वार्षिक प्रतिवेदन | Annual Report 2009-10

राष्ट्रीय अंगूर अनुसंधान केन्द्र

(भारतीय कृषि अनुसंधान परिषद)

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Correct Citation :
Annual Report 2009-10
National Research Centre for Grapes
Manjri Farm P.O., Solapur Road
Pune - 412 307, India

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Printed at : Flamingo Business Systems, Pune. Telefax : 020-24214636

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Preface

There is a continuous and steady growth of grape industry in India, which has reflected in increase in area and production. At present the area under this crop is 82,000 hectares and production is about 1.8 million tonnes. Wine industry, which received shock due to slow economy globally, is now restoring back to its normal position and being expanded in states of Karnataka, Andhra Pradesh apart from Maharashtra. Making raisins from table grapes is an important processing industry and being updated for quality production to enter into export market. Export of table grapes to EU market has reached to peak level this year. However, detection of plant growth regulator in this produce is receiving attention for further sustained growth. All these developments have also called for the production of quality plant material for both table and wine grapes whenever there is area expansion for new plantation. In order to have optimum and quality production with its sustenance and competitive price, precise and cost effective technology in terms of all agri inputs is an important component. Keeping all this in view, the infrastructure was further strengthened and developed both in laboratories and on the experimental vineyards farm. The facilities developed during this period include laboratory equipments viz. Atomic Adsorption Spectrometer and Cold Centrifuge and farm structures viz. modernization of polyhouse structure, etc.

The Institute is continuously progressing by introducing and commissioning most modern equipments to do research in viticulture and enology. For this purpose, we were fortunate enough to continue the support of APEDA, DBT and BARC in the area of food safety and improvement in crop varieties and rootstocks. The grey areas based on the work in the past in crop improvement, crop production, crop protection and post-harvest technology were addressed critically during the period.

During this period, technical work of grape crop in All India Coordinated Research Project on Subtropical Fruits with Central Institute of Subtropical Horticulture (CISH), Lucknow was also supervised and guided from time to time. The work reports were deliberated in the XIXth Group Workers Meeting held on 14-17th December 2009 at Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra.

Institute organized various training programmes at the campus and off the campus to transfer various techniques developed during the period and also participated in programmes organized by extension departments of various State Governments and the Grape Growers' Associations and exporters and guided their trainees and members respectively in various areas of viticulture.

Scientists were deputed to participate in the 2nd Latin American Pesticide Residue Workshop 'Food and Environment' during 6-19th June 2009 and to present a lead technical paper on 'Monitoring of pesticides in Indian table grapes'. One Scientist attended three months training programme on 'Fermentation technology in horticulture (winemaking)' during 1st October to 31st December 2009 at Research Centre Geisenheim (Forschungsanstalt Geisenheim), Germany. Few Scientists were also deputed within country to undergo training / study visits in high technology areas.

Revenue of Rs. 38.10 Lakhs was generated against the target of Rs. 37.95 Lakhs through training, consultancy, contract research and services, sale of planting material and farm produce.

With the limited manpower, the Institute has made all efforts to fulfill the aspirations of the various stakeholders of grape industry in the country. For all this success, the credit goes to the scientific, technical, administrative and supporting staff of the Institute besides the backup support from the Headquarters office at New Delhi.

I would like to place on record the guidance and the encouragement received from Dr. Mangala Rai, Former Secretary, DARE and Director General, ICAR; Dr. S. Ayyappan, new Secretary, DARE and Director General, ICAR and Dr. H. P. Singh, Dy. Director Genera, ICAR. I also appreciate the efforts and help received from my scientific and technical staff members in the preparation of this important document.

Place : Pune
Date : 14th July 2010

(P. G. ADSULE)
Director

कार्यकारी सारांश

राष्ट्रीय अंगूर अनुसंधान केन्द्र की स्थापना वर्ष 1997 में हुई । भारत में अंगूर उत्पादन और प्रसंस्करण से सम्बन्धित विभिन्न मुद्दों पर लक्ष्य निर्धारित अनुसंधान इस केन्द्र का अधिदेश है । वर्तमान में केन्द्र में फसल सुधार, फसल उत्पाय, फसल संरक्षण और कटाई पूर्व और उपरांत तकनीक के क्षेत्र में अनुसंधान प्रगति पर है । 15 संस्थानीय अनुसंधान कार्यक्रमों के अलावा, अनेक बाह्य निधिबद्ध परियोजनाएं भी उन्नति पर हैं । केन्द्र में परामर्श सेवाएं और अधिदेश से सम्बन्धित अनुबन्धित अनुसंधान पर भी कार्य किया जा रहा है । विभिन्न क्षेत्रों में पिछले वर्ष हुई उपलब्धियों का सारांश निम्न है ।

फसल सुधार

राष्ट्रीय अंगूर जीन बैंक में 4 नई प्रविष्टियों को शामिल किया गया तथा 37 प्रतिरूपों को निकाला गया । अब जननद्रव्य में 425 प्रविष्टियाँ हैं जिनमें 112 देशज तथा 313 विदेशी शामिल हैं ।

आनुवंशिक विविधता के विश्लेषण में मणि वजन को सर्वाधिक परिवर्तनशील लक्षण पाया गया । फल लक्षण विविधता में बाह्य लक्षण विविधता गुणांक, जीनोटाइप विविधता गुणांक से अधिक था । मणि वजन तथा व्यास, बीजों का वजन एवं संख्या तथा कुल घुलनशील ठोस को पैतृक गुणों की तरह देखा गया । प्रमुख घटक विश्लेषण (Principal Component Analysis) में मणि वजन तथा मणि व्यास का कुल जैविक विविधता में अधिकतम योगदान पाया गया ।

देशज प्रजातियों तथा जातियों के उपयोग से विकसित विभिन्न बीजरहित संकरों का उपज, फल गुणवत्ताओं तथा रोग सहनशीलता के लिए क्षेत्र मूल्यांकन किया । इन संकरों ने पितृक प्रजातियों की अपेक्षा बहुत अच्छा प्रदर्शन किया ।

134 अंगूर प्रविष्टियों को 25 माइक्रोसैटेलाइट प्राइमरों के प्रयोग से आण्विक स्तर पर विश्लेषित किया गया। आण्विक विश्लेषण ने संस्थान के जनद्रव्य में अनेक मदिरा प्रजातियों की जैविकीय पहचान सुनिश्चित निर्धारित की । किशमिश रोज़ाविस, सैन्टेनिअल सीडलैस तथा किशमिश चेरनी के क्लोनों में माइक्रोसैटेलाइट विश्लेषण द्वारा भेद नहीं पाया गया । परन्तु 16 प्राइमरों के एएफ्एलपी (AFLP) विश्लेषण द्वारा सैन्टेनिअल सीडलैस तथा इसके क्लोन मांजरी नवीन में अंतर पाया गया । इसी तरह एएफ्एलपी विश्लेषण से किशमिश चेरनी के क्लोनों में अंतर किया जा सकता है । आण्विक डाटाबेस सृजित करने के लिए विभिन्न मोड्यूलों का विकास एवं परीक्षण किया गया । सॉफ्टवेयर प्रयोग के लिए तैयार है ।

लवणता एवं नमी के स्ट्रैस के अंतर्गत मूलवृंतों 110 आर तथा 1631 सी में Na^+/H^+ एन्टीपोर्टर जीन की अभिव्यक्ति के विश्लेषण ने विभिन्न मूलवृत्तों में अलग प्रतिक्रिया दिखाई । Na^+/H^+ एन्टीपोर्टर जीन की अभिव्यक्ति लवणता तथा नमी के स्ट्रैस स्तर से प्रभावित हुई । 110 आर आरएनए के डीडीआरटी-पीसीआर से लवणता, नमी तथा सम्मिलित स्ट्रैस के फलस्वरूप हुए विशेषक ट्रांसक्रिप्ट (Transcript) को पहचाना गया ।

फसल उत्पादन

जिंक @ ५ ग्रा/लता के प्रयोग के परिणामस्वरूप डॉगरिज मूलवृंत में कली जल्दी स्फुटित हुई तथा प्रतिशत सफलता अच्छी थी । इसी तरह वीएएम और ह्यूमिक अम्ल के प्रवर्धन पदार्थ में प्रयोग ने पौधशाला में पादन स्थापन को अच्छा बनाया ।

विभिन्न मूलवृंतों पर कलमित थॉम्पसन सीडलैस का उपज एवं गुणवत्ता मानकों के लिए मूल्यांकन किया गया। 110 आर मूलवृंत पर कलमित लताओं में फलगुच्छों, मणिगुच्छों का वजन तथा उपज अधिकतम थी । विभिन्न मंडल संरचनाओं में, लतायें जो द्वितना पर थीं तथा दो कॉर्डनों क्षैतिज दिशा में थे, ने वृध्दि तथा उपज में अच्छा प्रदर्शन किया ।

पोटेशियम ऑक्साईड (K_2O) का 200-300 किग्रा/हे की दर से प्रयोग से मदिरा प्रजाति कैबरने सॉविग्नॉन में उपज तथा डंठल में पोटेशियम सार्थक रूप से बढा । तीन आइसोलेट (पृथक) जो कि *एस्परजीलियस नाइजर* से सम्बधित थे, फॉस्फोरस की घुलनशील क्षमताओं के लिए विभिन्न लवणता स्तरों पर ट्राईकैल्शियम फॉस्फेट तथा रॉक फॉस्फेट, को फॉस्फोरस के स्त्रोत के रूप में प्रयोग कर, परीक्षण किया गया । तीनों पृथक विभिन्न लवणता की दशाओं में फॉस्फोरस को घुलनशील बनाने में सक्षम थे । नाशिक जिला के विभिन्न हिस्सों में कैबरने सॉविग्नॉन की पत्ती में हरित रोग का कारण पोटेशियम उर्वरक की कमी पायी गयी ।

छिड़काव पानी की गुणवत्ता का अपतृण नियंत्रण पर महत्वपूर्ण प्रभाव पाया गया । कम विद्युतचालकता वाले पानी से बनाया गया अपतृणनाशी घोल अपतृण नियंत्रण और पुनर्जनन रोकने में अधिक सक्षम पाया गया । हालांकि कम गुणवत्ता वाले पानी से बनाए गए छिडकाव की सक्षमता सिट्रिक अम्ल के प्रयोग से बढ़ाई जा सकी ।

थॉम्पसन सीडलैस में गुच्छों को ढकने से 'पिंक बैरी' की व्यापकता में कमी आयी । ढके हुए गुच्छों में मणि गुण जैसे मणि कुरकुरापन, मणि लम्बाई और कुल घुलनशील ठोस पदार्थो में सुधार हुआ । शरद सीडलैस और थॉम्पसन सीडलैस में गांठ फुलाव विकार से मणि गुणों में गिरावट पायी गयी ।

फसल संरक्षण

अंगूर बगीचों में फंफूदीनाशक के छिड़काव सम्बधी निर्णय को अवलंब देने के उद्देश्य से डाउनी मिल्ड्यू की सम्भावना के आकलन के लिए एक मॉडल बनाया गया । यह मॉडल दैनिक तापमान और सापेक्ष आर्द्रता पर आधारित है । मॉडल की जांच पिछले दो साल के मौसम मापदण्ड और व्याधि आंकडों के आधार पर की गयी और इसे समुचित पाया गया ।

अग्रणी छटनी के बाद अंगूर व्याधि और विनाशकारी कीट प्रबंधन के लिए विभिन्न नए फंफूदी और कीट नाशकों का जैविक बल के लिए परीक्षण किया गया और इष्टतम मात्रा आंकी गयी ।

एंथ्रेक्नोज से प्रभावित अंगूर नमूनों से 361 आइसोलेट किए गये । इनमें से अधिकतर *कॉलेटोट्राइकम ग्लोस्पॉरॉइड्स* और कुछ *कॉलेटोट्राइकम केपसिसी* के सदस्य थे । कालोनी आकृति के आधार पर *कॉलेटोट्राइकम ग्लोस्पॉरॉइड्स* को 17 समूहों में बांटा जा सका ।

अंत:पत्ती स्थित उपयोगी सूक्ष्मजीवों की पहचान के लिए तना, पत्ती, पत्रवृन्त और जड़ से पृथक्कीकरण किया गया । इसके अलावा मूलक्षेत्र और पत्रक्षेत्र से भी पृथक्कीकरण किया गया । 293 विभिन्न आइसोलेट्स प्राप्त हुए और *कॉलेटोट्राइकम* और *प्लाजमोपेरा विटिकोला* के विरूद्ध परीक्षण में कुछ उपयोगी आइसोलेट्स की पहचान की गयी ।

