultural Research Management' at NAARM, Hyderabad during 14-26th July 2014. This special training was for direct recruited scientists other than ICAR.
- Mrs. Kavita Y. Mundankar participated in four week training program on "Introduction to GIS" during 5-30th May, 2014 organized at Training and Education Division, National Remote Sensing Centre (NRSC), ISRO, Dept. of Space, Govt. of India, Balanagar, Hyderabad.
- Ms. Anupa T. underwent three months professional attachment training on "Study of Embryo Rescue Techniques and Multiple Shoot Induction in grape (*Vitis vinifera* L.)" at ICAR-IIHR, Bengaluru.
- Mr. U.N. Borse, Technical Officer attended '5th Capacity Building Programme for Technical Assistants (two weeks)' organized by Indian Institute of Public Administration, New Delhi during 8-19th September 2014.
- Ms. Shailaja V. Satam attended a training programme on 'Office Automation using

Oracle ERP' organized by ICAR-Indian Agricultural Statistics Research Institute, New Delhi during 9-13 March 2015.

Training Programmes Organized

The following training programmes were organized at the Centre and Scientists were resource persons for their field of specialization.

For grape growers

- The Centre in association with Maharashtra State Grape Growers' Association (MRDBS), Pune organized training programme for grape growers in four batches during 24th June – 1st July (28 participants) and 7-14th July (29 participants), 17th -24th July (30 participants) and 28th July to 4th August 2014 (33 participants). These programmes are specifically organized for the children of grape growers, who are looking after their vineyards. Seven days programme covers advances in all aspect of viticulture and Scientists of ICAR-NRCG conduct the training and MRDBS looks after staying arrangements of the trainees.
- A special training progrmme entitled 'Enhancement of productivity and quality in grapes through hi-tech management practices' was conducted at the Centre during 10-12th March 2015. 25 grape growers, 5 Extention officials of Theni and Dindigul district of Tamil Nadu and 4 staff of Grape Research Station (GRS), Rayappanpatty, Theni participated in the training. The training program was sponsored by Tamil Nadu Agriculture University under its NADP-RKVY – capacity building scheme. Dr Indu S. Sawant, Dr. Anuradha Upadhyay, Dr. Roshni Samarth and Dr. Anupa T. coordinated the programme.

For technical personnel of APEDA nominated laboratories

- 'Sampling of peanut and peanut products for aflatoxin analysis' on 23rd April, 2014. A total of 7 participants from different APEDA nominated laboratories attended the programme. The programme was coordinated by Dr. K. Banerjee.
- 'Pesticide residue analysis in food using GC-MS/MS and LC-MS/MS' in collaboration with AOAC India Section during 4-6th August 2014. Training programme was attended by nine participants from different commercial testing laboratories. Topics covered were basic sample preparation techniques, instrumental method development, data interpretation and troubleshooting for the pesticide residue analysis in food using LC-MS/MS and GC-MS/MS. The programme was coordinated by Dr. K. Banerjee.
- 'Postharvest sampling of grapes for residue analysis' on 14th January 2015 for the representatives of laboratories involved in grape sampling for export to the EU. Total 49 participants from the different laboratories from Pune, Mumbai, Hyderabad, Chennai, Bangalore, Kochi and Kolkata attended the programme. The programme was coordinated by Dr. K. Banerjee and Dr. Ahammed Shabeer T.P.
- 'Pesticide residues and plant growth regulators analysis using GC-MS/MS and LC-MS/MS' during 2nd to 4th February, 2015 in collaboration with India section of AOAC international for around 15 chemists from different food testing laboratories. The training programme covered the area of multiresidue analysis for pesticide, the residue analysis methods for plant growth regulators (PGR), glyphosate and dithiocarbamates. The programme was coordinated by Dr. K. Banerjee and Dr. Ahammed Shabeer T.P.
- 'Development of capacities for the provision of PTs under EU-India Capacity Building Initiative for Trade Development in India (CITD)' organized by European Commission on 16-20th February, 2015 along with the local organizer NRL, ICAR-NRCG, Pune, under the banner of "EU-India Capacity Building Initiative for Trade Development in India (CITD)". The training included the analysis of mycotoxins and different aspects of proficiency testing for mycotoxins as per ISO/IEC 17043. Officials from EIC, Mumbai, EIC, Kolkata, NIPHM, Hyderabad and NRL, ICAR-NRC for Grapes participated in the program. The programme was locally coordinated by Dr. K. Banerjee and Dr. Ahammed Shabeer TP.
- 'Detection of pesticide residues through single residue methods' sponsored by EU-India Capacity Building Initiative for Trade and Development (CITD) during 30th March- 3rd April, 2015. Dr. Michelangelo Anastassiades from EU-Referral Laboratory, Germany gave the training.

For industry personnel

- 'Screening of contaminant residues in food commodities' for the officials from General Mills India Pvt. Ltd. during 20-21st May 2014. This training covered the area of sample preparation and analytical method validation for the screening of pesticides residues as per DG SANCO. Two chemists participated in this training programme and the program was coordinated by Dr. K. Banerjee.
- Two trainings entitled 'Plant protection in two pruning and single cropping system in viticulture' were organized during 4-5th September 2014 (coordinated by Dr. Indu S. Sawant and Dr. D. S. Yadav for 30 executives of Bayer CropScience Ltd) and 8-9th October 2014 (coordinated by Mrs. Amala U. and Ms. Anupa T. for 18 executives of Tropical Agrosystem Pvt. Ltd.). The training programme covered areas such as disease and insect pest management, weather forecasting for decision support, pesticide resistance and residues, biological control, post-harvest losses, nutrient, water and canopy management.

For ICAR-NRCG staff

- ISO internal auditors on 1st and 2nd September 2014 at ICAR-NRCG.
- Training of scientists on ERP MIS-FMS held at ICAR-NRCG on 15th September, 17th and 22nd October 2014.

Training given / summer training / invited lectures

Resource person

- Dr S.D. Sawant was resource person for Winter School on Recent Advances in Integrated Pest Management organized at NCIPM, New Delhi and he delivered a lecture entitled "Integrated Pest Management in Grapes: a success story" on 10th March 2015.
- Dr. R.G. Somkuwar was resource person for awareness programme for revised guidelines for new schemes organized by NHB on 12th August 2014 at Pune. He delivered a lecture on 'Production of export quality grapes through mechanization using advanced machineries'.

Post Graduate Project Work

During the year eight M.Sc. students from different universities across the country completed their 4-6 months project under scientists of the Centre.

Name of Scientist	Title of the project	Duration	No. of students	Institution / University
Dr. Indu S. Sawant	Screening of bacteria for production of growth promoting metabolites	01.01.2015 to 30.04.2015	1	Dr. D.Y. Patil Biotechnology & Bioinformatics Institute, Pune
Dr. Indu S. Sawant	Establishment of *Trichoderma* on fungicide treated grapes leaves Biodegradation of Cyantraniliprole by B. *Subtilis* isolated from grapevines (Vitis vinifera)	01.02.2015 to 31.05.2015	2	School of Studies in Biotechnology, Pt. Ravishankar Shukla University, Raipur, Chhattisgarh
Dr. R.G. Somkuwar	Water stress induced changes in grape rootstocks	01.02.2015 to 30.04.2015	1	Tilak Maharashtra Vidyapeeth, Pune
Dr. A.K. Sharma	Assessment of β-glucosidase activity in yeast strains	01.01.2015 to 30.06.2015	1	Amity University, Noida, Uttar Pradesh
Dr. D.S. Yadav	Isolation, identification and functional significance of gut flora of stem borer, *Stromatium barbtum F.*	01.01.2015 to 30.04.2015	1	Dr. D.Y. Patil Biotechnology & Bioinformatics Institute, Pune
Dr. Roshni Samarth	Evaluation of descriptors for varietal characterization in grapes Characterization of reference cultivars in grapes	07.12.2014 to 06.04.2015	2	Modern College of Agricultural Biotechnology, Pune

Professional attachment training to scientists of other institutes

Name of Scientist and Institute	Research topic for training	Duration	Guide at ICAR-NRCG
Mr. B. Gopalakrishnan ICAR-NIASM, Baramati	Training on use of ICP –MS and analysis of raisin samples for heavy metal contamination	12.05.2014 to 11.08.2014	Dr. A.K. Upadhyay
Mr. Rajkumar Arjun Dagadkhair ICAR- DCR, Puttur	Utilization of Wine Grape Pomace for the Preparation of Cookies	12.05.2014 to 11.08.2014	Dr. A.K. Sharma
Dr. Swati Sharma ICAR-CISH, Lucknow	Quality Evaluation of Imported Raisins available in Indian Market and Method development in black pepper for pesticide residue analysis by LC-MS/MS	14.11.2014 to 13.02.2015	Dr. A.K. Sharma

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. About 36 lectures and 5 practical sessions were conducted by the scientists of ICAR-NRCG, Pune.

Awards and Recognitions

Awards

- Dr S.D. Sawant and Dr. K. Banerjee were honoured with Crystal National Agri-Award, 2014, constituted by Krishi Anusandhan and Kisan Vikas Foundation, New Delhi. Dr K. Banerjee received the award under scientist category whereas Dr S.D. Sawant received special jury award. The awards were conferred by Dr Radha Mohan Singh, Union Minister of Agriculture and Mr. Nitin Gadkari, Union Minister of Road Transport and Highways of India on August 27, 2014.
- A paper entitled "Institutional Role on Promotion of Good Agricultural Practices (GAP) and Export of Grapes in Maharashtra" authored by Sukanya Som, R. Roy Burman, V. Sangeetha, V. Lenin, J. P. Sharma, K. Banerjee and Indu Sawant was conferred with Best Paper Award-2015 in 7th National Seminar on "Sustainable Rural Livelihood: Technological and Institutional Perspective" organized by Society for Community Mobilization for Sustainable Development at Sher-E—Kashmir University of Agriculture

& Technology for Jammu, Jammu during 8 – 10th January, 2015.

- A poster entitled 'Rootstock regulates fruit and wine quality parameters of Cabernet Sauvignon grapevine (*Vitis vinifera* L.)' authored by Satisha J., Kitture A. R., Sharma A. K., Sharma J. and Somkuwar R.G. and presented in "6th Indian Horticulture Congress" organized by The Horticultural Society of India, New Delhi in collaboration with TNAU, Coimbatore, Tamil Nadu on 6th to 9th November, 2014 received Best Poster Presentation award in the technical session on" Production technologies".
- Oral presentation "Seasonal incidence, host and host stage preference of mealy bug parasitoid, *Anagyrus dactylopii* Howard" by Amala U. was awarded 2nd Prize during International Conference on 'Changing scenario of pest problems in agri - horti ecosystem and their management' during 27-29th November 2014 and organised by the Entomological Research Association at Department of Entomology, Maharana Pratap University of Agriculture and Technology (MPUAT), Udaipur.