जीएलआरवी-३ विषाणु की पहचान के लिए आरटी-पीसीआर प्रोटोकोल का मानकीकरण किया गया । लक्षणहीन संवाहक पौधे भी एलाइजा और पीसीआर द्वारा विषाणु की उपस्थिति के लिए सकारात्मक पाये गये ।

अंगूर के मुख्य व्याधि और कीटों एवं कटाई उपरान्त अंगूर व्याधियों से सम्बधित सूचना संकलित की गयी और एचटीएमएल में वेबपेज बनाकर प्रदर्शित की गयी ।

अंगूर में थ्रिप्स जनसंख्या पुष्पण समय और वर्षा की अनुपस्थित से मेल खाती हुई पायी गयी । दीमक जनसंख्या में वृद्धि तापमान में वृद्धि, आर्द्रता में कमी और वर्षा की अनुपस्थिति के कारण पायी गयी । इसी प्रकार मीलीबग की संख्या में वृद्धि तापमान में वृद्धि और फल परिपक्वता से सम्बधित पायी गयी ।

अंगूर बगीचों मे थ्रिप्स की दो प्रजातियां जैसे *सिरटाथ्रिप्स डॉरसेलिस* और *रेटिथ्रिप्स सिरियाकस* पायी गयी । मीलीबग के परजीवी पाए गए जो मीलीबग के अन्दर विकसित होकर उन्हें सुखा देते हैं । अंगूर को प्रभावित करनेवाले जैसिड की मुख्य प्रजाति *एमरासका बिगुटुला बिगुटुला* की पहचान की गयी ।

विभिन्न वनस्पतिक पदार्थों का अंगूर के विनाशकारी कीटों के विरूद्ध जैवक्षमता का परीक्षण किया गया । मीलीक्वीट और मीलीकिलर क्रमशः 8 मिली/ली और 10 मिली/ली की दर से मीलीबग के विरूद्ध प्रभावी पाए गए ।

तीन नए कीटनाशकों की विघटन दर पर अध्ययन किया गया । एकल मात्रा पर औरियोफंगिन, फ्लोपिकोलाइट और फॉसिटिल-एल की अर्धआयु क्रमशः 2.5, 4.5 और 1.5 दिन आंकी गयी । अंगूर और मदिरा में 135 कीटनाशी और 25 कार्बनिक संदूषकों के लिए जीसी-टॉफएमएस पर आधारित एक बहुअवशेषी विश्लेषण विधि का मानकीकरण किया गया । एलसीएमएस/एमएस द्वारा अंगूर, आम और अनार में मेप्टाइल डिनोकेप के अवशेषों के सूक्ष्म और चयनशील आकलन के लिए एक परिष्कृत विधि का विकास किया गया ।

यूरोपीय संघ-एमआरएल के अनुपालन के लिए निर्यात अंगूर के 500 नमूनों का आंकलन किया गया । सभी नमूनों में अवशेषों की मात्रा एमआरएल से कम पायी गयी । इसके अलावा 50 घरेलू बाजार के नमूनों का भी आकलन किया गया और सभी नमूनों में अवशेषों की मात्रा पीएफए एमआरएल से कम पायी गयी । भारतीय मदिरा कारखानों से लिए गए मदिरा के नमूनों में भी कीटनाशी के अवशेष नहीं पाए गए ।

एजोक्सिस्ट्रॉबिन और मेटोमिनोस्ट्रॉबिन का तीन विभिन्न मृदा प्रकारों में विघटन का अध्ययन किया गया । सभी मृदा में दोनों पदार्थो का विघटन प्रथम + प्रथम गतिज के अनुसार हुआ । एजोक्सिस्ट्रॉबिन का विघटन मेटोमिनोस्ट्रॉबिन के मुकाबले तेज गति से हुआ ।

कटाई उपरान्त प्रौद्योगिकी

गुच्छे को 15 मिली ईथाइल ओलिएट और 30 ग्रा पोटॅशियम कार्बोनेट से उपचार के बाद 10 दिन सुखाने पर प्राप्त किशमिश में सबसे कम नमी की मात्रा और रंगत पायी गयी । मणि भरण अवस्था पर गुच्छों को ढकने से भी किशमिश में रंग प्रबलता कम की जा सकी । गुच्छों को 15 मिली ईथाइल ओलिएट और 25 ग्रा पोटॅशियम कार्बोनेट में 6 मिनट डुबाने पर बेहतर किस्म की किशमिश बनाई जा सकी ।

प्रौद्योगिकी और सूचना स्थानांतरण

अंगूर की खेती के विभिन्न पहलुओं और अंगूरी मदिरा प्रौद्योगिकी और सूचना का विभिन्न अंगूर उद्योग के विभिन्न हिताधारकों कि लिए प्रशिक्षण कार्यक्रमों के आयोजन उपलब्ध है, क्षेत्र दौरों, उत्पादक संघों में भागीदारी, सेमिनारों, केन्द्र पर संवाद, केन्द्र की वेबसाइट पर जानकारी डालकर तकनाकी स्थानांतरण किया जाता है । वैज्ञानिकों ने अंगूर उत्पादकों, उत्पादक संघों, राज्य सरकारों, आदि के द्वारा आयोजित सेमिनारों मे भाग लिया । अंगूर उत्पादकों के क्षेत्र के दौरों के दौरान विभिन्न मुद्दों पर वैज्ञानिकों के साथ बातचीत की । उत्पादक केन्द्र द्वारा आयोजित प्रशिक्षण कार्यक्रमों द्वारा लाभन्वित हुए ।

मानव संसाधन विकास

दूसरी लेटिन अमेरिका कीटनाशी अवशेष कार्यशाला में भाग लेने और 'भारतीय अंगूर में कीटनाशी अवशेषों की जाँच' नामक तकनीकी पत्र प्रस्तुत करने के लिए दो वैज्ञानिकों को 6-19 जून 2009 के दौरान प्रतिनियुक्त किया गया । एक वैज्ञानिक ने जर्मनी के गीज़नहेम अनुसंधान केन्द्र में अक्तूबर-दिसंबर 2009 में मदिरा बनाने की विधि में प्रशिक्षण प्राप्त किया । कई वैज्ञानिकों को देश के विभिन्न संस्थानों में उच्च तकनीक क्षेत्रों मे प्रशिक्षण या अध्ययन के लिए भेजा गया ।

राजस्व आय

प्रशिक्षण परामर्श, अनुबन्ध अनुसंधान और सेवाएँ, पौध सामग्री और अंगूर विक्रय से इस वर्ष रू. 38.10 लाख के राजस्व की प्राप्ति हुई ।

भावी प्रतिबल क्षेत्र

उपज कायम रखना, उत्पाद की गुणवत्ता में सुधार, नए रसायनों के विश्लेषण की विधि, गुणवत्ता मदिरा और किशमिश के उत्पादन के लिए बेहतर तकनीक आदि के शोध पर आनेवाले वर्षों में ध्यान दिया जाएगा ।

Executive Summary

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.

Presently research is conducted under broad areas of crop improvement, crop production, crop protection and pre and post harvest technology. Besides 15 institutional research programmes, several externally funded projects are in progress. The Centre also undertakes consulting and mandate related contractual research. The achievements during last one year are summarized as below:

Crop Improvement

Four new accessions were added to National grape gene bank and 37 duplicates were removed. The germplasm now has 425 accessions consisting of 112 indigenous and 313 exotic collection.

Berry weight was found to be the most variable character in the germplam in genetic diversity analysis. Phenotypic coefficient of variation was higher than the genotypic coefficient of variation for fruit characters. Berry weight and diameter, seed weight and number and TSS were observed to be heritable traits. Principal Component analysis identified berry weight and berry diameter to contribute maximum to the total genetic variability.

Several seedless hybrids developed using indigenous varieties and species were field evaluated for yield, fruit qualities and disease tolerance. Newly developed hybrids performed very well as compared to their parents.

134 grape accessions were characterized at molecular level using 25 microsatellite primers. Molecular analysis ascertained the genetic identity of several wine varieties in Institute's germplasm. Microsatellite analysis of clones of Kishmish Rozavis, Centennial Seedless and Kishmish Chernyi did not distinguish clones from their parent variety. However, AFLP analysis with 16 primers identified polymorphic peaks which could distinguish Centennial Seedless and its clone Manjri Naveen. Similarly clones of Kishmish Chernyi could be differentiated with AFLP analysis. Different modules of software for creating molecular database were also developed and tested during the period. The software is ready for use.

The analysis of expression of Na^+/H^+ antiporter gene in rootstocks 110R and 1613C under salinity and moisture stress showed differential response by different rootstocks. The expression of Na^+/H^+ antiporter gene was affected by different levels of salt and moisture stress. DDRT-PCR of 110R RNA identified differentially expressed transcript specific to salinity, moisture and combined stress.

Crop Production

Application of Zn @ 5 g/vine resulted in early bud sprouts and improved per cent success in establishing plants on Dogridge rootstock. Similarly, use of VAM and humic acid in propagating media improved plant establishment under nursery condition.

Thompson Seedless grafted on different rootstocks were evaluated for yield and quality parameters. The number of bunches, bunch weight and yield were maximum in vines grafted on 110R rootstock.

Among different canopy structures, vines raised on double stem and trained to double cordons with horizontal direction performed better in growth and yield parameters.

In wine variety, Cabernet Sauvignon, application of K_2O @ 200-300 kg/ha significantly increased the yield and petiole potassium content.

Three isolates belonging to *Aspergillus niger* were tested for their P solubilising capabilities under varied salinity levels with tri-calcium phosphate and rock phosphate as P source. All these three isolates were able to solubilize P under saline condition.

Leaf chlorosis observed in Cabernet Sauvignon grown in several parts of Nasik district was found to be due to inadequate potassium fertilization.

The water quality was found to have significant impact on weed control. The herbicide solution prepared with water having lower EC was more efficient in the control of weeds and preventing weed regeneration. However, efficacy of the spray with poor quality water could be increased significantly by use of citric acid.

The covering of bunches resulted in reduced incidence of pink berry in Thompson Seedless. The berry quality attributes viz. berry crispness, berry length and TSS were also improved in covered bunches. Swelling of knot disorder encountered in few vineyards recently in Sharad Seedless and Thompson Seedless adversely affected berry crispness, skin thickness and TSS.

Crop Protection

A model for estimating risk of downy mildew to support the decision on spraying in the vineyards was prepared. The model considers daily data on temperature and relative humidity. The model was tested using last two years data on weather parameters and disease incidence and was found reasonably accurate in estimating the risk.

Several new generation pesticides were tested for their bioefficacy for the management of grape diseases and insect pests after foundation and forward pruning and their optimum dose was estimated.

361 isolates were obtained from anthracnose affected grape samples. Majority of the isolates belonged to *Colletotrichum gloeosporoides* and a few isolates to *C. capsici*. Based on colony morphology, 17 groups were formed among *C. gloeosporoides*.

To isolate useful endophytic microorganisms, isolation was done from shoot, lamina, petiole and root. Isolation were also done from phyllosphere and rhizosphere. 293 isolates were obtained and tested *in vitro* against *Colletotrichum* and *Plasmopara viticola* and some promising isolates were identified.

Protocol was standardized for Reverse Transcription (RT-PCR) based detection of GLRaV-3 virus. Symptomless carrier plants were detected as positive by PCR as well as ELISA tests.

Information on eight important grapevine diseases and insectrperts and nine post-harvest grape diseases was compiled and displayed by creating web pages using HTML.

The increase in thrips population coincided with the flowering period and absence of rains. Mite population build up was attributed to increase in temperature, decrease in humidity and absence of rain. Similarly mealy bug population increased with increase in temperature and as the maturity of fruit increases in terms of level of sugar.

Two different species of thrips viz. *Scirtothrips dorsalis* and *Retithrips syriacus* were present in vineyards. The major species of jassids affecting grape was identified as *Amrasca biggutula biggutula*. Parasitoids of mealy bugs were collected. These parasitoids develop internally in mealy bug and mummify mealy bugs.

Different botanicals were tested for their bioefficacy against grape insect pests. Mealy quit and mealy kill @ 8 and 10 ml / L respectively were found effective against mealy bug. Among new generation insecticide, HGW80 was found effective.

Dissipatoin rate of three new generation pesticides was studied. At single dose the half life of Aureofungin, Fluopicolide and fosetyl-Al was 2.5 days, 4.5 days and 1.5 days respectively. A multiresidue analysis method was optimised and validated based on GC-TOFMS for 135 pesticides and 25 organic contaminants in grape and wine. An improved method was developed for sensitive and selective determination of residues of meptyldinocap in grape, mango and pomegranate by LC-MS/MS.

500 export grape samples were assessed for their compliance to the EU-MRL. In all the samples, residues were found to be below their MRLs. Fifty domestic samples were also evaluated and in all the samples residues were found to be below the PFA MRL. Samples of red and white wines obtained from Indian wineries were evaluated and were found free from pesticide residues.

Degradation of Azoxystrobin and Metominostrobin was explored in major soil types and both molecules followed 1^{st} + 1^{st} order kinetics in the soils. Azoxystrobin however, degraded faster than metaminostrobin.

Post-harvest technology

Bunch treatment with 15 ml ethyl oleate + 30 g potassium carbonate resulted in lowering moisture content and colour intensity after 10 days of drying under raisin shed. Similarly covering of bunches at veraison stage resulted in low colour intensity after drying. Dipping of bunches in a solution of 15 ml ethyl oleate and 25 g potassium carbonate for 6 minutes resulted in better quality raisins.

Transfer of Technology

Transfer of technology and information on various aspects of viticulture and enology is made available to the various stakeholders of grape industry by organizing training programmes, making field visits, participation in growers'/ associations' seminars, interaction with them at the Institute and placing information on the Institute's website. The scientists participated in seminars organized by various agencies like grape growers' associations, state governments, etc. The grape growers directly interacted with the scientists on various issues during the field visits. Growers were benefited by training programmes organized by the Institute.

Human Resource Development

Two Scientists were deputed to participate in the 2^{nd} Latin American Pesticide Residue Workshop 'Food and Environment' during 6-19^{th} June 2009 and to present a lead technical paper on 'Monitoring of pesticides in Indian table grapes'. One Scientist attended three months training

programme on 'Fermentation technology in horticulture (winemaking)' during 1st October to 31st December 2009 at Research Centre Geisenheim (Forschungsanstalt Geisenheim), Germany. Few Scientists were also deputed within country to undergo training / study visits in high technology areas.

Revenue Generation

Revenue of Rs. 38.10 Lakhs was generated through training, consultancy, contract research and services, sale of planting material and farm produce.

Future Thrusts

Sustaining yield, improving the produce quality, development of methodology for the analysis of new chemicals, improving techniques for the production of quality raisins and wines will be the focus of research in coming year.

लल

परिचय/Introduction

राष्ट्रीय अंगूर अनुसंधान की स्थापना जनवरी 1997 में भारत में अंगूर उत्पादन तथा प्रसंस्करण से सम्बधित मुद्दों पर लक्ष्य आधारित अनुसंधान कार्य के लिए हुई। गत 13 वर्षो में संस्थान ने बुनियादी सुविधाओं के विकास, अनुसंधान तथा तकनीकी प्रसार के क्षेत्र में अद्भुत उन्नती की है। प्रारंभ में महाराष्ट्र द्राक्ष बागाईतदार संघ, मांजरी के कुछ किराये के कमरों में संस्थान कार्य आरम्भ हुआ परन्तु अब संस्थान के पास प्रयोगशाला एवं प्रशासनिक भवन के अलावा जैवनियंत्रण प्रयोगशाला, राष्ट्रीय संप्रेषण प्रयोगशाला, फार्म कार्यालय, किशमिश शैड, तीन पौली/एफ्आरपी हाउस एवं 35 एकड़ पर फैला प्रयोगात्मक अंगूर क्षेत्र है। संस्थान में मूल एवं सामरिक अनुसंधान के लिए आवश्यक अति आधुनिक बुनयादी सुविधायें और उपकरण जैसे एलसीएमएस/एमएस, जीसीएमएस/एमएम-टीओएफ, आईसीपी-एमएम/एमएस, जेनेटीक एनालाइजर, आरटी-पीसीआर मशीन, इरगा, वितान विश्लेषक, मदिरा विश्लेषक, एएएस, बहुचैनेल विश्लेषक, प्रोग्रामेबल एलिसा प्लेट रीडर, पादप वृध्दी कक्ष एवं इनक्यूबेटर, उच्चक्षमता की स्टीरियो सूक्ष्मदर्शी, विभिन्न क्षमताओं के अपकेन्द्रक उपलब्ध है। संस्थान स्थित राष्ट्रीय अंगूर जीन बैंक में 425 प्रविष्टियों का जननद्रव्य संग्रह है। उत्कृष्ट सुविधाओं के परिणामस्वरूप देश के अन्य विश्वविद्यालयों के अतिरिक्त पुणे विश्वविद्यालय, पुणे एवं शिवाजी विश्वविद्यालय, कोल्हापूर ने परास्नातक शिक्षा के लिए केन्द्र को मान्यता दी है तथा केन्द्र में प्रत्येक वर्ष अनेक छात्र अपनी 6 महीने की परियोजनाओं पर कार्य करते हैं।

केन्द्र की पौधशाला, जिसे राष्ट्रीय बागवानी बोर्ड से तीन सितारा दर्जा हासिल है, मूलवृंत एवं खाने तथा मदिरा अंगूर की व्यावसायिक प्रजातियों की शुद्ध और असली पादप सामग्री उपलब्ध कराती है। नियमित क्षेत्रभ्रमण, उत्पादकों की सेमिनारों, अंगूर उत्पादकों के साथ चार्च, प्रशिक्षण कार्यक्रमों तथा वेबसाइट पर उपलब्ध सूचना के द्वारा प्रौद्योगिकी स्थानांतरण के कारण उत्पादकों एवं अन्य अंगूर उद्योग के हितधारकों के बीच संस्थान की दृश्यता तथा विश्वसनीयता बढी है । एपिडा से वित्तप्रेषित अंगूर निर्यात के लिए कीटनाशक अवशेषों की निगरानी योजना के सफलतापूर्वक कार्यान्वयन ने संस्थान की महिमा में काफी योगदान किया है ।

केन्द्र में अनुसंधान कार्यक्रम भारतीय अंगूर उद्योग की आवश्यकताओं के मूल्यांकन के बाद बनाए जाते हैं तथा उन्हें समय-समय पर पंचवर्षीय समीक्षा टीम एवं अनुसंधान सलाहकार समिति की सिफारिश तथा अंगूर उद्योग के अन्य हितधारकों के अदानों के आधार पर परिवर्तित किया जाता है ।

वर्तमान में फसल सुधार, फसल उत्पादन, फसल संरक्षण तथा तुडाई उपरान्त प्रौद्योगिकी, अनुसंधान के व्यापक क्षेत्र हैं । 15 संस्थानीय अनुसंधान कार्यक्रमों के अलावा, कई बाह्य वित्त प्रेषित परियोजनायें चल रहीं हैं । केन्द्र में परामर्श सेवाएं एवं अधिदेश से सम्बधित अनुबन्ध अनुसंधान भी प्रगति पर है ।

अधिदेश

अंगूर के उत्पादन एवं उत्पादकता को प्रभावित करनेवाली जैविक एवं अजैविक बाधाओं के हल के लिए मूल एवं सामरिक अनुसंधान, उपज कायम रखना, मदिरा उत्पादन और अन्य मूल्यवृद्धि उत्पादों द्वारा विविधीकरण को बढावा और क्षेत्र विशेष तकनीकों का विकास एवं आंकलन ।

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. During last thirteen years, the institute has made tremendous progress in terms of infrastructure development, research output and technology dissemination. Beginning with a few rented rooms in the office of the Maharashtra Rajya Draksh Bagaitdar Sangh (MRDBS) in Manjri, the institute now has a laboratory cum administrative building, separate buildings of biocontrol laboratory, National Referral Laboratory, farm office, raisin shed, three poly/FRP houses and experimental vineyards spread over 35 acres. The institute has world-class research infrastructure in terms of high tech instruments and tools viz. LC-MS/MS, GC-MS/MS-TOF ICP-MS, genetic analyzer, real time PCR machine, IRGA, canopy analyzer, wine analyzer, AAS, multichannel autoanalyzer, programmable ELISA plate reader, plant growth chamber and incubators, stereo microscopes of high magnification, different types of centrifuges are some of the high end equipments available for conducting basic and strategic research. The institute is the site for National Grape Gene Bank and has almost 425 grape accessions in its field germplasm collection. Such excellent infrastructure has resulted in recognition of the Centre for postgraduate studies by Pune University, Pune and Shivaji University, Kolhapur besides other universities in the country and every year several students complete their six months projects at this Institute. A nursery with a three star rating from NHB provides pure and genuine planting material of promising rootstock and commercial table and wine grape varieties. Transfer of technology through regular field visits, growers' seminars, in house interaction with grape growers, training programmes and information placed on website has increased the Institute's visibility and credibility among the growers and other stakeholders of grape industry. Successful implementation of APEDA funded Pesticide Residue Monitoring Plan for export grape has contributed substantially to the stature of the Institute.

The research programmes are formulated after assessing the needs of grape industry in India and modified time to time based on the recommendation of QRT, RAC, and inputs from other grape industry stake holders. Presently research is conducted under broad areas of crop improvement, crop production, crop protection and pre and post harvest technology. Besides 15 institutional research programmes, several externally funded projects are in progress. The Centre also undertakes consulting and mandate related contractual research.

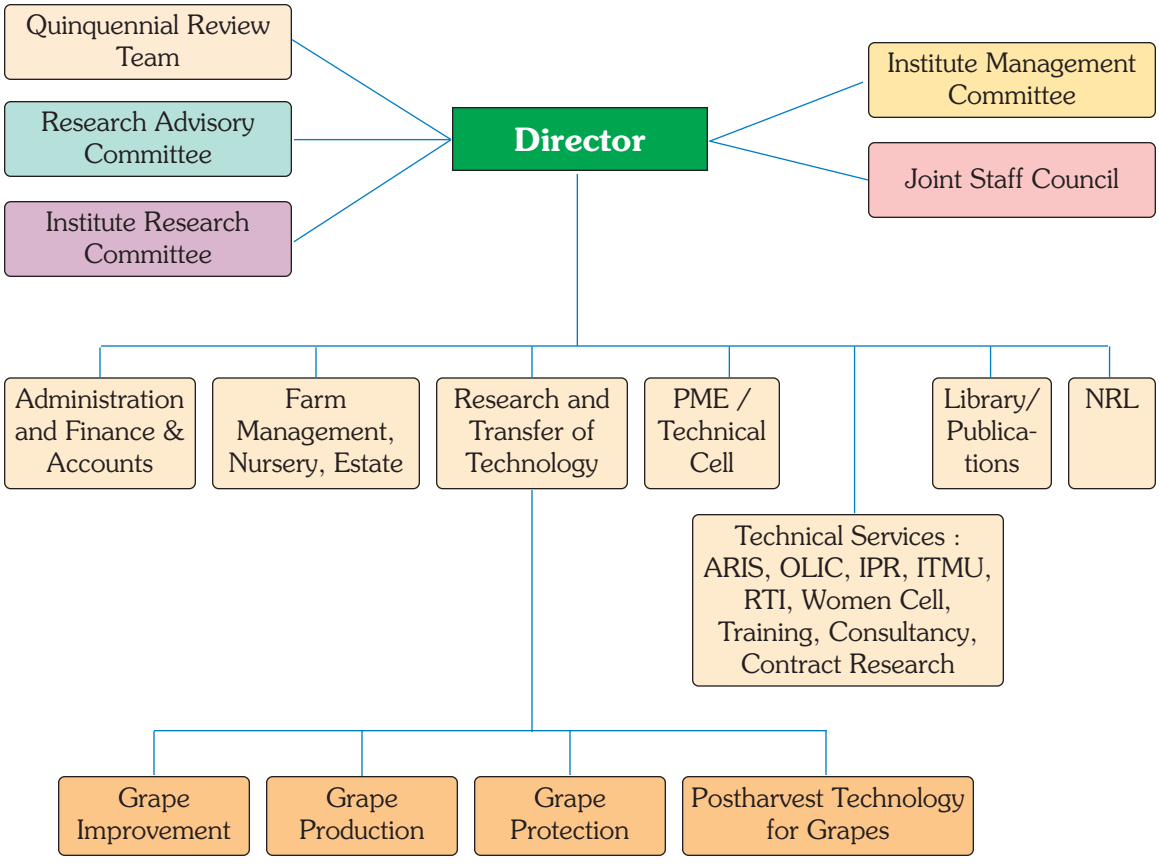
Mandate

To undertake the programmes covering basic and strategic research for resolving the major biotic and abiotic constraints affecting the grapes quality production, productivity, to sustain the productivity, promote diversification towards wine and other value added products and evaluation of technologies for developing region specific technologies.

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.