Recognitions

Invited Speakers

- Dr S.D. Sawant was invited to deliver a lecture on 'Weather Data based disease management in Horticultural crops' in the National Symposium on "Agrochemicals for Food and Environment Safety" organized by Society of Pesticide Science India at IARI, New Delhi on 28.01.2015.
- Dr S.D. Sawnt delivered an invited lecture on the occasion of Dr. P.B. Chavan Lecture Series at Dept. of Botany, Y.C. Institute of Science, Satara on February 18, 2015.
- Dr. Indu S. Sawant was invited to give a lead talk on 'Molecular characterization of mating type idiomorphs of *Erysiphe necator* from India' in the National Symposium on 'Understanding Host-pathogen Interactions Through Science of Omics' organized by the Indian Phytopathological Society, New Delhi at IISR, Calicut on 16-17th March 2015.
- Dr. Indu S. Sawant was invited to give a lead talk on 'Application of selected superior strains of microorganisms to minimize risks associated with fungicide based disease management in grapes' in the International Symposium on 'Innovations in Horticulture for Nutritional Security, Conserving Biodiversity and Poverty Alleviation' during 16-18th October organized by Department of Applied Plant Science, Babasaheb Bhimrao Ambedkar University, Lucknow and Indian Society of Horticultural Research and Development.
- Dr. Anuradha Upadhyay was invited as expert speaker during International Conference on "NextGen genomics and bioinformatics tools" held at National Institute of Mental Health and Neuro Sciences, Bengaluru during 17-19th November 2014.
- Dr. K. Banerjee was invited to lecture on 'Multiresidue analysis of pesticides utilizing advanced analytical tools' in the National Symposium on Agrochemicals for Food and Environmental Safety at IARI, New Delhi during 28-30th January 2015.
- Dr. K. Banerjee delivered an invited lecture on 'Overview of food safety programs in India: residue monitoring taking advantage of advanced analytical tools' in the 'Symposium on the Application of Chromatography and Spectroscopy Techniques in Pharma and Food Analysis' organized by Chromatographic Society of India, Mumbai during 18-19th December 2014.
- Dr. K. Banerjee delivered an invited lecture on 'Pesticide residues in pomegranate' in the National Seminar-Cum-Exhibition on Pomegranate for Nutrition, livelihood Security and Entrepreneurship Development during 5-7th December 2014.
- Dr. K. Banerjee delivered an invited lecture on 'Heavy metals and pesticide residues in horticultural crops' in the Indian Horticulture Congress, Coimbatore during 6-9th November 2014.
- Dr. K. Banerjee delivered an invited lecture on 'Targeted and non-target screening and quantification of contaminant residues in agricultural commodities: Taking advantage of advanced analytical tools' in the 13th IUPAC International Conference Symposium on effective residue analysis utilizing advanced analytical tools during 10-15th August 2014.
- Dr. K. Banerjee delivered an invited lecture on 'Pre-harvest contaminant management for better quality vegetables' in the National Conference on 'Pre-/Post-Harvest Losses & Value Addition in Vegetables' during 12-13th July 2014 at Indian Institute of Vegetable Research, Varanasi.

- Dr. K. Banerjee delivered an invited lecture on 'Some novel visions and resolutions in adopting frontier analytical tools and developing methodologies: a saga of building a community-friendly food safety system' in the National Academy of Agricultural Sciences, New Delhi on 4th June 2014.
- Dr. S.D. Ramteke gave a lead presentation 'Physiology of Flowering of grapevine' at Lucknow on 24-26th May 2014.
- Dr. A.K. Sharma was invited to give lecture on "Value addition in grapes" in the International Symposium on Innovations in horticulture for nutritional security, conserving biodiversity and poverty alleviation during 16-18th October, 2014 at Babasaheb Bhimrao Ambedkar University, Lucknow.

Chairman of technical session in workshop

- Dr S.D. Sawant chaired plant protection session of workshop of All India Coordinated Research Project (Fruits) held at Udaipur during 26-28th Feb. 2015. He also chaired session on plant protection during Joint Agrisco meeting of State Agricultural Universities hosted by Dr. BSKKV, Dapoli during 12-13 May 2014.

Editorial Boards

- Dr. Indu S Sawant is re-nominated as a member in National Editorial Board of The Horticultural Society of India for a period of two years i.e. 2015-16.
- Dr. K. Banerjee was selected as Member-Editorial Board of Chemical and Biological Technologies in Agriculture (Springer Plus: http://www.chembioagro.com/about/edboard).
- Dr. K. Banerjee was selected as Member-Editorial Board of the journal of Plant Protection Sciences (The Official Publication of the Association for Advancement in Plant Protection, Regn. No. S/1L37974/2006-07) (http://www.aappbckv.org/ journal/editorialboard.php)
- Dr. A. K. Sharma is nominated as Associate Editor of Progressive Horticulture a research Journal of Indian Society of Horticultural Research and Developement.

Members in professional societies

- Dr. K. Banerjee was nominated as Member-Panel for Method of Sampling and Analysis, Food Safety Standards Authority of India (http://www.fssai.gov.in/MediaCenter/ScientificPanels.aspx)

Fellows of societies

- Dr. Indu S Sawant is admitted as 'Fellow of Phytopathological Society of India' (FPSI), New Delhi.
- Dr. Indu S Sawant is admitted as 'Fellow of the Society for Biocontrol Advancement (FSBA), Bengaluru.
- Dr. K. Banerjee was elected as the President, AOAC, India Section

Members of Committees

International

- Dr. K. Banerjee was selected as Member-Program Advisory Committee (PAC), Malaysian Palm Oil Board (MPOB) in the subject area of food nutrition and quality. The main role of this PAC is to review the research programs of MPOB and assess the progress of their research projects purely on advisory capacity.

National

- Dr S.D. Sawant attended Departmental Promotion Committee meeting as member ICAR-NIASM, Baramati.
- Dr. Indu S. Sawant attended Departmental Promotion Committee meeting as DDG's nominee at ICAR-DMARP, Anand during 21-22nd August 2014.
- Dr. Anuradha Upadhyay was invited as outside expert for the selection of SRF and technical assistant at ICAR - Directorate of Onion and Garlic Research, Pune and attended the meeting of interview committee on 11th March 2015.
- Dr. A.K. Upadhyay attended Selection Committee meeting as an outside expert for selection of JRF at ICAR-National Institute of Abiotic Stress Management, Baramati on 18th August 2014.
- Dr. K. Banerjee was nominated as Member-Research Advisory Committee, Indian Institute of Vegetable Research, Varanasi, 2014-2017.
- Dr. S.D. Ramteke acted as member of Selection Committee of Technical personnel of ICAR-National Institute of Abiotic Stress Management, Baramati and Directorate of Onion and Garlic Research, Rajgurunagar, Pune.

- Dr. S.D. Ramteke attended the selection committee meeting of ICAR-Directorate of Floricultural Research, Pune for selection of SRF and Field Assistant on 27th and 31st January 2015.
- Dr. A.K. Sharma was the Chairman of Poster Evaluation Committee for two thematic areas and Co-chairman for another 3 areas in the International Symposium on Innovations in horticulture for nutritional security, conserving biodiversity and poverty alleviation during 16-18th October 2014 at Babasaheb Bhimrao Ambedkar University, Lucknow.
- Mr. S.N. Salve, Administrative Officer attended recruitment committee meeting as ICAR representative at ICAR Research Complex for Goa, Goa during 6-7th and 24-26th August 2014.

DG's Nominee

Dr S. D. Sawant attended the meeting of the following committee as DG's nominee

- Board of Management of UHS, Bagalkot on 8th May 2014 at Bagalkot.
- 305th Executive Council meeting of MPKV, Rahuri on 22nd May 2014.
- 29th meeting of Board of Management of UHS, Bagalkot held at Bengaluru on 9th March 2015.

Examiners / Reviewers

- Dr. Indu S. Sawant is appointed as Adjunct Professor in subject of Botany by Vasant Dada Sugar Institute, Pune.
- Dr. Anuradha Upadhyay was recognized as Ph.D. examiner by Shivaji University and reviewed a Ph.D. thesis entitled "Identification and molecular analysis of the genes associated with sucrose accumulation in sugarcane" by Shri S.B. Kalwade.
- Dr. S.D. Ramteke conducted qualifying examination of M. Sc. (Agriculture) students of UAS Raichur on 19th December 2014.
- Dr. A.K. Sharma was recognized as referee to evaluate Ph. D. thesis of a student of Homi Bhabha National Institute, Mumbai.

Copyright

- Copyright certificate received for computer software work "Information system for management of microsatellite data for grape germplasm in India" with registration no. SW-8145/2014.

Sequence deposited in NCBI database

- The sequence of Transcription factor VVERF1 from Thompson Seedless was deposited to NCBI gene bank. The gene bank accession number is BankIt1781556 Seq1 KP256369.

Linkages and Collaboration including Externally Funded Projects

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)

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

Collaborative Research

- Memorandum of Understanding was signed with University of Horticultural Sciences, Bagalkot, Karnataka for PG studies and research.
- A Memorandum of Understanding (MoU) was signed between ICAR-NRCG and Spices Board, Cochin for developing multi residue method for analysis of pesticide residues in three spice matrix viz, cardamom, chilli and cumin. As per MoU, Spices Board will pay Rs. 21 Lakhs (Rs. 7 Lakhs per spice) to ICAR-NRCG for developing and implementing the optimized method at Spice Board laboratories.
- A Memorandum of Agreement (MoA) was signed between ICAR-NRCG, Pune and ICAR-Central Institute of Fisheries Technology, Cochin, Kerala for collaborative research work on Chitin and Chitosan and its derivatives
- Mutual Confidentiality and Non-disclosure agreement between was signed between ICAR-NRCG and EID Parry (India) Limited. The Centre is likely to develop joint programme on isolation and evaluation of bio-control agents for the control of downy mildew. The agreement is the first step for the same.

Publications

Research Articles

1. Amala U. and Yadav D.S. 2014. Life table studies of pink mealybug, *Maconellicoccus hirsutus* under laboratory conditions. Indian Journal of Plant Protection 42(3): 280-282.
2. Amala U., Chinniah C., Sawant Indu S., Muthukrishnan N. and Muthiah C. 2014. Bio-efficacy and lethal reproductive effects of three entomopathogenic fungi against pink mealybug, *Maconellicoccus hirsutus* Green infesting grapes. Green Farming 5(4): 199-202.
3. Amala U., Chinniah C., Sawant Indu S., Muthukrishnan N. and Muthiah C.. 2014. Survey for Grapevine Mealy bug Incidence and their Natural Enemies in Tamil Nadu and Maharashtra. Bio pesticides International, 10(2): 169-175.
4. Hingmire S., Oulkar D.P., Shabeer A.T.P., Banerjee K. 2015. Residue analysis of fipronil and difenoconazole in okra by liquid chromatography mass spectrometry and their food safety evaluation. Food Chem. 176: 145-151.
5. Khot A.P., Ramteke S.D. and Deshmukh M.B. 2014. Influence of CPPU and GA_3 on bunch, berry characteristics and biochemical changes in relation to yield of grapes grafted on Dogridge rootstock Ann. Plant Physiol., 28 (2): 14-21.
6. Khot A.P., Ramteke S.D., Banerjee K. and Girame Rushali R. 2014. Dissipation and persistence of propargite in grape leaves and berries using GC-MS. Pestology vol. XXXVIII no. 4.
7. Ramteke S.D. and Khot A.P. 2014. Bioefficacy, phytotoxicity and terminal residue analysis of Diuron on narrow and broad leaf weeds in grapes. Ann. Plant Physiol., 28 (2): 38-43.
8. Sabale R., Shabeer A.T.P., Utture S.C., Banerjee K., Oulkar D.P., Adsule P.G., Deshmukh, M.B. 2015. Kresoxim methyl dissipation kinetics and its residue effect on soil extra-cellular and intra-cellular enzymatic activity in four different soils of India. J. Environ. Sci. Health, Part B. 50: 90-98.
9. Sahoo S, Manjaiaha K.M., Dattaa S.C., Shabeer A. T.P. and Kumar J. 2014. Kinetics of metribuzin release from bentonite-polymer composites in water. J. Environ. Sci. Health, Part B., 49, 591–600.
10. Salunkhe V.P., Sawant I.S., Banerjee K., Wadkar P.N., Sawant S.D., Hingmire S. 2014. Kinetics of degradation of carbendazim by *B. subtilis* strains: possibility of in situ detoxification. Environ. Monit. Assess. 186 (12): 8599-8610.
11. Satisha J., Upadhyay Anuradha and Maske S.R. 2014. Rootstocks induced changes in enzyme activity and other biochemical components during bud burst in Thompson Seedless grapevine buds. Vitis, 53 (2): 57-64.
12. Shabeer A.T.P., Banerjee K., Jadhav M., Girame R., Utture S.C., Hingmire S., Oulkar S.P. 2015. Residue dissipation and processing factor for dimethomorph, famoxadone and cymoxanil during raisin preparation. Food Chem. 170: 180-185.
13. Shabeer A.T.P., Saha A, Gajbhiye V.T., Gupta S, K.M. Manjaiah K.M. and Varghese E. 2014. Removal of Poly Aromatic Hydrocarbons (PAHs) from

Water: Effect of Nano and Modified Nano-clays as a Flocculation Aid and Adsorbent in Coagulation flocculation Process. Polycyclic Aromatic Compounds, 34:452–467.