Organizational set-up



Financial statement

(Rs. in Lakhs)

Sl. No.	Heads	R.E. 2009-10		Expenditure 2009-10		Final Grant		Revenue Generated
		Plan	Non-Plan	Plan	Non-Plan	Plan	Non-Plan	
1.	Estt. Charges	0.00	227.61	0.00	227.58	0.00	227.61	
3.	O.T.A.	0.00	0.03	0.00	0.03	0.00	0.03	
4.	T.A.	4.50	1.02	4.50	1.02	4.50	1.02	
5.	Equipments	87.39	0.00	87.39	0.00	87.39	0.00	
6.	Library books	4.00	0.00	4.00	0.00	4.00	0.00	
5.	Other charges	50.00	109.91	50.00	109.91	50.00	109.91	
6.	Works	19.11	10.00	19.11	10.00	19.11	10.00	
	Total	**165.00**	**348.57**	**165.00**	**348.54**	**165.00**	**348.57**	**38.10***

Staff position

Sl. No.	Post	Number of posts		
		Sanctioned	Filled	Vacant
1.	Research & Management Personnel	1	1	0
2.	Scientific	16	14	2
3.	Technical	8	8	0
4.	Administrative	9	8	1
5.	Supportive	7	7	0
	Total	41	38	3

Programme 1. Management of genetic resources of table, wine, raisin, juice and rootstock grape varieties

1.1 Collection and augmentation

Four rootstock varieties were introduced from Viticulture and Oenological Research Institute, Stellenbosch, South Africa (Table 1). Thirty-seven duplicates were removed and the germplasm now has the total cumulative number of 425 accessions. The break up of germplasm resources is given in table 2.

Table 1. Introduction of rootstocks during 2009-10

Sl. No.	Rootstock	Source	Quantity
1.	135-5 EVEX (EC659392)	Viticulture and Oenological Research Institute Stellenbosch, South Africa	5
2.	143 Mgt. (EC659393)	- do -	5
3.	1045Paulsen (EC659394)	- do -	5
4.	140Ruggeri (EC659395)	- do -	5

Table 2. Total cumulative number of accessions from indigenous and exotic source

Description	Indigenous	Exotic
Varieties	10	239
Hybrids	52	__
Cultivars	25	21
Rootstock	__	26
Selections/mutants	23	22
Related species	2	5
Source total	112	313
Germplasm total	425	

1.2 Studies on genetic variability in grapes

During the year, 230 accessions (genotypes) have been analyzed for 10 fruit characters. The analysis of results indicated that berry weight was the most important character responsible for variability in the grape germplasm. The next important character was berries per bunch. Most of the results for genotypic and phenotypic variability and correlations among the characters followed the trend of data collected and reported in last year's Annual Report.

Data on genetic diversity among fruit characters (Table 3) indicated that grape accessions show high level of variability for 10 characters. Coefficient of variability was high for bunch weight, number of berries per bunch and seed weight indicating scope for further improvement through breeding. While phenotypic coefficient of variation (PCV) was recorded higher than genotypic coefficient of variation (GCV) for all the 10 characters. Heritability was high for berry weight, berry diameter, seed number, seed weight and TSS. Expected genetic advancement (GA) through cross breeding was high for seed weight, berry weight and berry diameter.

Table 3. Genetic variability among 230 grape accessions for fruit characters

Parameters	Mean	Range	PCV	GCV	H^2	GA%	C.V.	CD (0.05)
Bunch weight (g)	175.50	14.0 -1401.00	68.72	60.16	0.87	180.53	36.44	11.720
Berries / bunch (No.)	86.67	14.0 - 315.0	11.75	10.54	0.89	184.78	24.09	3.820
10 berry weight (g)	23.92	4.56 - 85.76	3.89	3.82	0.98	202.59	14.68	0.644
Berry diameter (mm)	14.87	6.0 - 25.50	0.14	0.13	0.97	200.00	6.19	0.169
Juice (%)	62.86	20 - 80	0.13	0.11	0.89	183.40	5.93	0.684
Seeds/10 berry (No.)	16.53	0.0 - 43.0	2.48	2.39	0.97	198.00	17.23	0.522
Seed weight /10 berry (g)	0.62	0.0 - 2.025	0.18	0.18	0.96	251.00	21.99	0.025
TSS (°B)	20.11	11.00 - 32.00	0.08	0.07	0.96	198.00	5.31	0.196
Acidity (%)	0.76	0.130 - 2.190	0.03	0.01	0.58	119.20	10.13	0.014
pH	3.55	2.790 - 4.750	0.01	0.00	0.39	81.13	2.37	0.015

Correlations among ten characters (Table 4) indicated that bunch weight was positively correlated with berry weight and berry diameter, but negatively correlated with TSS. Similarly, number of berries in a bunch was negatively correlated with berry weight and berry diameter. Berry weight was also negatively correlated with TSS as an influence of dilution factor.

Principal Component (PC) analysis (Table 5) among the 10 variables indicated that berry weight and berry diameter contributed much to the total genetic variability in grapes. The two major vectors PC1 and PC2 together contributed upto 98.50 per cent of cumulative variance.

Table 4. Correlations among fruit characters in 230 grape accessions

Character	Berries/ bunch (No.)	Berry weight (g)	Berry diameter (mm)	Juice (%)	Seeds/10 berries (No.)	Seed weight/ 10 berries (g)	TSS (°B)	Acidity (%)	pH
Bunch weight (g)	0.459**	0.584**	0.542**	0.096	-0.027	-0.008	-0.291**	0.010	-0.098
Berries/ bunch (No.)		-0.207**	-0.165**	0.105*	-0.113*	-0.028	0.021	0.004	-0.129*
10 Berry weight (g)			0.895**	0.065	0.044	0.015	-0.383**	0.008	-0.002
Berry diameter (mm)				0.108*	0.050	0.023	-0.373**	-0.002	0.005
Juice per cent					0.122*	-0.029	-0.118*	-0.006	0.056
Seeds /10 berries (No.)						0.030	0.004	0.032	0.119*
Seed weight/10 berries (g)							-0.002	-0.002	-0.026
TSS (°B)								0.029	0.330**
Acidity (%)									0.027

Table 5. Principal Component Analysis based on 10 characters

	PRIN 1	PRIN 2	PRIN 3	PRIN 4	PRIN 5	PRIN 6	PRIN 7	PRIN 8
VAR 3	0.982	-0.153	-0.010	-0.110	0.017	0.002	-0.000	0.000
VAR 4	0.175	0.957	0.038	0.219	-0.061	0.001	-0.001	0.001
VAR 5	0.070	-0.238	0.047	0.925	-0.178	0.082	-0.204	-0.001
VAR 6	0.015	-0.049	0.018	0.199	-0.016	-0.013	0.978	-0.024
VAR 7	0.006	0.012	0.251	0.164	0.952	0.049	-0.021	-0.007
VAR 9	0.000	-0.004	0.034	0.005	-0.010	-0.011	-0.003	-0.070
VAR11	-0.000	0.001	0.000	-0.006	-0.003	-0.021	-0.031	-0.478
VAR12	-0.000	-0.001	0.005	-0.000	0.002	0.049	0.011	0.874
VAR 8	-0.003	-0.030	0.965	-0.102	-0.236	-0.012	-0.003	-0.000
VAR10	-0.008	0.018	-0.005	-0.083	-0.036	0.994	0.030	-0.054

Programme 2. Germplasm utilization and genetic enhancement

New seedless /rudimentary soft seeded hybrids

The field disease tolerance, yield and fruit qualities of some of the promising seedless hybrids (Fig. 1-7) developed at the Centre were compared with their parents. The data on quality characters is given in table 6.