14. Shetty D.S., Narkar S.P., Sawant I.S. and Sawant S.D. 2014. Efficacy of quinone outside inhibitors (QoI) and demethylation inhibitors (DMI) fungicides against grape anthracnose. Indian Phytopathology, 67: 174-178.
15. Somkuwar R.G., Bahetwar A., Khan I., Satisha J., Itroutwar P., Bhongale A. and Oulkar D. 2014. Changes in growth, photosynthetic activity, biochemical parameters and amino acid profile of Thompson Seedless grapes (*Vitis vinifera* L.). Journal of Environmental Biology. 35: 1157- 1163.
16. Somkuwar R.G., Bhange M.A., Upadhyay A.K., and Ramteke S.D. 2014. Interaction effect of rootstocks on gas exchange parameters, biochemical changes and nutrient status in Sauvignon Blanc wine grapes. Journal of Advances in Agriculture. Vol. 3(3): 218 – 225.
17. Somkuwar R.G., Ramteke S.D., Satisha J., Bhange M.A., and Itroutwar P. 2014. Effect of canopy management practices during forward pruning on berry development and photosynthesis in Tas-A-Ganesh grapes. Journal of Horticultural Science. 9(1): 18-22.
18. Somkuwar R.G., Samarth R.R., Itroutwar P. and Navale S. 2014. Effect of cluster thinning on bunch yield, berry quality and biochemical changes in local clone of table grapes cv. Jumbo Seedless (Nana Purple). Indian Journal of Horticulture. 71 (2): 184-189.
19. Somkuwar R.G., Samarth Roshni R., Satisha J., Ramteke S.D. and Itroutwar Prerna. 2014. Status of dry matter at harvesting stage in commercially grown grape varieties under tropical climatic condition. J. Agric. Res. Technol., 39 (3): 407-412.
20. Somkuwar R.G., Satisha J., Sawant S.D., Taware P.B., Bondage D.D. and Itroutwar P. 2014. Rootstocks influence the growth, Biochemical contents and Disease Incidence in Thompson Seedless Grapevines. British Journal of Applied Science and Technology 4(6): 1030-1041.
21. Somkuwar R.G., Sharma J., Satisha J., Ramteke S.D., Khan I and Itroutwar P. 2014. Growth, fruitfulness and yield in relation to mycorrhizal inoculants in Thompson Seedless grapes (*Vitis vinifera* L.) grafted on Dog Ridge rootstock. Progressive Horticulture. 46 (1) 23-30.
22. Sharma A K, Kumar R, Azad Z R A A and Adsule, P G. 2015. Use of fine wine lees for value addition in ice cream. Journal of Food Science and Technology, 52(1), 592-596. DOI 10.1007/s13197-013-1007 - x.

Papers Presented at Symposia / Workshops / Meetings

International

1. Amala U., Chinniah C., Sawant Indu S., Muthukrishnan N. and Muthiah C. 2014. Seasonal incidence, host and host stage preference of mealybug parasitoid, *Anagyrus dactylopii* Howard". International Conference on "Changing scenario of pest problems in agri - horti ecosystem and their management" at Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology (MPUAT), Udaipur, Rajasthan on 27-29th November 2014. Pp 153-154.
2. Amala U., Chinniah C., Sawant Indu S., Muthukrishnan N. and Muthiah C. 2015. Predatory potential of neuropteran predator *Chrysoperla zastrowi sillemi* against the insects infesting grapevine". International Conference on 'Innovative Insect management approaches for Sustainable Agro ecosystem" at Department of Entomology, Agricultural College and Research Institute, Madurai on 27-30th January 2015.
3. Amala U., Chinniah C., Sawant Indu S., Muthukrishnan N. and Muthiah C. 2015. Action of three entomopathogenic fungi against two spotted spider mites, *Tetranychus urticae* Koch infesting grapevine. International Conference on 'Innovative Insect management approaches for Sustainable Agro ecosystem" at Department of Entomology, Agricultural College and Research Institute, Madurai on 27-30th January 2015.
4. Maske S.R., Satisha J., Upadhyay A., Malakar D., Singh. A., 2014. Rootstock's influence on proteome and metabolome variations in Thompson Seedless grapes

during 3-4 mm (EL 29) stage of berry development. In "International Biology symposium in Proteomics: Present and Future" held at Centre for Cellular and Molecular Biology, Hyderabad during 22-24th Nov. 2014. Pp: 87 (Abstract No. 23).

5. Sharma, A K; and Sawant, S D. 2014. Value addition in grapes: Indian scenario in International Symposium on Innovations in Horticulture for Nutritional security, conserving biodiversity and poverty alleviation organized by Indian Society of Horticultural Research and Development and BBAU, Lucknow on 15-17 Oct, 2014.

National

Oral presentations

6. Sawant S.D., Ghule M.R. and Sawant I.S. 2014. 'Report of QoI and CAA fungicide resistance in *Plasmopara viticola* from vineyards of Sangli district of Maharashtra' In. National Symposium on 'Plant Pathology in Genomic Era" organized by the Indian Phytopathological Society, New Delhi at Indira Gandhi Krishi Vishwavidyalaya' Raipur, Chhattisgarh.
7. Sawant I.S. 2014. 'Biodegradation of Pesticides and Detection of Microbial Metabolites' in the scientific discussion on "Potential applications of LC-MS and GC-MS instruments for various life science experiments" on 18th June 2014 at NRCG.

Poster presentations

The following posters were presented at 6th Indian Horticulture Congress" organized by The Horticultural Society of India, New Delhi in collaboration with TNAU, Coimbatore, Tamil Nadu during 6-9th November 2014.

8. Ramteke S.D., Khot A.P., Rajurkar A.B., Bhagwat S.R. and Waghmare S.S. 2014. Bioefficacy, phytotoxicity and terminal residue analysis of Diuron on narrow and broad leaf weeds in grapes.
9. Samarth Roshni R., Shetty Dinesh, Khandagale Kiran, and Sawant Indu S. 2014. Association of leaf micro-morphological characters with downy mildew resistance in grapes.
10. Samarth Roshni R., Upadhyay Anuradha, Deore Pushpa and Sawant Indu S. 2014. Marker assisted breeding for downy mildew resistance in grape cultivar Thompson Seedless.
11. Satisha J., Kitture A. R., Sharma A. K., Sharma J. and Somkuwar R. G. 2014. Rootstock regulates fruit and wine quality parameters of Cabernet Sauvignon grapevine (*Vitis vinifera L.*).
12. Satisha J., Upadhyay Anuradha, Maske S. R, Malakar D., Singh A., Pillai M., Kitture A. R. and Banerjee K. 2014. Proteome and metabolome variations in Thompson Seedless grapes during veraison stage as influenced by rootstocks.
13. Sharma A.K., Banerjee K. Utture S., Upadhyay A.K. and Sawant S.D. 2014. Initiatives in Indian wine sector to produce and supply safe wines with their traceability.
14. Somkuwar R.G., Sharma A. K., Itroutwar P. D. and Bhange M. A. 2014. Impact of bunch load on berry quality, yield and raisin recovery in Thompson Seedless grapes.
15. Upadhyay A.K., Sharma J., Shetty D.S., Lodaya J.D., Mulik R.U., Satisha J. and Shaikh M.S. Shabir. 2014. Effect of moisture stress at critical crop growth stages on biochemical and nutritional parameters and its impact on yield of Thompson Seedless grapevines.
16. Upadhyay, Anuradha, Shinde M.P., Upadhyay A.K., Satisha J., Patil S., Taware P. B., Mulik R. U., Kadoo N. Y. and Gupta V. S. 2014. Salinity stress induced response of grapevine (*Vitis vinifera L.*) var. Thompson Seedless at morphological, physiological and molecular level.

The following posters were presented at National Conference on Frontiers in Agrochemicals and Pest Management organized by Shivaji University, Kolhapur during 30-31 January 2015.

17. Jadhav M.R., Banerjee K. and Raut P. 2015. Dissipation and distribution of sulfadiazine and trimethaprim residues in egg and chicken tissues. In Frontiers in Agrochemicals and pest management at Kolhapur during 30-31 January 2015.
18. Bhongale A., Somkuwar R.G., Vijapure A. 2015. Changes in organic acid contents at different berry development stages in white wine grapes.
19. Hingmire S., Kamble N., Utture S., Oulkar

D., Shabeer A.T.P., Banerjee K. 2015. Degradation kinetics of Hexaconazole, λ-cyhalothrin and Captan residues in Okra and Brinjal.

20. Kamble N., Goon A., Utture S., Kandaswamy C, Shabeer A.T.P. and Banerjee K. 2015. Development of an analytical method for multiresidue analysis of pesticides and PCBs in egg, chicken and milk by gas chromatography tandem mass spectrometry.
21. Khot A.P., Ramteke S.D. and Deshmukh M.B. 2015. Influence of CPPU and GA3 on bunch and berry characteristics, biochemical changes relation to yield in Tas-A-Ganesh grape.
22. Mulik R. Upadhyay A.K., Sharma J. and Lodaya J. 2015. Assessment of cadmium and lead in grapes from Maharashtra.
23. Savalekar K., Patil C. Oulkar D., Shabeer A.T.P. and Banerjee K. 2015. Phenolic profiling of grape varieties Sauvignon Blanc and Shiraz grown in different geographical regions of India.

The following posters were presented at National Symposium on 'Agrochemicals for Food and Environment Safety' organized by Society of Pesticide Science India during 28-30th January 2015.

24. Shabeer A.T.P, Banerjee K, Jadhav M, Girame R, Hingmire S, Oulkar D and Utture S. 2015. Residue dissipation and generation of processing factor (PF) for pesticide residues during raisin preparation.
25. Shabeer A.T.P, Jadhav M, Banerjee K, Girame R, Hingmire S, Oulkar D and Utture S. 2015. Development and Validation of a Multi-residue Method for the Determination of 270 Pesticides in Raisin by Liquid Chromatography Tandem Mass Spectrometry (LC-MS/MS).

The following posters were presented at National conference of Plant Physiology (NCPP-2014) OUAT, Bhubaneswar during 23-25th November 2014.

26. Ramteke S.D., Khot A.P., Bhagwat S.R. and Waghmare S.S. 2014. Efficacy of Progibb 40% WSG to improve the yield and quality of Tas-A-Ganesh grapes grafted on Dogridge rootstock. Abstract id: T1-16, pp:36.
27. Ramteke S.D., Khot A.P., Bhagwat S.R., Shinde M.P. and Birhade A.P. 2014. Impact of gibberellic acid on gas exchange, yield and quality parameters of Fantasy Seedless grapes. Abstract id: T1-13, pp: 35.
28. Ramteke S.D., Khot A.P. and Bhagwat S.R. 2015. Influence of Gibberellic acid on gas exchange, biochemical and quality parameters in relation to yield of Crimson Seedless grapes. In National symposium on "Organic Agriculture" at Madurai, T.N. during 26-27th February 2015. P-304, pp: 162.
29. Som S., Burman R.R., Sangeetha V., Lenin V. Sharma J.P., Banerjee K., and Sawant I.S. 2015. "Institutional Role on Promotion of Good Agricultural Practices (GAP) and Export of Grapes in Maharashtra". Paper presented in the '7th National Seminar on "Sustainable Rural Livelihood: Technological and Institutional Perspective" organised by Society for Community Mobilization for Sustainable Development at Sher-E—Kashmir University of Agriculture & Technology for Jammu, Jammu from January 8 – 10, 2015.

Guest lectures

30. Sawant I.S. 2014. 'Possibilities of micro-organisms replacing fungicide use in viticulture '9th Foundation Day of Kan biosys, Pune on 9th May 2014 for 100 participants at Pune.