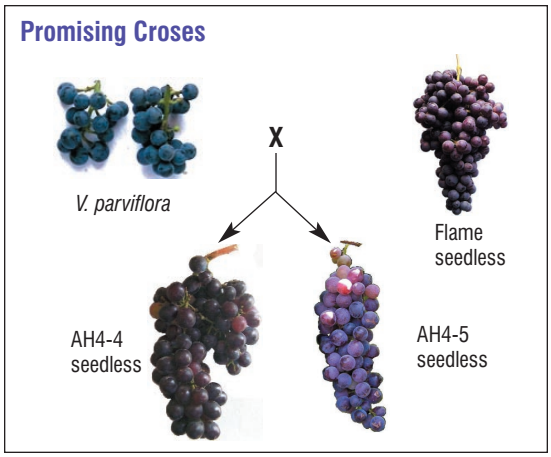


Fig. 1

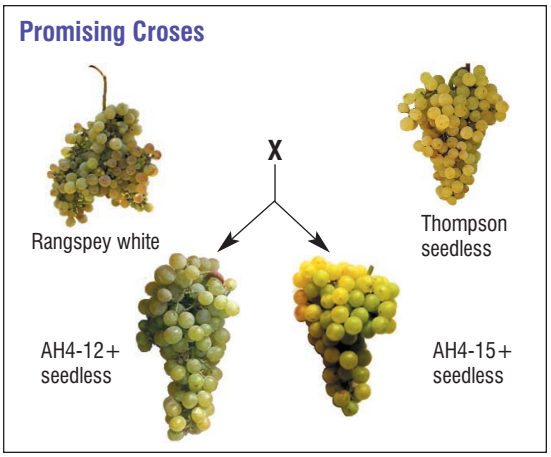


Fig. 2

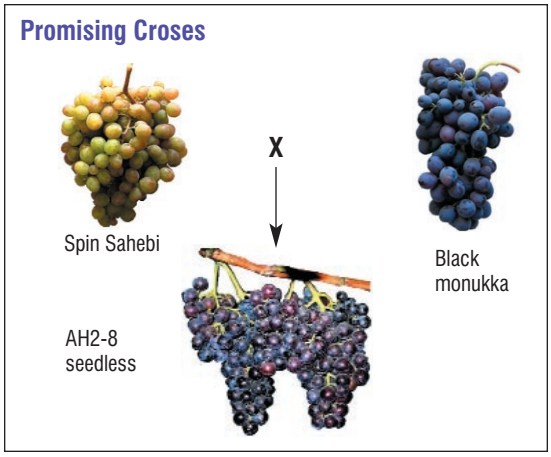


Fig. 3

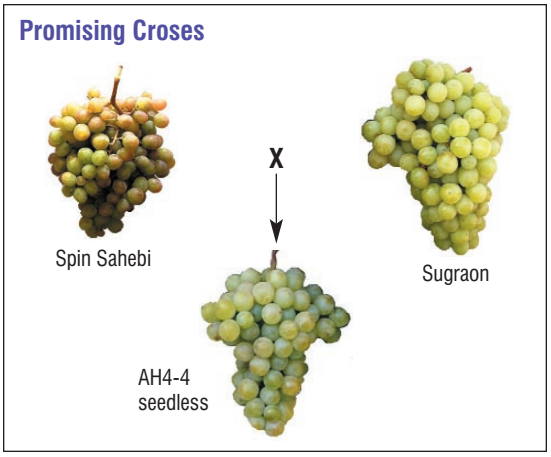


Fig. 4

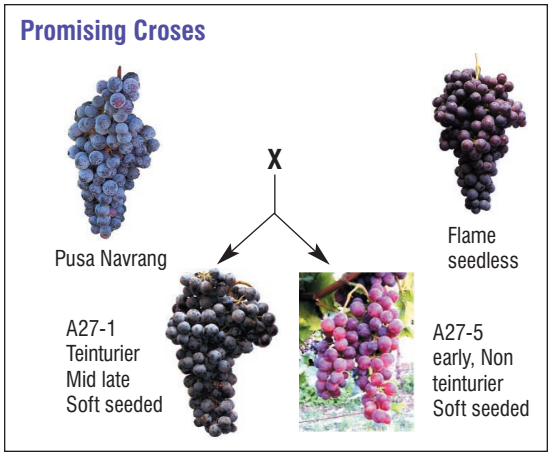


Fig. 5

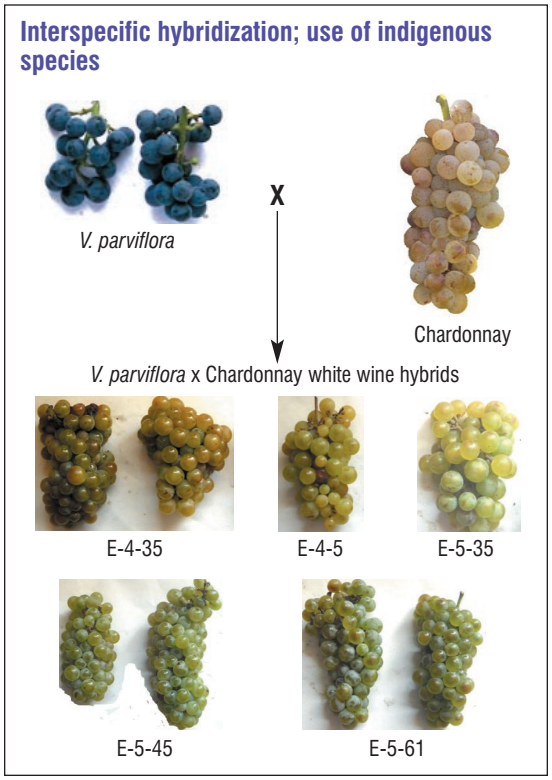


Fig. 6

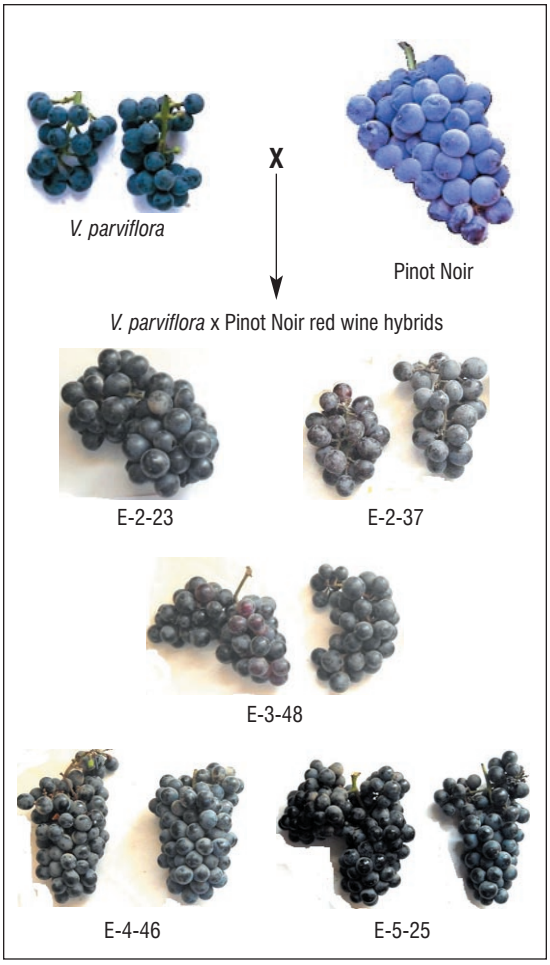


Fig. 7

Table 6. Evaluation of some promising hybrids in comparison with their parents

Sl. No.	Parent/ hybrid	Bunch weight (g)	Berry weight (g)	Berry diameter (mm)	Juice % v/w	Seed Number	Seed weight (g)	TSS (°B)	Acid (g/L)	pH	Disease rating at field level	Parents/Origin
1.	Pusa Navrang	110.0	16.0	14.0	66.7	22.7	1.2	16.3	12.7	3.1	MR	MA × RR
2.	Pinot Noir	95.0	10.3	11.0	70.0	13.0	0.6	22.0	5.2	3.6	MS	France
3	Chardonnay	128.0	14.8	13.2	64.0	24.0	1.1	18.0	6.4	3.4	MS	France
4.	Spin Sahebi	230.0	28.0	18.0	59.0	17.0	1.1	23.0	4.2	3.6	MR	Afghanistan
5.	Flame Seedless	185.0	19.5	16.0	55.0	–	–	18.0	5.6	3.5	HS	3 generation hybrid
6.	Rangspey White	247.0	12.3	15.0	54.0	28.0	1.9	16.4	7.7	3.4	R	North western Himalayas
7.	AH 4-19+	170.0	36.5	16.0	68.0	19.0	0.4	21.2	12.1	3.3	MR	Rangspey × Maroo seedless
8.	AH4-4+	180.0	20.5	14.0	60.0	0.0	0.0	17.8	7.9	3.2	MR	VP × FLS
9.	AH2-22	210.0	29.5	16.8	60.0	0.0	0.0	17.8	8.2	3.1	MR	Spin Sahebi × TS
10.	A2-4	345.0	29.0	16.4	64.0	0.0	0.0	18.0	7.0	3.4	MR	Spin Sahebi × SS
11.	AH 4-15+	185.0	28.0	16.0	67.0	0.0	0.0	20.0	7.0	3.3	MR	Rangspey × TS
12.	A 14-3	116.7	9.8	11.4	48.0	11.0	0.5	23.0	6.0	3.7	MR	F2-PN
13.	AH2-8	230.0	30.0	16.0	62.0	0.0	0.0	20.0	8.0	3.4	MR	Spin Sahebi × BM
14.	A27-1	290.0	32.8	18.0	62.0	22.0	0.7	19.0	9.1	3.1	MR	PN × FLS
15.	A27-5	190.0	28.6	16.0	59.0	15.0	0.6	20.0	5.4	3.3	MR	PN × FLS
15.	A2-34	160.0	18.8	14.7	50.0	10.0	0.1	15.0	3.3	11.6	R	Spin Sahebi × TS
16.	AH1-22+(T)	163.3	34.1	19.0	70.7	16.0	1.3	16.5	14.9	3.0	MR	PN × RG
17.	AH2-20	196.7	21.4	15.1	70.7	0.0	0.0	18.7	10.4	3.2	MR	Spin Sahebi × SHS
18.	AH3-29 (T)	106.7	14.9	14.7	68.7	17.0	0.7	19.7	11.8	3.2	MR	PN × Chardonnay
19.	AH3-28+(T)	110.0	17.7	15.7	68.7	21.3	0.7	19.7	16.4	3.1	MR	PN × Rangspey Black

MA: Madeleine Angevine, RR: Rubi Red, VP: Vitis parviflora, FLS: Flame Seedless, TS: Thompson Seedless, PN: Pusa Navrang, RG: Red Globe. BM : Blacke Monuleka, SHS : Shared seedless, SS : Superiur seedless MR: Moderately resistant, MS: Moderately susceptible, HS: Highly susceptible, R: Resistant

Programme 3. Application of biotechnological research in grapes

3.1 Molecular characterization and creation of molecular database for Indian grape germplasm (DBT funded project)

I. Molecular characterization

i. SSR analysis

134 grape accessions were analyzed with 25 primers. 25 primers detected 405 alleles in 134 accessions with an average of 16 alleles per primer. The number of alleles detected by each primer ranged between 9 to 26.

With this analysis, so far, 188 genotypes have been characterized. These include all the rootstocks available at the Centre, indigenous material collected from HP, hybrids developed in India (IIHR, IARI), hybrids raised at the NRCG and at different stages of evaluation, wine varieties received from France, all the table, raisin and wine varieties commercially grown in India, clonal material of Thompson Seedless, clones of Kishmish Chernyi collected from Farmer's field, clones of Kishmish Rozavis and Centennial Seedless identified at the Centre.

a. Ascertaining the genetic identities of wine varieties in Centre's germplasm

There were reports that some of the wine varieties in the germplasm perform very different from its characteristic features, casting doubt about their genetic purity. Especially there were doubt about two varieties viz. Merlot and Zinfandel. To confirm the genetic purity, some of the wine varieties in germplasm were compared with wine varieties obtained from France. These varieties are Cabernet Franc, Sauvignon Blanc, Shiraz (Syn. Syrah), Cabernet Sauvignon, Merlot and Zinfandel. The allele profiles of Cabernet sauvignon matched for all the 25 primers. Sauvignon Blanc showed identical banding pattern for all but one primer, while Syrah and Cabernet Franc from two sources differed at two loci. However the allele profile of Merlot available in germplasm was different from allele profile of Merlot received from France. Zinfandel available in the germplasm showed allele profile identical to Syrah for all but one locus.

b. Microsatellite analysis of clonal material

Five clones of Black seedless variety Kishmish Chernyi viz. Sharad Seedless, Nath Seedless, Nana Purple, Sarita Seedless and Krishna Seedless; One clone of Kishmish Rozavis viz. Kishmish Rozavis White (KRW) and one clone of Centennial Seedless viz. Manjri Naveen were analysed with 25 microsatellite primers. No difference was observed for clones of Centennial Seedless and Kishmish Rozavis. In case of Kishmish Chernyi, variation was detected in Sharad Seedless for one of the primer.

ii. AFLP analysis of clonal material

a. Centennial Seedless and its clone Manjri Naveen

Centennial Seedless and its clone were analysed with 16 combinations of Mse and fluorescently labelled EcoRI selective primers. Amplification was obtained with only 14 primer combinations. Amplified product was analysed on genetic analyzer. A total of 421 AFLP fragments more than 100 bp in size, were obtained with 14 primer combination. Peaks with rfu 100 and above only were considered. A few polymorphic peaks were observed (Fig. 8). Confirmation of polymorphism is in progress.

b. Kishmish Rozavis and its clone Kishmish Rozavis White

Kishmish Rozavis and its clone KRW were also analyzed with 16 primer combinations. Amplification was obtained with all the primers. Sixteen AFLP primer combinations resulted in 523 peaks. Peaks with rfu 100 and above and molecular weight more than 100 bp only were considered. No clearly distinguishable polymorphic peak was observed.

c. Kishmish Chernyi and its clones

Five clones of Kishmish Chernyi viz. Sharad Seedless, Nath Seedless, Nana Purple, Sarita Seedless and Krishna Seedless were analysed with 16 AFLP primer combinations. A total of 594 fragments were obtained among six accessions with these 16 primer combinations. Polymorphic bands were observed for some of the clones (Fig. 9). Confirmation of polymorphism is in progress.

II. Molecular database

i. Designing and coding

GUI design, Functional design and coding were carried out for the following modules

a. Module to generate similarity percentage of the selected accession with those in the database with respect to the specified primers.

b. Module to search and retrieve the desired data from the molecular database

c. Module to do parentage analysis

d. Module to identify unknown variety with respect to available data in molecular database

e. Module to generate report on list of variety and list of reference variety

f. Module to generate report on primer list

g. Module to generate report on PCR conditions

h. Module to generate report on allele data a) variety wise report for all/selected primers b) primer wise report for all/ selected varieties

i. Module to generate report on varieties having identical allele data

a. Module to generate similarity percentage of the selected accession with those in the database with respect to the specified primers

This screen allows user to know the similarity percentage of a selected variety with other varieties in the database. After selecting the varieties and primers, percentage range is selected. The coding was done to support the above functionality.

b. Module to search and retrieve data in different formats

This screen allows user to search the molecular data base to retrieve the information on variety, primer and band size/allele data. By specifying only selected accession names for search criteria and then by clicking on the 'Show Result' button the module will generate report on all the primers with band data for the selected varieties.

By specifying only selected primer names for search criteria and then by clicking on the 'Show Result' button the module will generate report on all the accessions having band data for the selected primers.

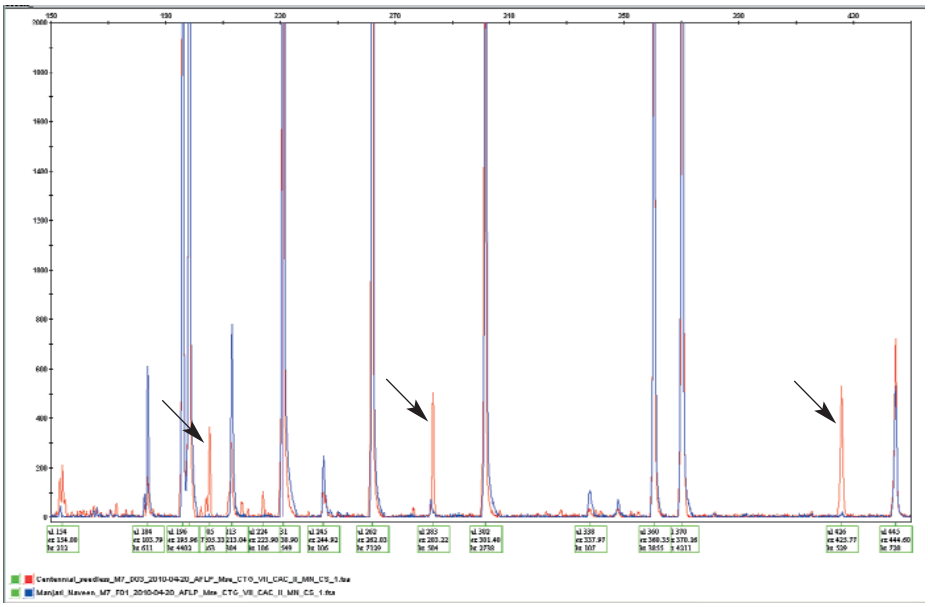


Fig. 8. AFLP analysis of Contenniel Seed less and Manjari Naveen. Arrows indicate polymorphic peaks.