Technical Bulletin

1. Somkuwar R.G., Upadhyay A.K., Satisha J., Sawant S.D., Yadav D.S. 2015. Establishment of New Vineyard. ICAR-National Research Centre for Grapes, Pune

Books

1. Ramteke S.D. 2014. Draksh Utpadan: Shanka –Samadhan in Marathi, Pub. MRDBS.

Book Chapters

1. Banerjee K., Shabeer A.T.P., Goon A. and Utture S. (2014). Pesticide residues and heavy metals in fruits and vegetables: issues and strategies. Horticulture for Inclusive Growth. Edited by: K.L. Chadha, Pritam Kalia and S.K. Singh. pp. 961-973, Westiville Publishing House, New Delhi.
2. Karmakar R., Saha S., Dutta D. and

Banerjee K. (2015). Behaviour of pesticides in soil and its impact on soil quality. Book Chapter 12, pp. 354-370. In: Principles of Soil Science, edited by A. Rakshit, P. Raha and P.S. Bhadoria. Kalyani Publishers.

3. Shabeer A.T.P. and Banerjee K. (2015). Pesticide Residues. Managing Post Harvest Quality and Losses in Horticulture Crops. Volume 1. General Issues. Edited by: K.L Chadha and R.K. Pal. pp.231-251. Daya Publishing House. New Delhi.
4. Sharma, A. K. and Adsule, P G. 2014. Grape. In: Managing Postharvest Quality and Losses in Horticultural Crops Vol.-II, (eds. K L Chadha and R K Pal) Daya Publishing House, New Delhi pp. 407-422.

Somkuwar R.G. 2015. द्राक्षवेल लागवड, छाटणी व पानाचे **व्यवस्थापन**. In Agro Guide. Sakal papers Pvt Ltd. pp. 210- 212. (Special Edition for Grapes in Marathi).

Scientific Review

1. Sawant I.S. 2014. *Trichoderma* - foliar pathogen interactions. The Open Mycology Journal, 8, (Suppl-1, M3) 58-70.

Institutional publications

1. Sawant S.D., Upadhyay, Anuradha, Sawant, Indu S., Satisha, J., and D.S. Yadav (Eds.). 2014. Annual Report 2013-14, National Research Centre for Grapes, Pune. Pp. 104.
2. सावंत, सं दि; उपाध्याय, अनुराधा; शर्मा, अजय कुमार; यादव, दी सिं (संपादक). 2014. वार्षिक प्रतिवेदन 2013-14, राष्ट्रीय अंगूर अनुसंधान केंद्र, पुणे, पृ 80।

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

Research Advisory Committee (RAC) Meeting

The following are the members of 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 17th meeting of the Research Advisory Committee (RAC) of ICAR-NRCG, Pune was held on 7-8th February 2015 under the Chairmanship of Dr. B.M.C. Reddy, Vice Chancellor, Dr. YSR Horticultural University, Andhra Pradesh.

On the first day, the action taken report and progress of ongoing projects as well as new project proposals were presented and deliberated. On the second day, the visit to varietal demonstration block at farmers' field was arranged and the ICAR-NRCG varieties were shown at physiological maturity. The RAC interacted with farmers from Maharashtra who were also invited to demonstration block. Grape juice made from ICAR-NRCG hybrid variety Medika and AICRP Centre's hybrid H-516 was served and the juices of both varieties were appreciated. The RAC also interacted with the President, MRDBS and other office bearers of grape growers association.

The following were the recommendations and suggestions:

Recommendations

1. The grape being perennial and vegetatively propagated fruit crop, collection of data through multi-locational trials under AICRP is required for release of varieties and is time consuming. At times, the centres do not report the data on the performance of a variety hybrid. Thus the committee strongly recommends that the institute should discuss and take up the possibility of modifying the guidelines for release of varieties of perennial crops which differ from annual and seasonal crops. The multi-locational data from farmer's field in trials conducted by the Centre can be used.
2. The required modifications in package of practices for superior clonal selections should be carried out, after field experimentation.
3. Impact analysis of institute technologies is very important to confirm their relevance to the farmer's needs. Therefore, this activity has to be carried out.
4. There is a need to develop or introduce a seedless variety with self-thinning, bold berries, less GA dependent and higher shelf life.
5. Efforts on resistance breeding for mildews to be intensified.
6. For comparison of quality of wine, uniform bunch load should be maintained. The on-ongoing experiments on wine grapes to be concluded.
7. The experiment on 'Standardization of growth regulator schedule for new varieties' should be properly structured with clear objectives.
8. The role of PGR, climate and genotype on berry cracking should be systematically studied.
9. Source: sink relationship studies using 14C-GA. Utility of the same may be seen looking into the complexity of 'radiotracer' studies.
10. Work on organic grape cultivation to be initiated.
11. Research on protected cultivation to be taken up.
12. The collaboration of NCIPM and NBAII for research on insect management may be explored.
13. Research concentration is towards residue free export of grapes. There is need to provide safe grapes to Indian consumer also.
14. Promising β-glucosidase producing yeast strains to be selected and tested for their use in quality wine production.
15. In the experiment of grape juice, colour and quality retention should be studied during 6 months of storage period under ambient condition.
16. The conclusion of enology experiments should be drawn mainly based on scientific sensory evaluation data besides compositional analysis.
17. In the Research programme on winery waste, work on Red Wine pomace utilization may be included.

Suggestions

1. The promising clonal selections made by the farmers should be included in DUS testing.
2. The non-traditional area in Himachal Pradesh, Madhya Pradesh and Rajasthan may be explored for grape cultivation in collaboration with SAUs and state department of Horticulture.
3. The institute varietal release committee may deliberate and decide on a uniform system of nomenclature of varieties released by

the centre to ensure their unique identity.

4. Cost: benefit analysis has to be done wherever relevant.

The meeting ended with a vote of thanks by Member Secretary to the Chairman and Members of the Committee and participating scientists of ICAR-NRCG.

Institute Research Committee Meeting

The 19th Institute Research Committee meeting was held on 29th April – 1st May 2014 under the chairmanship of Dr. S. D. Sawant, Director. All the scientists attended the meeting. Progress reports of the ongoing research projects were presented by all the principal investigators. Dr. J. Satisha, Member Secretary, IRC coordinated the meeting.

The mid-term Institute Research Committee meeting for the year 2014-15 was held on 27th Sept 2014; 01 and 31st Oct. 2014; 3rd Nov 2014 and 03 and 13th Jan 2015 under the chairmanship of Dr. S.D. Sawant, Director. As grape industry needs package of practices for newer varieties, stress was given to take up research on upcoming new commercial varieties such as A18/3, Crimson Seedless, Autumn Royal and Nana Purple. Some of the other potential future research projects discussed were;

- Protected cultivation of grapes to overcome vagaries of nature (hailstorm, untimely rains etc.).
- Initiating research work on identifying physiological/biochemical bases of browning of raisins during drying due to rains or other adverse climatic conditions to improve raisin quality.
- Change in pruning time of Fantasy Seedless and Crimson Seedless to get coloured off-season grapes in the months of June-July for higher returns through export.
- To initiate activity from coming fruiting season on low temperature drying of grapes collected from Nasik growers. Also develop raisin grapes in Nasik during next season.
- The project on "Post-Harvest Losses in grapes" to be prepared in discussion with Director.

Technical programmes and research achievements were discussed for all the projects. Dr. D.S. Yadav was made new Member Secretary due to transfer of Dr. J. Satisha to ICAR-IIHR, Bengaluru.

Institute Management Committee (IMC) Meeting

Thirty-fifth Institute Management Committee meeting was held on 9th July 2014. Agenda items viz. purchase of equipment during 2014-15, work items to be undertaken during 2014-15, and materials to be purchased under Information Technology were discussed.

Priority Setting, Monitoring and Evaluation (PME) Committee Meeting

Sixth meeting of the Priority Setting, Monitoring and Evaluation Committee was held on 15th April 2014. Revised project proposal 'Analysis and Safety evaluation of agrochemical residues and contaminants in agricultural commodities and processed products' was approved. RPP-III for the project proposals 'Standardization of pre-harvest factors for production of quality red wines' and 'Standardization of techniques for minimization of browning in raisins' were presented. RPP-III for the project proposal 'Standardizing Irrigation Schedule for Cabernet Sauvignon vines raised on 110R rootstock' was evaluated.

RFD Committee Meeting

RFD Committee meeting was held on 1st October 2014 and approved midterm achievements of RFD 2014-15. Subsequently as per the directions received from Headquarters, monthly meetings of RFD committee were held during January, February and March 2015 to discuss and approve the monthly achievements of RFD. A meeting was also held on 21st March 2014 to discuss and approve the first draft of RFD 2015-2016.

Other meetings / workshops

Scientific discussion on 'Potential applications of the GC-MS and LC-MS instruments for various life science experiments'

ICAR - National Referral Laboratory (NRL) at National Research Centre for Grapes is equipped with a range of advanced GC-MS and LC-MS instruments and at present, the application of these instruments are mostly confined in the field of food safety assessment in relation to the residues of pesticides and other food and environmental contaminants. Considering the potential applications of these instruments in the field of agricultural sciences

such as metabolomics, chemical profiling, proteomics, lipidomics etc., a one day scientific discussion on "Potential applications of LC-MS and GC-MS instruments for various life science experiments" was organised on 18th June 2014 to explore the possibility of planning inter-disciplinary research programmes utilising these advanced facilities.

Dr. S.D. Sawant, Director NRCG chaired the session and welcomed the dignitaries including NRCG scientists, research experts from different institutes in Pune. In his introductory remark, Dr. S.D. Sawant stressed the need of collaborative research of multi-disciplinary approach utilising these techniques.

The programme was graced by the presentations of eminent researchers from other institutions, viz. Dr. D.G. Naik, Agharkar Research Institute; Dr. Venkateswaralu Panchagnula and Dr. Mahesh Kulkarni, NCL, Dr. Manoj Pillai, AB Sciex; Dr. Soma Dasgupta, Thermo Scientific and Ms. Leena Thorat, University of Pune in addition to the speakers from ICAR - NRCG viz. Dr. K. Banerjee, Dr. Ahammed Shabeer T.P., Dr. Indu Sawant, Dr. Dasharath Oulkar, Dr. Sagar Utture and Ms. Mayura Nakade. All these presentations deliberated various aspects and current trends of applications of these advance instrumentation techniques in agricultural research especially in the field of metabolomics, proteomics, lipido-proteomics, profiling of aroma compounds, fatty acids, amino acids, etc. and insect behavioural studies.

In the concluding remark Dr. S.D. Sawant urged the scientists of ICAR - NRCG to take active initiatives in developing innovative and collaborative interdisciplinary research in their respective subject of specialization.

Workshop on Neutraceutical Potential of Grapes and Its Utilization

A one day workshop on "Neutraceutical potential of grapes and its utilization" was organised at the ICAR-NRC Grapes on 20th March 2015 to streamline the current research endeavours of the institute in exploring the tenturian varieties of grapes as potential source of nutraceutical products. All the scientists of the institute participated and actively contributed in this one-day workshop. Dr. S.D. Sawant, Director ICAR-NRCG chaired the program, and eminent researchers from other institutions, viz. Dr. S. Walia and Dr. Supradip Saha from the Division of Agricultural Chemicals, IARI, New Delhi, Dr. D.G. Naik, from Chemistry Division, Agharkar Research Institute, Pune and Dr. Pooja Doshi from the Division of Biochemistry, University of Pune deliberated on various approaches and techniques of exploration of the neutraceutical potential of plants and how to develop effective neutraceutical products. It was a highly interactive workshop which enlightened the participants regarding the workflow of purification of natural products, e.g. anthocyanins, flavonoids, etc. from fresh grape berries as well as the by-products of wine industries and their utilization in preparing neutraceutical products. Dr Ahammed Shabeer T.P. and Dr. A.K. Sharma, Scientists from ICAR-NRCG, who are running an institute project on phenolic profiling of grapes and winery waste utilization, updated the participants about the research accomplishments made so far, and it received high appreciation.

In the concluding remark Dr. S.D. Sawant urged the scientists of ICAR-NRCG to take active initiatives in developing innovative and collaborative interdisciplinary research in their respective subject of specialization to facilitate utilization of grapes in developing neutraceutical products and functional foods. The workshop was conceived and coordinated by Dr Kaushik Banerjee.