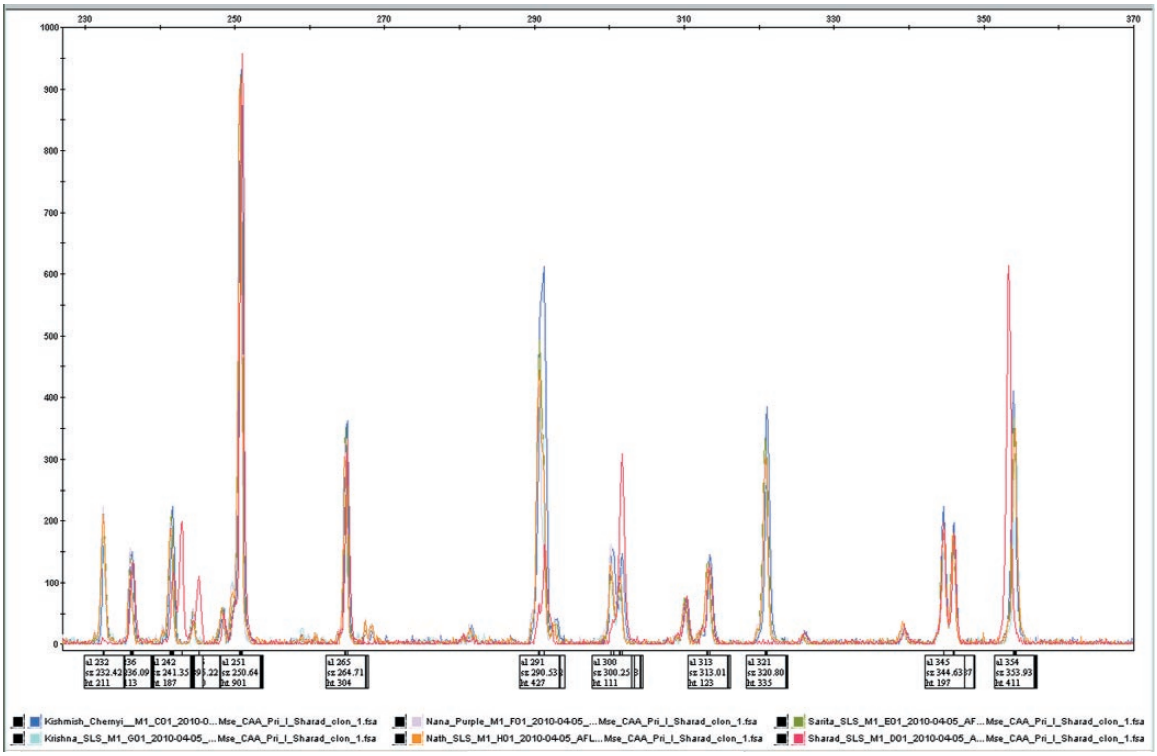


Fig. 9. AFLP analysis of Kishmish cherunji and its clones.

By specifying selected primer and accession names for search criteria and then clicking on the 'Show Result' button the module will generate report on band data for specified accessions and primers. By specifying selected primer and band sizes for search criteria and then by clicking on the 'Show Result' button the module will generate report on accessions for specified primers and bands. The result of the search can be exported into different file formats viz. acrobat, Excel, html etc. for later use.

c. Parentage analysis module

For doing the parentage analysis for a variety, specify the primers and bands and check the 'Parentage Analysis' option as shown in the screen, then click on the 'Show Result' button to view the result of parentage analysis. The program gives a list of all the varieties, which can be the parents for the variety having the specified primer and band data.

d. Module to identify variety

Through this screen user can identify the variety whose allelic data with a set of primers is known. The allelic data of the variety to be identified is compared with the data of other varieties in the database. The identified variety is the one in the database whose data matches.

e. Module to generate report on list of variety and list of reference variety

It generates report on list of varieties present in the database.

f. Modules to generate report on primer list and PCR conditions

There modules generate a printable report on primer data and PCR condition date present in the database.

g. Module to generate report on PCR conditions

This module generates report on PCR condition data.

h. Module to generate report on allele data variety / primer wise

Through this module report on allele data can be obtained either variety wise or primer wise depending on which display option the user has specified. To get the report user has to check the Variety Names and then the Primers Names on which report is to be generated and then user has to choose either 'Variety wise report' or 'Primer wise report' display option. Then clicking on 'Display Report' button generates the report.

i. Module to generate report on varieties having identical allele data

Through this module a report on varieties having same allele data for a set of selected primers can be obtained. To generate the report user has to specify primer names from the list and then click on the 'Ok' button.

ii. Testing and debugging

Manual testing of modules in the application and rectification of identified errors were carried out for all the modules and accordingly changes in the program logic, code and GUI were made. This testing and debugging process was carried out recursively.

Programme 4. Development of propagation and nursery technology

4.1 Effect of zinc (Zn) on rooting success through hardwood cuttings

Grape rootstock is propagated mainly through hardwood cuttings for which one season old matured cuttings with appropriate shoot diameter is harvested from mothervine. The storage available in the mothervine helps in early sprout and establishment of the rooted plants in the nursery. Micro-nutrients especially Zn in the cuttings is considered as auxin activator that helps in early sprouting of cuttings. Keeping this in view, an experiment was conducted to study the effect of Zn on rooting success in Dogridge rootstock.

Zinc was applied to the mothervines two months before harvest of cuttings for propagation. The concentrations used were 5, 10, 15 and 20 g per plant and was compared to the control. The observations were taken on the number of days taken for bud sprout, per cent success, shoot length, shoot diameter, internodal length, number of leaves/shoot and leaf area. Among the different treatments, Zn @ 5.0 g/vine was found to be the best for days taken for bud sprout (7.65) as compared to other treatments. The highest number of days were taken for bud sprout under control (12.72). Application of Zn also improved per cent success significantly and higher success (86.91%) was recorded with Zn @ 5 g/vine followed by Zn @ 15 g/plant (84.53%) and Zn @ 20 g/plant (80.96%) while minimum per cent success was obtained in control (76.24%). The observation recorded at 120 days after planting the cuttings on shoot diameter, shoot length and internodal length showed non-significant differences. The nutrient content in the shoots of rooted cuttings recorded at 120th day after planting indicated the use of Zn @ 5 g/plant for better success in rooted cuttings of Dogridge rootstock.

4.2 Effect of different biofertilizers on growth performance and biochemical constituents of 110R and Dogridge rootstocks

This experiment was conducted to study the effect of different biofertilizers on growth performance of 110R and Dogridge rootstocks. The propagating media was treated with PSB, humic acid, VAM, cow urine and was compared with control.

Significant differences were recorded for shoot length in 110R. Higher shoot length of 8.03 cm at 120 days of pruning was recorded in VAM treated cuttings as compared to 5.73 cm in control. However, the differences for shoot length in Dogridge were non-significant. Shoot diameter was significantly differed among all the treatments in both the rootstocks. In 110R, higher shoot diameter of 1.80 mm was recorded in VAM treated cuttings followed by 1.57 mm in IBA treated plants. The lowest shoot diameter of 1.30 mm was recorded in control treatment. In Dogridge, highest shoot diameter was recorded in cow urine treated cuttings (1.20 mm) followed by IBA (1.87 mm) and humic acid (1.67) mm). The lowest shoot diameter of 1.33 mm was recorded in control.

Significant differences were recorded for leaf area, primary root length and plant biomass. In 110R, higher leaf area of 24.30 cm^2 was recorded in VAM treated plants as compared to lowest in control (20.30 cm^2). The primary root length was also higher in VAM treated plants. In Dogridge, PSB treated plants showed higher leaf area of 24.40 cm^2 compared to 22.30 cm^2 in control. However, primary root length was more (14.40 cm^2) in cow urine treated plants as compared to 12.70 cm^2 in control.

The biochemical status of the plants treated with different biofertilizers showed significant differences among the rootstocks. In 110R rootstock, higher amount of protein 105.54 mg/g was recorded as compared to 89.19 mg/g in control. Higher amount of total phenol (38.30 mg/g) and carbohydrate (51.57 mg/g) was recorded in VAM treated plants followed by 34.53 mg/g in IBA treated plant as compared with 43.48 mg/g in control. Significant differences were also recorded for starch content indicating the superiority of VAM treatment.

In Dogridge rootstock, cow urine treated plants recorded higher protein (83.74 mg/g) while, the minimum protein content of 71.11 mg/g was recorded in control. Higher amount of phenols was recorded in cow urine treated plant (27.47 mg/g) as compared to the lowest in control. Carbohydrate content varied significantly among the different treatments. Higher amount of carbohydrate was recorded in VAM treated plants (88.68 mg/g) followed by humic acid treated plants (86.16 mg/g). This indicates the superiority of VAM and humic acid treatment in terms of storage of nutrients that helps in early establishment of plants under nursery condition.

4.3 To study the biochemical status of different rootstock

While propagating the grape rootstock through hardwood cuttings, different rootstocks behave differently for rooting success and growth performance. The availability of storage in the mother vine at the time of harvesting of cuttings plays an important role. Considering this, an experiment was conducted to study the biochemical status in different rootstocks. Semi-matured shoots of 14 different rootstocks were collected, dried and a fine powder was made to study the biochemical constituents.

Among the different biochemical parameters, significant differences were recorded for protein content in different rootstocks. Higher amount of protein (152.38 mg/g) was recorded in Dogridge rootstock followed by 147.62 mg/g in 1103P and lowest (90.36 mg/g) in B2/56 rootstock. Significant differences were recorded for carbohydrate content among the different rootstocks. Total carbohydrate content varied from 135.94 mg/g in SO4 to 220.0 mg/g in 99R rootstock. Starch content varied significantly among the different rootstocks. The shoots of *V. champini* had minimum quantity of starch (36.89 mg/g) where as highest amount of starch 202.04 mg/g was recorded in the shoots of *V. longi* rootstock. Reducing sugar varied from 1.99 mg/g to 7.36 mg/g in all the rootstocks studied. Minimum quantity of reducing sugar was recorded in St. George whereas the highest amount was estimated in Dogridge rootstock. Total phenol ranged from 2.96 mg/g in St. George to 5.54 mg/g in Salt Creek rootstock. The presence of total phenol in variable amount indicates the variability in reaction to different diseases on different stock:scion combinations.

4.4 To study the biochemical constituents in different plant parts of different grape rootstocks

An experiment was conducted to study the biochemical constituents in different plant parts of different grape rootstock. The fresh samples were collected from roots, shoots and leaf of fourteen rootstocks belonging to different *Vitis* species. Carbohydrate contents varied significantly among all the rootstocks in different parts of vine. The carbohydrate in the shoot varied from 136.94 to 214.24 mg/g, in roots it ranged from 153.65 to 250.70 mg/g, whereas in leaf it was 42.97 to 65.93 mg/g. This indicates that the storage of food material varies in different plant parts. Protein content in shoot ranged from 90.36 to 152.38 mg/g, 234.41 to 520.24 mg/g in roots and 55.95 to 122.62 mg/g in leaf.

The starch content ranged from 36.89 to 202.04 mg/g in shoot, 90.47 to 194.64 mg/g in roots and 17.71 to 30.63 mg/g in leaves. Changes in reducing sugar were also recorded among the different parts of plants. It ranged from 3.46 to 9.76 mg/g in roots, 1.99 to 7.36 mg/g in shoots and 4.17 to 7.41 mg/g in leaves. Total phenolics varied significantly among the different plant parts. It was ranged from 6.57 to 13.36 mg/g in roots, 2.99 to 5.54 mg/g in shoots and 2.30 to 4.94 mg/g in leaves.

Programme 5. Use of rootstocks for grape cultivation

5.1 Vegetative parameters

Thompson Seedless grafted on different rootstocks and own rooted vines were studied for vegetative parameters during the years. Significant differences were recorded for all the vegetative parameters studied. Own rooted Thompson Seedless was early to sprout (10.76 days) as compared to all different rootstocks. The days taken for bud sprout ranged from 10.91 in St. George grafted vines to 13.23 days in vines grafted on Dogridge. October pruned biomass varied from 0.82 kg in 99 R rootstock to 1.22 kg in Dogridge grafted vines. The shoot length recorded at 90th days after back pruning also varied significantly among the different rootstocks with maximum shoot length obtained in the vines grafted on Dogridge (121.43 cm) and the lowest shoot length in own root (93.63 cm). The cane diameter ranged from 7.05 mm in own root to 8.85 mm in Dogridge grafted vines. Total number of canes also varied significantly among the different rootstocks. The vines grafted on 110R rootstock exhibited more number of canes/vines (52.49) followed by those grafted on St. George 42.18.