As a followup to this discussion, Dr. Ahammed Shabeer T.P visited laboratory at IARI and took up work of extraction of anthocyanins from grape variety Medika.

Consultancy, Patents and Commercialisation of Technology

Six consultancy programmes on different aspects of grape cultivation were undertaken for various organizations as detailed below:

Title of the consultancy project	Sponsored by	Consultants	Project Cost Rs.
1. Guiding the grape growers in the crop seminar on grape at Pimpalgaon Baswant, district Nasik	Deepak Fertilisers and Petrochemicals Corporation Ltd	Dr. S.D. Sawant Dr. A.K. Upadhyay Dr. D.S. Yadav	20,226
2. Delivering lecture on 'Grape Vineyard Management' in the seminar at Sangli	Agrowon, Sakal	Dr. S.D. Sawant	67,42
3. Guiding the grape growers in the seminar at Bori and at Sarkalwadi, district Pune	Krishi Vigyan Kendra, Baramati	Dr. S.D. Sawant Dr. A.K. Upadhyay	26,967
4. Guiding the grape growers on grape pest and disease diagnosis and management in the current situation in the Charchasatra organized at Barshi district Solapur	ATMA, Solapur	Dr. R.G. Somkuwar Dr. A.K. Upadhyay Dr. D.S. Yadav	19,101
5. Guiding grape growers on water and nutrient management, disease and insect management in grapes in farmers seminar at Nasik	Maharashtra Chamber of Commerce, Industry and Agriculture	Dr. R.G. Somkuwar Dr. A.K. Upadhyay Dr. S.D. Ramteke	20,226
6. Guiding the grape growers on grape management after October pruning in the grape seminar organized at Pimpalgaon Baswant, district Nasik	Rallis India Limited	Dr. R.G. Somkuwar Dr. A.K. Upadhyay Dr. S.D. Ramteke	20226

Distribution of planting material under Material Transfer Agreement

Under Material Transfer Agreement, 219 cuttings belonging to 48 genotypes were distributed to Division of Fruit Science, ICAR-IARI, New Delhi and 20 cuttings belonging to 4 genotypes to ICAR-IIHR Regional Station, Hirehalli.

Sale of planting material

Approximately 42668 grafted 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, Thompson Seedless, Fantasy Seedless and Crimson Seedless were in demand. Among rootstocks, maximum cuttings of Dogridge were sold.

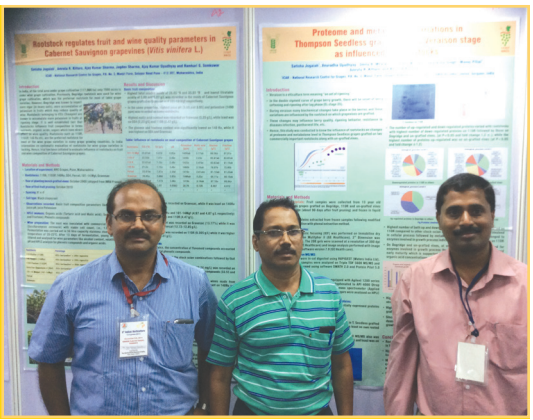
Approved On-Going Institute Programmes

- Conservation, characterization and utilization of grape.
- Genetic improvement of grape.
- Development and refinement of production technologies for enhancing quality, productivity and sustainability in grape.
- Development and refinement of integrated protection technologies in grape.
- Development of pre-and post-harvest technologies for processing of grapes and value addition.
- Food safety in grapes and its processed products.
- Improving knowledge and skill of stakeholders for increasing area, production and quality of grapes and sustaining its productivity.

Flagship Programme

- Decision support system for viticultural operations.

Participation of Scientists In Conferences, Meetings, Workshops, Seminars, Symposia Etc.



International Seminars / Symposia / Conferences

Name of the scientists	Title of Seminars / Symposia / Conferences	Period	Organizer and place
Dr. Indu S. Sawant and Dr. A.K. Sharma	International Symposium on Innovations in Horticulture for Nutritional Security, Conserving Biodiversity and Poverty Alleviation	16-18th Oct. 2014	Babasaheb Bhimrao Ambedkar University, Lucknow
Mrs. Amala U.	International Conference: Changing scenario of pest problems in agri-horti ecosystem and their management'	27-29th Nov. 2014	Entomological Research Association, Udaipur and Department of Entomology, Rajasthan College of Agriculture, MPUAT, Udaipur
Mrs. Amala U.	International Conference on 'Innovative Insect Management Approaches for Sustainable Agro-Ecosystem	27-30th Jan. 2015	Agricultural College and Research Institute (TNAU), Madurai

National Seminars / Symposia / Conferences

Name of the scientists	Title of Seminars / Symposia / Conferences	Period	Organizer and place
Dr S. D. Sawant	Horticulture Conference	19th July 2014	Sakal Media Group and YCMOU, Nashik
Dr S. D. Sawant	Bengaluru International Wine Festival – 2014	25-26th July 2014	Bengaluru
Dr S. D. Sawant	National Seminar-Cum-Exhibition on 'Pomegranate for Nutrition, livelihood Security and Entrepreneurship Development'	7th Dec. 2014	ICAR-NRC on Pomegranate, Solapur

Name of the scientists	Title of Seminars / Symposia / Conferences	Period	Organizer and place
Dr S. D. Sawant	Silver jubilee symposium of NAAS 'Strategic Approaches for Horticulture Research, Education and Development – Way Forward'	26-27th Dec. 2014	NAAS, N. Delhi
Dr S. D. Sawant	National Symposium on Plant Pathology: Disease Diagnosis & Management for Sustainable	28th Jan. 2014	Society for Pesticide Science India, N. Delhi
Dr. Indu S. Sawant and Dr A.K. Sharma	Conference on sustainable solutions in food industry. gave a presentation on 'New grape juice variety, MEDIKA, from ICAR-NRCG' for introducing the variety to the participants from food industry	27th Feb. 2015	Protein Foods & Nutrition Development Association of India, Mumbai
Dr. Indu S. Sawant	National Symposium on Understanding Host-pathogen Interactions Through Science of Omics	16-17th March 2015	Indian Phytopathological Society, New Delhi at IISR, Calicut
Dr. R.G. Somkuwar Dr. Anuradha Upadhyay Dr. A.K. Upadhyay Dr. K. Banerjee Dr. S.D. Ramteke Dr. J. Satisha Dr. A.K. Sharma Dr. Roshni R. Samarth	6th Indian Horticulture Congress 2014	6-9th Nov. 2014	Horticultural society of India and Tamil Nadu Agricultural University (TNAU) at Coimbatore
Dr. K. Banerjee and Dr. Ahammed Shabeer T.P.	National Symposium on Agrochemicals for Food and Environment Safety	28-30th Jan. 2015	Society of Pesticide Science India
Dr. S.D. Ramteke	National Conference of Plant Physiology-2014 on Frontiers of Plant Physiology Research: Food Security and Environmental Challenges	23-25th Nov. 2014	Orissa University of Agriculture & Technology, Bhubaneswar and Indian Society for Plant Physiology, New Delhi
Ms. Anupa T.	National Meet on Distant Hybridization in Horticultural Crop Improvement	22-23rd Jan. 2015	Indian Institute of Horticultural Research, Bengaluru

Workshops / Meetings

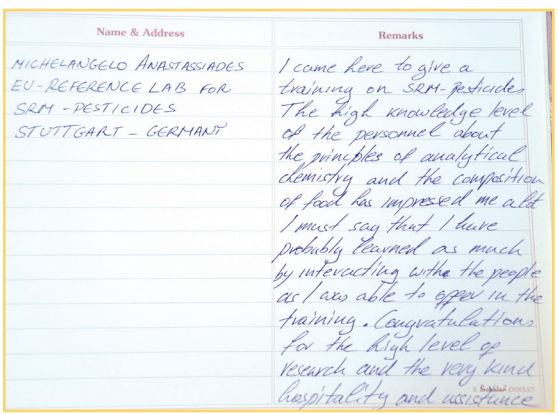
Name of the scientists	Title of workshop / meeting	Period	Organizer and place
Dr. S.D. Sawant	XXIII Meeting of ICAR Regional Committee No. VII	17-18th Oct. 2014	Raipur
Dr S.D. Sawant	Interactive meting of Vice Chancellors of AUs and ICAR Directors	28th April 2014 and 29-30th July 2014	ICAR, New DElhi
Dr S.D. Sawnt	ICAR-DAC Interface Meeting	16th May 2014	Joint Secretary (NHM), New Delhi
Dr S.D. Sawant and Dr Indu S. Sawant	Meeting for Presentation of XII plan EFC	14th July 2014	Secretary, DARE & DG, ICAR, N. Delhi
Dr S.D. Sawant and Dr Indu S. sawant	Meeting for Presentation of Vision 2050	26-27th Nov. 2014	Secretary, DARE & DG, ICAR, N. Delhi
Dr S.D. Sawant	Joint Agrisco meeting of SAUs	12-13th May 2014	BSKKV. Dapoli
Dr S.D. Sawant	H-PGR	30th May 2014	DDG (HS), ICAR at ICAR-IIHR, Bengaluru
Dr S.D. Sawant	Round Table on Agriculture	3rd June 2014	India Agriculture Today group, N. Delhi
Dr S.D. Sawant	Meeting of Sub-Committee on Development of Standards for Alcoholic Beverages including Wine	31st July 2014	FSSAI, New Delhi
Dr S.D. Sawant	Meeting with Dr. Jose Graziano da Silva, Director General, FAO	8th Sep. 2014	N. Delhi
Dr S.D. Sawant	Meeting of Directors of NRC's and Project Coordinator (Fruits)	13th Oct. 2014	DDG(HS), N. Delhi
Dr S.D. Sawant	Discussion with Parliamentary Committee on Agriculture	29th Jan. 2015	Secretary (Agriculture), Govt. of Maharashtra, Mumbai
Dr S.D. Sawant	National Farmers Meet: Farmers, Traders and Researchers	14th March 2015	Horticulture Science Division, ICAR at TNAU, RRS, Paiyur
Dr S.D. Sawant and Dr R.G. Somkuwar	Group Discussion of AICRP on Fruit	26-28th Feb. 2015	Project Coordinator (Fruits), Udaipur
Dr. R.G. Somkuwar	'Rural Programme Advisory Committee' meeting	3rd Sept. 2014.	Aakashwani Kendra, Pune
Dr. Anuradha Upadhyay	Meeting of RFD-Nodal Officers of institutes of Horticultural Science Division	24th Nov. 2014	NASC, Complex, New Delhi under the Chairmanship of Dr. N. K. Krishna Kumar, DDG (Hort.), ICAR.
Dr. Anuradha Upadhyay	Awareness workshop on key issues related to genetically modified (GM) crops	17th Jan. 2015	MPKV Rahuri at YASHDA, Pune
Dr. A.K. Upadhyay	Scientific Advisory Committee meeting	7th June 2014	KVK, Narayangaon

Name of the scientists	Title of workshop / meeting	Period	Organizer and place
Dr. A.K. Upadhyay	Advisory committee meeting of the NFBSFARA (National Fund)	28th June 2014	NAS Complex, New Delhi
Dr. A.K. Upadhyay	Expert Review Workshop of the NFBSFARA (National Fund)	10th Feb. 2015	NAS Complex, New Delhi
Dr. A.K. Upadhyay	Scientific Advisory Committee meeting	25th Feb. 2015	KVK, Narayangaon
Dr. A.K. Upadhyay	Meeting regarding impact of unseasonal rains on grapes and the insurance issues.	12th March 2015	KVK, Narayangaon
Dr. K. Banerjee	Research Advisory Council meeting of ICAR-IIVR, Varanasi as an invitee	Dec. 2014	ICAR-IIVR, Varanasi
Dr. S.D. Ramteke	'Rural Programme Advisory Committee' meeting	2nd Jan. 2015	Aakashwani Kendra, Pune
Dr. J. Satisha	Workshop on 'Priority Setting, Monitoring and Evaluation in National Agricultural Research System: Status, Experiences and Way forward'.	27th May 2014	NAIP and IFPRI at New Delhi
Dr. J. Satisha	Annual Zonal Workshop of KVKs of Zone-V'. Presented the technologies developed at the Centre.	29th Sept. – 1st Oct. 2014	KVK, Baramati.
Dr. A.K. Sharma	Workshop on 'Impact of capacity building programs under NAIP'.	6-7th June 2014.	organized by NAIP and IFPRI at AP Shinde Hall, NASC Complex, New Delhi
Dr. A.K. Sharma	Meeting with Principal Secretary (Industry and Environment), Govt. of Maharashtra, to present details on raisin making and trading.	19th Sept. 2014	ICAR-NRCG, Pune
Dr. A.K. Sharma	Indo-French Workshop on Scientific Cooperation for Agricultural Research	9-12th March 2015	INFRA, ICAR and CEFIPRA at NASC Complex, New Delhi
Dr. A.K. Sharma	Executive Body meeting of IGPB	6th Jan. 2015	at Mumbai
Mrs. Kavita Y. Mundankar	National workshop on launch of project 'Coordinated programme on Horticulture Assessment and Management using geoinformatics (CHAMAN)'.	16th Sept. 2014	Department of Agriculture and Cooperation, at NASC complex, New Delhi.