5.2 Yield and quality parameters

Rootstock plays an important role in achieving the higher yield and also better quality in grapes. Significant differences were recorded among the different yield contributing characters. Total number of bunches / vine varied significantly among the different rootstocks. Highest number of bunches / vine were recorded in 110R rootstock (64.58) followed by 61.00 in own rooted vines and 58.18 in 99R whereas St. George exhibited minimum number of bunches (42.34) per vine. The average bunch weight was less in own rooted vines (126.85) as compared to 110R (193.20) and Dogridge (185.70 g). The same trend was also recorded for 50 berry weight. Berry diameter was also higher in Dogridge rootstock, while own rooted vines had minimum berry diameter of 15.13 mm. The differences for TSS among own root and 110R grafted vines were at par. Higher yield of 14.95 kg / vine was recorded in 110R rootstock followed by 13.85 kg vine in Dogridge, whereas St. George had less yield (8.69 kg) as compared to 10.47 kg in own rooted vines.

5.3 Biochemical changes in different berry development stages

To study the influence of different rootstocks on biochemical changes at different berry development stage, fresh samples from leaf and berries were collected.

Significant differences were recorded for all the biochemical parameters among different rootstocks studied. Phenolic content in leaf was found to be reduce from 3 leaf stage to 6-8 mm berry growth and was again increased at veraison stage. At 3-4 mm berry stage, the total phenol in leaf varied from 5.03 (99R) to 6.21 (1103P). At veraison stage, the total phenol increased and ranged from 8.24 (Dogridge) to 10.33 (own root). The concentration of phenol in leaf was reduced from veraison to

harvest. In berries, the concentration of phenol increased from 3-4 mm berry stage to 6-8 mm berry development stage, however, the phenol content reduced from veraison stage to harvest. Protein content in leaf was also reduced from 3-4 mm to 6-8 mm berry stage. This was again increased at veraison stage of berries and then drastically reduced till harvest stage. However, in berries the protein content was maximum at 3-4 mm and was found to be reduced in all the berry growth stages till harvest. Reducing sugar in leaf increased from 3-4 mm to veraison stage however, from veraison stage, it then reduced till harvest stage of berries. In berries, the reducing sugar was recorded to increase from 3-4 mm berry stage to the harvest stage. Carbohydrate content in leaf increased from 3-4 mm berry stage to 6-8 mm berry size. This was again reduced till veraison stage. However, in berries carbohydrate content was increased from 3-4 mm berry stage to harvest stage.

Programme 6. Horticultural practices for quality and yield in table and wine grapes

6.1 Source:sink in relation to different training modification in Tas-A-Ganesh grapes

i. Effect of stems on growth and yield parameter

Single and double stems were retained to study their effect on growth and yield parameters. October biomass was higher in double stem (1.07 kg) as compared to the single stem (0.86 kg/vine). However, the interaction effect among stems and training modifications was non-significant. Higher shoot length of 103.16 cm was recorded in double stem as compared to 80.75 cm in single stem. Significant differences were recorded for shoot diameter, with higher shoot diameter in single stem than in double stem.

Number of bunches were more in double stem (56.56) as compared to 51.74 in single stem. Among the different modifications, more number of bunches (68.85) were recorded in four cordon followed by double cordon (50.96). Average bunch weight was more in double cordon (167.54) than in single stem (161.95). However, among the training modifications, double cordon resulted in to higher average bunch weight (168.75 g) as compared to other training modifications. The difference for berry length, TSS and 50 berry weight was non-significant. Berry diameter was higher in single stem (16.16 mm) as compared to the double stem (16.07 mm). The yield / vine was higher in double stem as compared to single stem indicating that the vines raised as double stem and trained to double cordons with horizontal directions are better in growth and yield.

ii. Effect of plant type on growth and yield parameters

Tas-A-Ganesh vines were grafted on Dogridge rootstock and compared with own rooted vines for growth and yield parameters. Pruned biomass during forward pruning was higher (0.86 mg/vine) in grafted vines as compared to the own rooted vines (0.68 kg/vine). Among the training modifications, single cordons produced more pruned biomass as compared to double and four cordons. Higher shoot length was recorded in grafted vines (80.75 cm) as compared to the own rooted vines (66.96 cm). Significant differences were recorded for shoot diameter with 7.89 mm in grafted vines as compared to 7.32 mm in own rooted vines.

More number of canes (64.06) were produced on grafted vines than in own rooted vines (51.55).

Significantly higher fruitfulness (78.47%) were recorded in grafted vines than in the own rooted vines (71.76). With the increase in number of canes / vine, the leaf area index was also higher in grafted vines (1.91) than in own rooted vines (1.31).

Higher number of bunches were recorded in the vines grafted on Dogridge rootstock. Higher bunch weight (161.95 g) 50 berry weight (149.91 g) and berry diameter (16.16 mm) were recorded in grafted vines as compared to 133.40, 138.31 g and 15.0 mm respectively in own rooted vines. Since the number of bunches and bunch weight were also higher in grafted vines, the yield / vine in grafted vines was more than the own rooted vines.

Programme 7. Nutrient and soil management in grapes

7.1 Standardizing K dose for Cabernet Sauvignon vines grafted on 110R rootstock

An experiment was initiated on standardizing potassium dose for Cabernet Sauvignon vines raised on 110R rootstock and irrigated with saline water since April 2009. The vines were 1.5 year old at the time of initiating the experiment. Irrigation water had EC=2.0 dS/m. The experimental soil had a pH (1:2.5) = 7.65, EC (1:2) =1.29, Organic carbon = 0.67%, Calcium carbonate = 6.9% and 1N neutral ammonium acetate extractable K= 141.3 kg/ha. The potassium treatments ranging from 0 to 600 kg K_2O/ha in the form of potassium sulphate were imposed after foundation pruning in 12 splits in a year.

Data in table 7 and 8 indicated that application of K_2O @ 200-300 kg/ha increased the yield and potassium content significantly over control. Highest yield was obtained in the treatment 500 kg K_2O/ha which was at par with treatments T4 to T8. Potassium application of 300 kg K_2O/ha and above resulted in significant increase in bunch weight over control treatment. Significantly higher K content was recorded at flowering stage in treatments T6 to T8 compared to other treatments. They also recorded significant increase in K content over control at 135 days after foundation pruning.

Table 7. Effect of K treatments on yield and yield related parameters of Cabernet Sauvignon

Treatment (kg K_2O/ha)	Bunch number	Bunch weight (g)	Fruit Pruning weight (g/vine)	Yield (t/ha)
T1 : control	32.0	31	244.0	3.32
T2 : 50 kg	31.3	32	260.3	3.43
T3 : 100 kg	32.0	33	273.7	3.60
T4 : 200 kg	36.0	36	269.0	4.36
T5 : 300 kg	36.7	42	283.7	5.21
T6 : 400 kg	35.7	39	285.0	4.71
T7 : 500 kg	38.7	41	270.7	5.32
T8 : 600 kg	36.0	40	275.3	4.83
Sem ±	3.6	3	20.6	0.47
CD at 5%	7.6	6	NS	1.00

Table 8. K and Na content in the petiole of Cabernet Sauvignon vines at 135 DAFP and flowering stage (FS)

Treatment (kg K_2O/ha)	Petiole K (%)		Petiole Na (%)	
	BDS	FS	BDS	FS
T1 : control	0.56	0.49	0.17	0.15
T2 : 50 kg	0.56	0.54	0.17	0.13
T3 : 100 kg	0.63	0.53	0.16	0.13
T4 : 200 kg	0.66	0.57	0.17	0.15
T5 : 300 kg	0.69	0.59	0.17	0.14
T6 : 400 kg	0.68	0.66	0.15	0.14
T7 : 500 kg	0.72	0.70	0.15	0.15
T8 : 600 kg	0.74	0.69	0.15	0.14
Sem ±	0.05	0.03	0.012	0.02
CD at 5%	0.10	0.07		

7.2 Isolation of salinity tolerant P solubilizing fungi and bioactivities of poorly soluble rock phosphate

The salinity tolerant P solubilizing fungal isolates belonging to *Aspergilus niger* were isolated from vineyard soils. Three efficient *Aspergillus niger* isolates were tested for their P solubilizing capabilities under varied NaCl salinity ranging from 200 to 10000 ppm with tri-calcium phosphate (Fig. 10) and rock phosphate (Fig. 11) as P sources. All the isolates were able to solubilize P in salinity concentration upto 10,000 ppm NaCl for both the P sources. Amount of P solubilized in case of rock phosphate was less compared to that solubilized from calcium triphosphate at all the salinity levels under study. In case of rock phosphate, a sharp reduction in solubilized P content was observed when the salinity increased from 200 to 5000 and 10000 ppm.

Udaipur rock phosphate was also reacted with liquid culture supernatant (LCS) obtained after 12 days growth of *Aspergillus niger* isolates (Fig.12). Amount of LCS ranged from 400 ml/kg to 1000 ml/kg rock phosphate. LCS obtained from all three isolates could increase the soluble phosphorus content which increased with increasing amounts of LCS added. In the third experiment, the solubilized P content by LCS from different isolates was compared with 2% citric acid using different rock phosphate:LCS/citric acid ratios. LCS from all the three sources solubilized significantly higher phosphorus compared to citric acid. Above results indicated that these strains can be used under saline-alkali conditions.

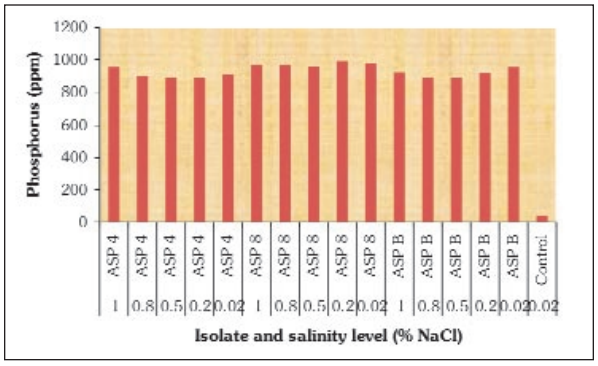


Fig. 10. Salinity tolerance of Isolates with calcium triphosphate as P source

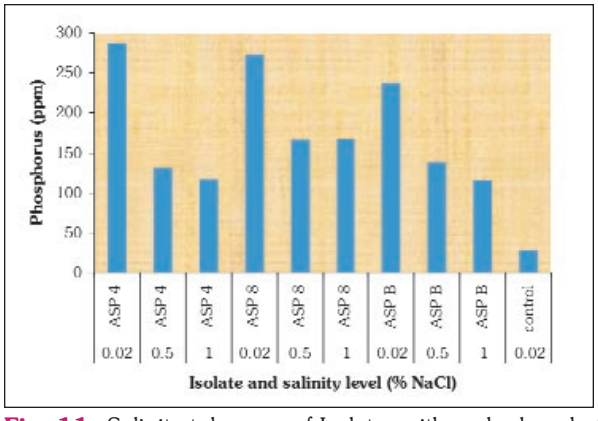


Fig. 11. Salinity tolerance of Isolates with rock phosphate as P source

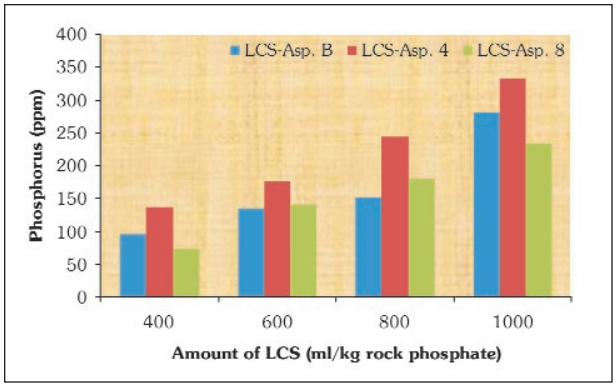


Fig. 12. P solubilization from rock phosphate using Liquid Culture Supernatant

7.3 Effect of sulphur sources on available sulphur content in soil

Fertis is the micronized source of sulphur that can be applied through the drip water which will lead to labour saving. Further, it gives flexibility in application. Sulphur availability in soil from the Fertis source was compared with dust powder, a commonly used sulphur source in the vineyards. Both the sources increased the available sulphur content in the soil at all the level of application (Fig. 13), under laboratory condition. Increasing levels of sulphur, increased the available sulphur content in the soil. Both the sources increased DTPA extractable Mn content over control.