Visitors

Distinguish visitors

- Dr. G.K. Vasantha Kumar, Special Secretary, Food Processing & Harvest Technology, Govt. of Karnataka visited on 11th April 2014.
- Shri Laxmi Narayan Yadav, Member of Parliament (Lok Sabha) and Member of Second Sub-Committee of the Committee of Parliament on Official Language visited on 15th January 2015.
- A Committee from Shivaji University, Kolhapur visited on 23rd March 2015 for inspection for granting permanent recognition to ICAR-NRC Grapes.
- Dr Michelangelo Anastassiades, EU-Reference lab for SRM- Pesticides, Stuttgart, Germany visted this institute during 30th March – 3rd Aprl 2015.



Name & Address	Remarks
MICHELANGELO ANASTASSIADES EU-REFERENCE LAB FOR SRM-PESTICIDES STUTTGART - GERMANY	I come here to give a training on SRM-pesticides. The high knowledge level of the personnel about the principles of analytical chemistry and the composition of food has impressed me a lot. I must say that I have probably learned as much by interacting with the people as I was able to appear in the training. Congratulations for the high level of research and the very kind hospitality and assistance

Farmers' visits

- Approximately 700 farmers from Karnataka (170), Madhya Pradesh (440), Telangana (35) and Maharashtra (55) visited the Centre during the year. The information on different varieties & cultural practices followed in grape cultivation, and technologies developed was given to them.

Education Tours

- A team of 30 Group-A Trainee Officers in the Department of Agriculture, Govt. of Maharashtra visited NRC Grapes on 21st June 2014. They were given guidance on various aspects of grape cultivation by the Director and Scientists of NRC Grapes in half day sessions.
- About 450 students of different colleges and institutes from Maharashtra (appx 200), Karnataka (210), and Madhya Pradesh (38) visited the Centre while on their educational tour. They were apprised about laboratory facilities, vineyards and ongoing research activities.

Personnel

RMP

1. Dr. S.D. Sawant, Director

Scientific

2. Dr. Indu. S. Sawant, Principal Scientist (Plant Pathology)
3. Dr. R.G. Somkuwar, Principal Scientist (Horticulture)
4. Dr. Anuradha Upadhyay, Principal Scientist (Biotechnology)
5. Dr. A.K. Upadhyay, Principal Scientist (Soil Science)
6. Dr. K. Banerjee, Principal Scientist (Agricultural Chemistry)
7. Dr. S.D. Ramteke, Principal Scientist (Plant Physiology)
8. Dr. J. Sharma, Principal Scientist (Soil Science) (till 15.05.2014)
9. Dr. J. Satisha, Principal Scientist (Horticulture) (till 30.11.2014)
10. Dr. A.K. Sharma, Senior Scientist (Horticulture)
11. Mrs. Kavita Y. Mundankar, Scientist (Computer Applications in Agriculture)
12. Dr. D.S. Yadav, Scientist (Entomology)
13. Dr. Roshni R. Samarth, Scientist (Plant Breeding)
14. Dr. Ahammed Shabeer T.P., Scientist (Agricultural Chemistry)
15. Mrs. Amala U., Scientist (Entomology)
16. Ms. Anupa T., Scientist (Fruit Science) (w.e.f. 08.04.2014)

Technical

17. Mr. U.N. Borse, Technical Officer
18. Mr. P.B. Jadhav, Senior Technical Assistant
19. Mr. B.B. Khade, Senior Technical Assistant
20. Ms. Shailaja V. Satam, Senior Technical Assistant
21. Mr. B.J. Phalke, Senior Technical Assistant
22. Mr. S.S. Bhoite, Technical Assistant
23. Mr. E.G. Kamble, Senior Technician

Administrative

24. Mr. S.N. Salve, Administrative Officer
25. Mr. O. Babu, Assistant Administrative Officer
26. Mr. Munish N. Ganti, Assistant Finance and Accounts Officer
27. Mr. B.M. Chavan, Private Secretary
28. Mr. K. Ali, Assistant
29. Mr. N.S. Pathan, Assistant
30. Mrs. Anita Mathew, Assistant (till 20.01.2015)
31. Ms. Pallavi K. Tated, Assistant
32. Mr. P.P. Kalbhor, UDC
33. Mr. V.D. Gaikwad, , UDC

Skill Supporting Staff

34. Mr. S.S. Donde, Skilled Supporting Staff
35. Mr. K.G. Raskar, Skilled Supporting Staff
36. Mr. B.R. Chakankar, Skilled Supporting Staff
37. Mr. S.V. Lendhe, Skilled Supporting Staff
38. Ms. Lata Pawar, Skilled Supporting Staff
39. Mr. N.K. Najan, Skilled Supporting Staff
40. Mr. K.K. Kale, Skilled Supporting Staff

Infrastructure Development

Laboratory

- Equipments like Soil penetrometer, PCR work station, Fume hood, Laminar air flow, Cultural rack and trolley, Centrifuge, Digital CCD camera for stereo binocular microscope, Software for Leica CCD Camera, Deep freezers, Refrigerated Shelf, Electronic balances, Air oven, pH meters, Liquid nitrogen tanks, Deep freezer cum refrigerators, Stabilizers and accessories for lyophylizer and fermenter were procured and installed during the year under XII plan fund.
- Internet access bandwidth was upgraded from 4 mbps to 10 mbps. ArcGIS, software for GIS based applications was procured. Licenses for MS office 2013 pro plus, Windows Server client access, Quickheal Total Security Antivirus, EndNote X7 were procured. Security bundle license for Watchguard XTM 505 was renewed for next three years.
- Facility of video conferencing is established between KVK, Baramati and ICAR-NRCG, Pune. Using this facility, scientists will be able to interact with grape growers in that area frequently.

Farm

- 45 HP compact tractor 'Kubota L4508' suitable for using heavy duty sprayers and implements and Martgani sprayer with adjustable volume and optional ESS facility were procured for use in experimental vineyards.
- Battery operated pruning machines, cane training machine and cane shredder were procured for easy mechanization in grape vineyard.
- Imported cane crusher as an attachment to tractor is procured. The equipment is useful to easy harvest of green manuring crops and recycling of pruning waste. 45 HP tractor is required to run this equipment.

New Structures

Guest House with 6 rooms was furnished and opened for guests.

Library

Forty Hindi and eight English books were added to the library. Besides access of journals through CeRA, four Indian journals were subscribed for the benefit of scientists and other staff.

Other Activities

राजभाषा कार्यकलाप

हिन्दी चेतना मास

केंद्र में दिनांक 16 सितंबर से 13 अक्तूबर, 2014 तक हिन्दी चेतना मास का आयोजन हुआ था। इस दौरान कविता पाठ, हिन्दी निबंध लेखन, व्याकरण एवं पत्रलेखन, प्रश्नोत्तरी, वाद- विवाद, कम्प्युटर पर हिन्दी टंकण आदि प्रतियोगिताओं का आयोजन किया गया था। इस अवसर पर मुख्य आतिथि के रूप में श्री. शशिपाल सिंह, वरिष्ठ तकनीकी अधिकारी (सी-डैक) को आमंत्रित किया गया था। निदेशक महोदय द्वारा मुख्य आतिथि का स्वागत किया गया।

प्रतियोगिताओं में सभी कर्मचारियों ने उत्साह के साथ भाग लिया। विजेताओं को नकद पुरस्कार दिया गया। वर्ष 2014-15 में अधिक से अधिक कार्यालयीन कामकाज हिन्दी में करनेवाले अधिकारी और कर्मचारियों की सराहना की गई।

कार्यालय में नियमित रूप से प्रयोग किए जानेवाले सभी प्रपत्र द्विभाषी होने पर संतोष व्यक्त किया गया तथा वित्त एवं लेखा अनुभाग और बिल अनुभाग द्वारा राजभाषा में किए जा रहे कार्यों की सराहना की गई। कार्यालयीन कामकाज में हिन्दी भाषा की कठिनाइयों पर सुझाव तथा दैनिक कामकाज में राजभाषा के प्रयोग का अनुरोध किया गया। श्री. एन. एस. पठाण, श्री. वी. डी. गायकवाड, कु. शैलजा साटम, श्रीमती. लता पवार और श्री. एस.एस. दोंदे आदि कर्मचारियों को हिन्दी में किए गए कार्य के लिए विशेष पुरस्कार दिया गया।

डॉ. ए. के. शर्मा , वरिष्ठ वैज्ञानिक ने सभी अधिकारी और कर्मचारियों के प्रति धन्यवाद ज्ञापन के साथ हार्दिक आभार प्रकट किया। समापन समारोह के कार्यक्रम का संचालन डॉ. अनुराधा उपाध्याय, प्रधान वैज्ञानिक द्वारा किया गया।

हिन्दी कार्यशाला

वर्ष 2014-15 के दौरान दिनांक 13/10/2014, 24/12/2014 और 09/01/2015 को हिन्दी कार्यशालाओं का आयोजन किया गया था। पहली कार्यशाला में सी डैक के तकनीकी अधिकारी श्री शशिपाल सिंह और उनके सायिों ने मंत्रा राजभाषा, लीला राजभाषा, श्रुतलेखन राजभाषा और प्रवाचक राजभाषा पर जानकारी दी। अन्य दो कार्यशाला में हिन्दी शिक्षण योजना, पुणे में सहायक निदेशक, श्री राजेंद्र वर्मा ने संसदीय राजभाषा समिति की प्रश्नावली भरने के संबंध में, तिमाही रिपोर्ट ऑनलाइन भरने के संबंध और राजभाषा विभाग की साइट पर अकाउंट खोलने आदि के लिए प्रशिक्षण दिया।

तिमाही बैठक तथा प्रतिवेदन

केंद्र में नियमित रूप से तीन महीने के अंतराल पर दिनांक 30/06/2014, 06.09.2014, 19/12/2014, 14/01/2015 और 25/02/2015 को बैठकें हुई। बैठकों का तिमाही प्रतिवेदन परिषद के राजभाषा अनुभाग को प्रस्तुत किया गया।

वैबसाइट का द्विभाषी करण

संस्थान की वैबसाइट का हिन्दी रूपान्तरण किया गया। वैबसाइट पर अंगूर से संबंधित जानकारी हिन्दी और अँग्रेजी के अलावा मराठी में भी उपलब्ध कराई गई।

पत्राचार

इस वर्ष कुल 2257 पत्र हिन्दी या द्विभाषी जारी किए गए जो कुल पत्रों का 57% था। 'क' क्षेत्र को 70%, 'ख' क्षेत्र को 52% और 'ग' क्षेत्र को 54% पत्राचार हिन्दी या द्विभाषी था।

संसदीय राजभाषा समिति की दूसरी उप समिति द्वारा निरीक्षण

संसदीय राजभाषा समिति की दूसरी उप समिति ने दिनांक 15/01/2015 को पुणे के सन एण्ड सैंड होटल में हुई बैठक में केंद्र के राजभाषा संबंधी प्रगति का निरीक्षण किया और प्रगति को संतोष जनक पाया। राजभाषा कार्यान्वयन में सुधार के लिए बहुमूल्य सुझाव दिए।

Women's Complaint Committee

A meeting of Women's Complaint Committee was held on 27/03/2015 under the Chairmanship of Dr. Indu S. Sawant, Pr. Scientist to review complaints regarding sexual harassment of women at the work place. No complaints were received by the committee regarding sexual harassment.

CPP portal

ePublishing accounts were created for ePublishing of and creation of tender documents through Central Public Procurement Portal (CPP Portal) of Government of India.

Minimum Government Maximum Governess

Purchase procedures for purchase of low cost (up to Rs. 15000/-) items was simplified to reduce paper work while following all prescribed purchase procedures.

Mera Gaon Mera Gaurav

The Centre has identified Walva village in Sangli district for implementation of 'Mera Gaon Mera Guarav'. The first meeting of ICAR-NRCG scientist and farmers of the village is conducted on 21st March 2015.

Swach Bharat Mission

- All permanent and temporary staff participated in Swach Bharat Mission and cleaned the laboratory premises.
- The staff of the Centre cleaned and planted trees in the campus adjoining National Referral Laboratory on 26th January 2015.
- An initiative has been taken up to separate biodegradable and non degradable waste. Biodegradable waste is subjected to composting and the composted material is used for farm management. Areas have been marked for disposing off different types of wastes like paper, broken glass wares and chemicals.

Personnel

New Joining

Ms. Anupa T., Scientist (Fruit Science) joined on 08.04.2014.

Transfer

Dr. J. Sharma, Principal Scientist (Soil Science) was transferred to Regional Station, Indian Agricultural Research Institute, Shimla on 15.05.2014.

Dr. J. Satisha, Principal Scientist (Horticulture) was transferred to ICAR-IIHR, Bengaluru on 29.11.2014.

Obituary

Mrs. Anitha Mathew, Assistant passed away on 20.01.2015 after a long struggle with cancer. She started her career as Lower Divisonal Clerk at this Institute on 11.09.1997. She is survived by her husband and a daughter. May her soul rest in peace.

Celebrations

Independence Day

Independence Day was celebrated at the Centre on 15th August 2014 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 Awareness Week

Vigilance awareness week was observed during 27th October to 1st November 2014 wherein participants were made aware about efforts to prevent corruption and malpractices in the office. An essay competition was also organised in which all the staff participated enthusiastically. Additional D.C.P./S.P., Anti-Corruption Bureau Mr. Dilip V. Kadam along with his team participated in the programme as the Chief Guest and delivered a lecture on 'Combating corruption – technology as an enabler'.

Road Safety week

Road Safety Week was organized at the Centre during 11-17th January 2015. During the week, various posters and slogans were displayed in the premises to bring awareness about importance of traffic rules among staff and their family members. On concluding day, a competition on traffic signs and rules was held for the staff members. Mr K.G. raskar and Mr Prasad Navale were the winners of this completion. Sh. Vijay Ingawale, Senior Inspector, RTO, Pune was invited to educate the staff and he presented different aspects of road safety.

Rashtriya Ekta Diwas

139th birth anniversary of Sardar Vallabhbhai Patel' observed as 'Rashtriya Ekta Diwas' was (National Unity Day) on 31st October 2014.

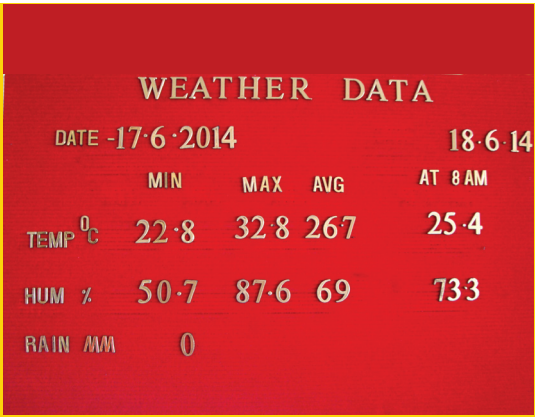
Birth anniversary of Dr. G.S. Cheema

120th birth anniversary of Dr. G.S. Cheema celebrated at this Centre on 2nd August 2014.

Republic day

Republic day was celebrated on 26th January, 2015. Dr. S.D. Sawant, Director hoisted the flag and addressed the staff members and their families. A tree plantation programme was also held and perennial fruit trees were planted in the surrounding of NRL building.

Meteorological Data



Year and Month	Air temperature (°C)		Relative humidity (%)		Pan evapo-ration (mm)	Solar ra-diation Dgt (W/m²)	Total rainfall (mm)	No. of rainy days
	Min.	Max.	Min.	Max.				
Apr 2014	18.2	39.4	14.5	73.4	7.1	255.2	7.8	2
May 2014	22.9	38.7	22.2	73.5	7.1	249.4	9.4	2
Jun 2014	23.7	35.3	41.1	81.3	6.5	235.1	20.8	6
Jul 2014	22.8	30.4	60.2	88.3	2.9	160.8	163.6	23
Aug 2014	21.4	31.0	62.8	95.9	1.2	180.5	202.0	27
Sep 2014	20.1	32.0	54.1	95.3	2.8	201.5	34.6	16
Oct 2014	17.5	33.2	80.5	82.7	4.1	208.1	25.8	12
Nov 2014	15.4	30.4	36.4	92.4	3.8	Not available	44.0	1
Dec 2014	8.3	30.7	32.9	97.3	3.0	173.2	2.2	3
Jan 2015	8.2	31.6	28.9	94.8	3.3	166.4	0.2	1
Feb 2015	9.7	35.8	16.9	85.6	4.4	185.6	20.8	1
Mar 2015	14.0	38.6	24.0	94.9	5.7	244.5	47.8	8
Total	--	--	--	--	--	--	**579.0**	--

Source: Weather station, NRC for Grapes, Pune

ABBREVIATIONS

1. ABA: Abscissic Acid
2. AICRP: All India Coordinated Research Project
3. AKMU: Agricultural Knowledge Management Unit
4. AMAAS: Application of Microorganisms in Agriculture and Allied Sector
5. AOAC: Association of Official Analytical Chemist
6. APEDA: Agricultural and Processed Food Products Export Development Authority
7. AUDPC : Area Under Disease Progress Curve
8. BRNS- BARC: Board of Research in Nuclear Sciences-Bhabha Atomic Research Centre
9. CCC: Chlormequat Chloride
10. CEFIPRA: Indo French Centre for the Promotion of Advanced Research
11. CFT BVDU: Centre for Food Testing, Bharati Vidyapeeth Deemed University
12. CHAMAN: Coordinated programme on Horticulture Assessment and Management using geoinformatics
13. CIB & RC: Central Insecticides Board and Registration Committee
14. CITD: Capacity Building Initiative for Trade Development in India
15. CoI: Cytochrome Oxidase1
16. CPPU: N-(2-chloro-4-pyridyl)-N'-phenyl urea
17. Cq: Quantification Cycle
18. DAP: Day After Pruning
19. DARE: Department of Agricultural Research and Education
20. DBT: Department of Biotechnology
21. DDG: Deputy Director General
22. DEP: Differentially Expressed Protein
23. DG-SANCO: Directorate-General for Health and Consumers
24. DMI: Demethylation Inhibitors
25. DRD: double the recommended dose
26. DUS: Distinctness Uniformity and Stability
27. EIC: Export Inspection Council
28. FRAP: Ferric Reducing Antioxidant Power
29. FSSR: Food Safety and Standard Rules
30. FYM: FarmYard Manure
31. GA_3: Gibberellic Acid
32. GAP: Good Agricultural Practices
33. GC-MS/MS: Gas Chromatography-Mass Spectrometry/ Mass Spectrometry
34. GO: Gene Ontology
35. HAU: Haryana Agricultural University
36. HPLC: High Pressure Liquid Chromatography
37. HYPM: Half-yearly Progress Monitoring System of Scientists
38. IAA: Indole Acetic Acid
39. IARI: Indian Agricultural Research Institute
40. IBA: Indole Butyric Acid
41. IC number: Indigenous Collection number
42. ICAR: Indian Council of Agricultural Research
43. IFPRI: Indo French Centre for the Promotion of Advanced Research (IFCPAR)
44. IGPB: Indian Grape Processing Board
45. IIHR: Indian Institute of Horticultural Research
46. IISR: Indian Institute of Spices Research
47. IIVR: Indian Institute of Vegetables Research
48. IJSC: Institute Joint Staff Council
49. IMC: Institute Management Committee
50. IMD: India Meteorological Department
51. INRA: Institut National de Recherche Agronomique
52. IRC: Institute Research Committee
53. ISRO: Indian Space Research Organization
54. ITMU: Institute Technology Management Unit
55. IUPAC: International Union of Pure and Applied Chemistry
56. JRF: Junior Research Fellow
57. KVK: Krishi Vigyan Kendra

58. LC-MS/MS: Liquid Chromatography-Tandem Mass Spectrometry
59. LSD: Least Square Difference
60. MIS-FMS: Management Information System-Financial Management System
61. MPKV: Mahatma Phule Krishi Vidyapeeth
62. MPOB: Malaysian Palm Oil Board
63. MPUAT: Maharana Pratap University of Agriculture and Technology
64. MRDBS: Maharashtra Rajya Draksh Bagayatdaar Sangh
65. MRL: Maximum Residue Limit
66. NAARM: National Academy of Agricultural Research Management
67. NAAS: National Academy of Agricultural Sciences
68. NADP-RKVY: National Agriculture Development Programme-Rashtriya Krishi Vikas Yojana
69. NAIP: National Agricultural Innovation Project
70. NASC: National Agricultural Science Centre
71. NBAII: National Bureau of Agriculturally Important Insects
72. NBPGR: National Bureau of Plant Genetic Resources
73. NCBI: National Centre for Biotechnology Information
74. NCIPM: National Centre for Integrated Pest Management
75. NCL: National Chemical Laboratory
76. NCMSL: National Collateral Management Services Limited
77. NDRI: National Dairy Research Institute
78. NEH: North Eastern Hills
79. NFBSRA: National Fund for Basic and Strategic Research in Agriculture
80. NHB: National Horticulture Board
81. NHRDF: National Horticulture Research and Development Foundation
82. NIPHM: National Institute of Plant Health Management
83. NRL: National Referral Laboratory
84. NRSC: National Remote Sensing Centre
85. PAC: Program Advisory Committee
86. PDI: Per cent Disease Index
87. PF: Processing Factor
88. PHI: Pre-Harvest Interval
89. PME: Priority Setting, Monitoring and Evaluation
90. POD: Peroxidase
91. PPO: Polyphenol Oxidase
92. PPV&FR: Protection of Plant Variety & Farmer's Rights
93. PRD: Partial rootzone drying
94. PT: Proficiency Test
95. PVC: Polyvinyl Chloride
96. QoI: Quinone Outside Inhibitors
97. QRT: Quinquennial Review Team
98. QTL: Quantitative Trait Loci
99. RAC: Research Advisory Committee
100. RD: recommended dose
101. RFD: Results Framework Document
102. RMP: Residue Monitoring Plan
103. RPP: Research Project Proposal
104. RSD: Relative Standard Deviaton
105. SAU: State Agricultural University
106. SBA: Society for Biocontrol Advancement
107. SC: Soluble Concentrate
108. SPE-tD: Solid Phase Extraction-thermal Desorption
109. SRF: Senior Research Fellow
110. TD: Thermal Desorption
111. TNAU: Tamil Nadu Agricultural University
112. TOF: Time of Flight
113. TSP: Tribal Sub-Plan
114. TSS: Total Soluble Solids
115. UAS: University of Agricultural Sciences
116. USDA: United States Department of Agriculture
117. VSI: Vasantdada Sugar Institute
118. WAC: Water Absorbing Capacity
119. WCC: Women's Complaint Committee
120. WG: Wettable Granule
121. WGPP: Wine Grape Pomace Powder
122. WUE: Water Use Efficiency

Results-Framework Document (RFD)

for

National Research Centre for Grapes (ICAR)

2013-2014

Address
P.B. No. 3. Manjri Farm, Solapur Road
Pune – 412 307, Maharashtra
Website: http://nrcgrapes.nic.in

Section 1 : Vision, Mission, Objectives and Functions

Vision

Harnessing viticulture and enology science to ensure comprehensive and sustained grape production through crop improvement, assessment, refinement and adoption of most appropriate and precisive technologies in grape production and value addition thereby increasing net returns to grape growers and all the stakeholders involved in the industry.

Mission

To undertake the programs involving basic and strategic research for resolving the major biotic and abiotic constraints affecting the grape production, productivity and its quality and to have sustained productivity and promote diversification to wine production and other value added products

Objectives

1. Improving grape productivity, fruit quality and value addition
2. Transfer of technology

Functions

To attend to issues relating to all aspects of viticulture and enology research, education and extension at national and international level through collaborations in research involving improvement, production, protection and post-harvest technology, training and dissemination of developed technologies to stake holders for increasing production and productivity of grapes.

Section 2 : Inter se priorities among key objectives, success indicators and targets

Sl. No.	Objectives	Weight	Actions	Success Indicators	Unit	Weight	Target/Criteria Value				
							Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%
1.	Improving grape productivity, fruit quality and value addition.	62	Collection, conservation and characterization of Germplasm	Germplasm added/characterized	Number	6	10	9	8	7	5
			Breeding of varieties for good traits and tolerance to biotic and abiotic stress	Varieties, Hybrids and clones developed / evaluated / under process of development and evaluation	Number	6	5	4	3	2	1
			Production of Elite, true to type and virus free planting material	Cuttings and grafts distributed	Number	14	40000	36000	32000	28000	24000
			Development of production and protection technologies	Improved production technologies developed or in process	Number	18	5	4	3	2	1
			Measures of food safety	Samples analyzed for monitoring pesticide residue and protocols developed	Number	15	300	270	240	210	180

Sl. No.	Objectives	Weight	Actions	Success Indicators	Unit	Weight	Target/Criteria Value				
							Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%
2.	Transfer of technology	27	Effective dissemination of scientific and technical know how	Field visits, seminars, trainings organized	Number	17	25	22	20	18	16
				Web based advisory services for pests and diseases	Number	10	45	41	36	31	27
	* Efficient functioning of RFD System	3	Timely submission of Draft RFD (2013-14) for approval	On-time submission	Date	2	15/05/2013	16/05/2013	17/05/2013	20/05/2013	21/05/2013
			Timely submission of Results for RFD (2012-13)	On-time submission	Date	1	01/05/2013	02/05/2013	05/05/2013	06/05/2013	07/05/2013
	*Administrative Reforms	4	Implement ISO 9001 as per the approved action plan	% Implementation	%	2	100	95	90	85	80
			Prepare an action plan for Innovation	On-time submission	Date	2	30/07/2013	10/08/2013	20/08/2013	30/08/2013	10/09/2013
	*Improving internal efficiency / responsiveness / service delivery of Ministry / Department	4	Implementation of Sevottam	Independent Audit of Implementation of Citizen's Charter	%	2	100	95	90	42. 85	43. 80
				Independent Audit of implementation of public grievance redressal system	%	2	100	95	90	50. 85	51. 80

*Mandatory Objective (s)

Section 3 : Trend values of the success indicators

Sl. No.	Objectives	Actions	Success Indicators	Unit	Actual value for FY 11/12	Actual Value for FY 12/13	Target Value for FY 13/14	Projected Value for FY 14/15	Projected Value for FY 15/16
1.	Improving grape productivity, fruit quality and value addition.	Collection, conservation and characterization of Germplasm	Germplasm added/ characterized	Number	8	8	9	10	11
		Breeding of varieties for good traits and tolerance to biotic and abiotic stress	Varieties, Hybrids and clones developed / evaluated / under process of development and evaluation	Number	3	4	4	5	5
		Production of Elite, true to type and virus free planting material	Cuttings and grafts distributed	Number	30000	33000	36000	38000	40000
		Development of production and protection technologies	Improved production technologies developed or in process	Number	3	3	4	4	5
		Postharvest technology and value addition	Number of postharvest technologies developed or under process of development	Number	2	2	2	3	3
		Measures of food safety	Samples analyzed for monitoring pesticide residue and protocols developed	Number	250	260	270	300	320

Sl. No.	Objectives	Actions	Success Indicators	Unit	Actual value for FY 11/12	Actual Value for FY 12/13	Target Value for FY 13/14	Projected Value for FY 14/15	Projected Value for FY 15/16
2.	Transfer of technology	Effective dissemination of scientific and technical know how	Field visits, seminars, trainings organized	Number	20	22	22	28	30
			Web based advisory services for pests and diseases	Number	30	35	41	43	45
	* Efficient functioning of RFD System	Timely submission of Draft RFD (2013-14) for approval	On-time submission	Date	--	--	16/05/2013	--	--
		Timely submission of Results for RFD (2012-13)	On-time submission	Date	--	--	02/05/2013	--	--
	*Administrative Reforms	Implement ISO 9001 as per the approved action plan	% Implementation	%		--	95	--	--
		Prepare an action plan for Innovation	On time submission	Date	--	--	10/08/2013	--	--
	*Improving internal efficiency / responsiveness / service delivery of Ministry / Department	Implementation of Sevottam	Independent Audit of Implementation of Citizen's Charter	%	--	--	95	--	--
			Independent Audit of implementation of public grievance redressal system	%	--	--	95	--	--

Section 4 : Acronyms

Sl. No.	Acronym	Description
1	INM	Integrated Nutrient Management
2	IPM	Integrated Pest Management

Section 4 : Description and definition of success indicators and proposed measurement methodology

Sl. No.	Success indicator	Description	Definition	Measurement	General Comments
1	Germplasm added/characterized	Germplasm are genetic resources of grapes which are source of genetic variability	Germplasm is collection of all cultivars, wild species etc for conservation and utilization	Number of accessions added/characterized	--
2	Varieties, Hybrids and clones developed / evaluated /under process of development and evaluation	Source materials for improved varieties to be evaluated	Best performing varieties will be identified for their evaluation before release	Number of varieties, hybrids, clones developed or under process of development	--
3	Cuttings and grafts distributed	Production of planting material through cuttings/grafting	It is an asexual method of propagation by which new planting material is produced without production of seeds.	Number	In grapes, planting material mainly consists of rooted cuttings of rootstocks and bench grafts.
4	Improved production technologies developed or in process	Developing production technologies to improve input use efficiency and increase Benefit: cost ratio of growers	Input use efficiency refers to judicious use of agricultural inputs to increase grape production per unit of inputs used.	Developing irrigation schedules, INM, IPM schedules etc.	Improving water, nutrient and pesticide use efficiency is most important factor to reduce cost of production in grapes.
5	Number of postharvest technologies developed or under process of development	New technologies to carry out a process of raisin, wine and juice making.	Development of new technologies to improve production of quality raisins, wine and juice.	Number of technologies and quality of end product	There is a need to develop advanced technologies for processing of grapes into value added products.
6	Samples analyzed for monitoring pesticide residue and protocols developed	New methodology development for analysis of more number of agrochemical residues in grapes and its processed products	Pesticide residue refers to the pesticides that may remain on or in food after they are applied to food crops.	Number of methodologies developed and samples analysed for monitoring pesticide residues	Monitoring pesticide residues is highly essential for both export and domestic markets with respect to food safety issues
7	Field visits, seminars, trainings organized	Capacity building activities to improve knowledge and skill of grape growers, extension workers etc.	Training is a process of acquiring new skill, attitude and knowledge through various means	Number	--

Section 4 : Description and definition of success indicators and proposed measurement methodology

Sl. No.	Success indicator	Description	Definition	Measurement	General Comments
8	Web based advisory services for pests and diseases	Prophylactic spray of pesticides based on weather advisory services will reduce pesticide application and reduce cost	Web based advisory service is an advice given to growers based on the weather forecasting and possibility of occurrence of pests and diseases	Number of weekly advices given	Improve pesticide use efficiency and reduce cost of production in grapes.

Section 5 : Specific performance requirements from other Departments

Location Type	State	Organisation Type	Organisation Name	Relevant Success Indicator	What is your requirement from this organisation	Justification for this requirement	Please quantify your requirement from this Organisation	What happens if your requirement is not met.
	Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Punjab, Madhya Pradesh, Mizoram etc	State Departments, Grape growers Associations, Individual grape growers	Department of Horticulture, Grape Growers Associations etc	Cuttings and grafts distributed	Indent for planting material of grapes.	Indents given	Number of planting material will be produced as per the indent	Less or more number of planting materials will be produced.

Section 6 : Outcome/Impact of activities of Organisation/ Ministry

Sl. No.	Outcome/ Impact of organisation /RCs	Jointly responsible for influencing this outcome/impact with the following organisation(s)/ departments/ ministry(s)	Success Indicators	Unit	2011-12	2012-13	2013-14	2014-15	2015-16
1.	Production of quality seed and planting materials of grapes, development of improved varieties and technologies to increase production of grapes.	Grape growers association/ state department of horticultures/national horticulture mission/ grape processing board etc.	Distribution of planting materials	Number	30000	33000	36000	38000	40000
			Awareness of stakeholders & capacity building through training/ seminars/field visits	Percent	65	70	85	80	80

Performance Evaluation Report

Sl. No.	Objectives	Weight	Action (s)	Success Indicators	Unit	Weight	Target / Criteria Value					Achievements	Performance	
							Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%		Raw score	Weighted score
1	Improving grape productivity, fruit quality and value addition.	62	Collection, conservation and characterization of Germplasm	Germplasm added/ characterized	No.	6	10	9	8	7	5	9	90	5.4
			Breeding of varieties for good traits and tolerance to biotic and abiotic stress	Varieties, Hybrids and clones developed / evaluated /under process of development and evaluation	No.	6	5	4	3	2	1	7	100	6
			Production of Elite, true to type and virus free planting material	Cuttings and grafts distributed	No.	14	40000	36000	32000	28000	24000	42068	100	14
			Development of production and protection technologies	Improved production technologies developed or in process	No.	18	5	4	3	2	1	4	90	16.2
			Postharvest technology and value addition	Number of postharvest technologies developed or under process of development	No.	3	3	2	1	-	-	3	100	3

Sl. No.	Objectives	Weight	Action (s)	Success Indicators	Unit	Weight	Target / Criteria Value					Achievements	Performance	
							Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%		Raw score	Weighted score
2	Transfer of technology	27	Effective dissemination of scientific and technical know how	Field visits, seminars, trainings organized	No.	17	25	22	20	18	16	42	100	17
				Web based advisory services for pests and diseases	No.	10	45	41	36	31	27	41	90	9
	*Efficient functioning of RFD System	3	Timely submission of Draft RFD (2013-14) for approval	On-time submission	Date	2	15/05/2013	16/05/2013	17/05/2013	20/05/2013	21/05/2013	08/05/2013	100	2
			Timely submission of Results for RFD (2012-13)	On-time submission	Date	1	01/05/2013	02/05/2013	05/05/2013	06/05/2013	07/05/2013	30/04/2013	100	1
	*Administrative Reforms	4	Implement ISO 9001 as per the approved action plan	% Implementation	%	2	100	95	90	85	80	0	0	0
			Prepare an action plan for Innovation	On time submission	Date	2	30/07/2013	10/08/2013	20/08/2013	30/08/2013	10/09/2013	30/07/2013	100	2

Sl. No.	Objectives	Weight	Action (s)	Success Indicators	Unit	Weight	Target / Criteria Value					Achievements	Performance	
							Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%		Raw score	Weighted score
	*Improving Internal Efficiency / responsiveness / service delivery of Ministry / Department	4	Implementation of Sevottam	Independent Audit of Implementation of Citizen's Charter	%	2	100	95	90	85	80	100	100	2
				Independent Audit of implementation of public grievance redressal system	%	2	100	95	90	85	80	100	100	2
Total composite score														**94.60**

*Mandatory objective

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