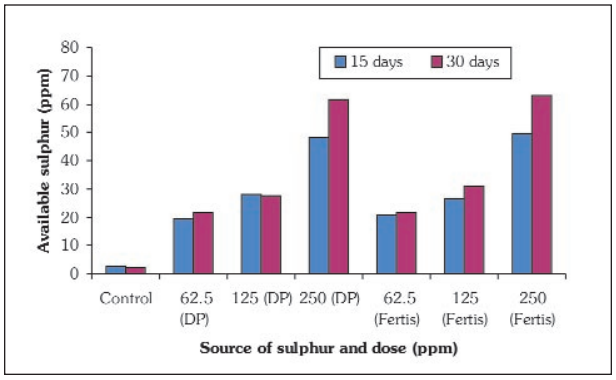


Fig. 13. Effect of sulphur source and dose on the available sulphur content

7.4 Diagnosis on nutrient imbalance in Cabernet Sauvignon vines exhibiting leaf chlorosis

During the course of survey in the Nasik district, a number of vineyards with Cabernet Sauvignon grapes were found to show either reddening of the leaf at the margin or irregular reddening pattern in the leaves (Fig. 14 and 15). This differed from the classical K deficiency symptoms. The vineyards were sampled after veraison stage. The leaf and petiole samples were analysed for various nutrients viz. Ca, Mg, Na and K. In all the affected leaves, the K content in the leaf blade and petiole was below 0.57% whereas the healthy leaf had K content above 0.71%. The other nutrient under investigation did not differ between healthy and affected leaf. This showed that the vineyards were inadequately fertilized with potassium fertilizers.

Fig. 14. Cabernet Sauvignon leaves showing various symptoms

Fig. 15. Cabernet Sauvignon vine with leaf chlorosis

Programme 8. Water management in grapes

8.1 Effect of carrier water quality on the control of weeds in the vineyards

8.1.1 To study the efficacy of herbicide Glyphosate 41 SL in the management of Cynodon weeds using different quality of water for spray.

The soil of the experimental site was calcareous exhibiting swelling and shrinkage properties. Vineyard rows having more or less similar weed density were selected for the experiment. The weed population among different plots was 705 to 762/m^2. A spray solution of 1500 liters per hectare basis was used. The weed plants were sampled after 10 days and were analysed for sugar, phenol, protein and chlorophyll content. Glyphosate was used @ of 5.0 and 7.5 ml using three different carrier water qualities viz. open well (EC=1.95 dS/m), bore well (EC=1.10 dS/m and Corporation water (EC=0.14 dS/m). The weedicide was applied at 12-13 leaf stage (nearing flowering stage, stolon length ranging from 45-50 cm).

The quality of water used for spraying the herbicide had significant impact on killing regeneration of weeds. Irrespective of quality of water, the higher concentration of herbicide i.e. 7.5 ml/L had better control of the weed as compared to the use @ 5.0 ml/L. However, the per cent regeneration of stolons per m^2 was significantly reduced in the treatments with canal water and bore well water. The results for bore well water with 5.0 ml/L glyphosate were on par with that for well water with 7.5 ml/L. The use of glyphosate @ 5.0 ml/L with well water registered highest regeneration among the herbicide treatments. Unsprayed control showed 100% regeneration.

The degradation of chlorophyll was fast in herbicide treatments with canal water followed by bore well water. The degradation of chlorophyll was on par in case of canal water, bore well water and well water sprayed @ 5.00, 7.5 and 7.5 ml, respectively. The reducing sugars were significantly increased in case of herbicide sprayed samples over unsprayed control whereas the total sugars and starch content reduced significantly in herbicide sprayed weeds. The protein content was lowest in case of

spray treatments using canal water (both concentrations) and bore well water (7.5 ml/L) followed by the well water (7.5 ml/L). The protein contents in weed samples sprayed with 5 ml/L and 7.5 ml/L glyphosate through bore well and well water, respectively were on par but was significantly less than the unsprayed control. The herbicide spray caused significant increase in total phenolic content of the weed over unsprayed control. It was highest in canal water and well water at 7.5 ml/L of glyphosate. The results were at par in other treatments except the unsprayed control.

The results showed that the water quality had significant impact on weed management with the water having lowest EC was more superior in weed control and its effect on preventing regeneration than the higher EC water.

8.1.2 To study the effect of different additives to spray water for improving the efficacy of herbicide Glyphosate 41 SL in the management of Cynodon sp. weeds.

In this experiment, glyphosate was sprayed at 7-8 leaf stage (younger age, stolon length ranging from 25-30 cm) using flat fan nozzle and knapsack sprayer. The same sources of carrier water and glyphosate concentrations ranging from 3 to 5 ml/L were used for the second experiment. The citric acid was used @ 0.5g /L and GA @ 5 ppm.

Significant differences were observed in the control of weeds in sprayed treatments over unsprayed control. The percent killing was on par between all treatments except T2 and T8. The use of additives along with different water sources (Table 9) indicated that the efficacy of the spray with poor quality water increased significantly by use of citric acid as observed in treatment T3 where the EC value of water used for spraying was 1.95 dS/m.

Table 9. Effect of carrier water quality and adjuvant on the control of Cynodon sp.

Treat-ment	Description	% Control	Chlorophyll	Protein	Phenol
T1	5 ml glyphosate with well water	93.34 ± 3.98	1.44 ± 0.04	17.99 ± 0.54	15.95 ± 1.12
T2	3 ml glyphosate with well water	57.67 ± 6.34	2.56 ± 0.15	27.46 ± 1.65	12.17 ± 0.37
T3	3 ml glyphosate with well water + citric acid	83.33 ± 9.16	1.71 ± 0.10	21.89 ± 1.53	14.61 ± 0.73
T4	3 ml glyphosate with bore well water + Citric acid	91.33 ± 8.22	1.60 ± 0.06	19.08 ± 0.76	14.47 ± 0.87
T5	3 ml glyphosate with bore well water + GA + citric acid	94.67 ± 2.98	1.58 ± 0.11	18.93 ± 0.95	14.29 ± 0.57
T6	3 ml glyphosate with corporation water	94.33 ± 1.84	1.53 ± 0.05	18.79 ± 1.32	12.19 ± 0.37
T7	3 ml glyphosate with corporation water + GA	95.33 ± 2.37	1.48 ± 0.07	18.67 ± 0.56	11.94 ± 0.84
T8	Unsprayed control	0.00 ± 0.00	2.89 ± 0.09	32.37 ± 1.62	8.81 ± 0.53
p-value		<0.001	<0.001	<0.001	<0.001

Programme 9. Grape physiology including use of bioregulators

9.1 Studies on pink berry in white grapes and its management

I. Effect of paper cover bags on incidence of pink berry formation

The different paper covers were used to cover the bunches in order to avoid the pink berry formation at 75 days after pruning. The treatment details are given in table 10.

Table 10. Details of paper cover treatments

Treatments	Paper cover
T1	Tyvek (Closed)
T2	Tyvek (open)
T3	White paper (closed)
T4	News paper (open)
T5	News paper (closed)
T6	No cover (open bunches)

The data in table 11 indicated the significant differences on the occurrence of pink berry in covered and uncovered bunches. The number of pink berries was recorded more in uncovered as compared to covered bunches. The other parameters like berry crispness, berry length, skin thickness and TSS showed the significant differences. The berry crispness was found less in uncovered bunches as compared to covered bunches. Likewise, the skin thickness and berry length was found less in uncovered bunches. No significant differences were recorded for shelf life.

Table 11. Effect of paper covers on bunch and berry characters

Treatment	Number of pink berries	Number of green berries	Berry length (mm)	TSS (°B)	Skin thickness (Um)	Berry crispness (g)
T1	1.3+2.3a	65.3+12.7a	21.1+0.3a	20.1+0.6b	20.2+2.0b	186.8+9.0bc
T2	2.0+3.4a	78.7+4.2a	21.3+0.6a	19.5+1.1b	21.9+0.2ab	199.3+4.5ab
T3	0.0+0.0a	84.7+18.6a	20.6+0.1a	20.0+1.1b	21.3+0.9ab	197.0+8.8abc
T4	0.0+0.0a	72.7+14.4a	20.9+1.0a	19.4+0.3b	21.2+0.0a	201.5+9.5ab
T5	0.0+0.0a	74.0+14.4a	20.8+0.9a	18.7+1.0b	21.7+0.3a	209.0+15.2a
T6	28.6+28.2ab	59.0+42.5a	18.3+0.9b	25.5+1.4a	19.2+1.4a	180.0+7.5c

Letters indicate the treatment wise significant difference. Treatments followed by the same letter are not significantly different according to Duncan's multiple range test at $p<05$.

9.2 Management of other physiological disorder

9.2.1 Swelling of knot disorder

This year also occurrence of swelling of knot disorder in Sharad Seedless and Thompson Seedless was reported particularly from Walwa and some parts in Indapur area.

The samples were collected from Walwa, Sangli and Indapur, Pune regions and analysed for berry characters. The berry crispness was found to be less in affected samples as compared to unaffected berries. Similarly, the berry thickness, TSS, acidity, reducing sugar and protein content in the berries were found less in affected berries as compared to unaffected berries.

9.5 New chemicals/ botanicals for improving bud break and grape quality

9.5.1 Bio efficacy of GA_3 (40 %) in grapes

GA_3 contains granules of 40% Gibberrellic acid and is used to increase the berry size and quality of grapes. The trial was sponsored by M/s Sumitomo India Pvt. Ltd., New Delhi, India

The data on bunch, berry, quality and yield showed the significant differences within the treatments. Among these parameters, the mean bunch weight was recorded more in GA_3 treatments as compared to the untreated control. All the treatments of GA_3 were on par with each other but higher than the untreated control with respect to 50 berry weight. The berry size particularly berry length was also increased in all the treatments of GA_3 as compared to control. However, the TSS and acidity did not show the similar trend. Yield per vine was recorded significantly high in GA_3 treatment. The physiological loss in weight varied significantly upto 3rd day in the shelf and the minimum PLW was recorded in all the GA_3 treatments as compared to untreated control.

9.5.2 Bio efficacy of milagro in grapes

Milagro or green boost is a plant growth improver. It is a extract of sugar cane flowers which acts as a biostimulant. This trial was sponsored by Greencrop International Pvt. Ltd., Shivajinagar, Pune.

The data on effect of milagro showed significant differences with respect to shoot length, bunch, berry and yield parameters. The shelf life data also showed the significant differences from 4th day onwards. The shoot length and bunch parameters like mean bunch weight and 50 berry weight were recorded significantly more in milagro treatments as compared to untreated control. Likewise, the berry parameters recorded better in milagro treatments as compared to untreated control. Among the milagro treatments, application of 30 ml milagro/100 L water performed better than other two treatments.

The physiological loss in weight showed significant differences from 4th day onwards and application of 30 ml milagro/100 L water recorded the least loss of weight during the cold storage upto 7 days.

9.5.3 Bioefficacy of Silixol in grapes

Silixol is a unique formulation of stabilized, highly concentrated silicic acid. Plants take up silicon as silicic acid, the bio available form of silicon which is transported to all plant parts. The trial was sponsored by Prithvi Pharma Pvt. Ltd., Mumbai.

The bunch weight (g) and number of berries per bunch were not affected significantly by Silixol levels as well as spraying schedule. But the 50 berry weight was significantly improved by all the levels of Silixol over control. The maximum 50 berry weight was recorded with application of 1.0 L Silixol in four splits at 15, 30, 45 and 60 days after October pruning.

The application of Silixol resulted in reduction of berry diameter while berry length was increased. Silixol application @ 2.0 L/ha increased berry skin thickness which was significantly superior over all the levels of Silixol, whereas higher berry crispness was recorded with application of 1.0 L/ha Silixol compared to all other levels of Silixol.

9.5.4 Bioefficacy of hydrogen cyanamide in grapes

Hydrogen cyanamide (H_2CN_2) is a liquid formulation used for obtaining uniform bud break in grapes. The trial was conducted at centre's research farm and was sponsored by M/s Mauni Agrochemical Industries Pvt. Ltd., Kopargaon, district Ahmednagar.

The per cent bud break was significantly higher in all the treatments of H_2CN_2. The duration of bud break and days taken for bud break was the least for H_2CN_2 treatments.

Number of berries/bunch, mean bunch weight and 50 berry weight did not show significant differences among the treatments. However, yield/vine was significantly differed and the treatments of H_2CN_2 resulted into more yield as compared to untreated control. No effect of H_2CN_2 was found on berry size. The quality parameters like TSS and acidity recorded the significant differences, however no clear trend was found.

No phytotoxic effect of H_2CN_2 was recorded either on vine or berries.

Programme 11. Integrated disease management in grapes

11.1 Development and testing of disease forecasting models and development of pest alert systems

A model for estimating risk of downy mildew to support the decision on spraying in the vineyards was prepared. The model has considered the following facts

- The downy mildew normally becomes active after the onset of monsoon (Initiation of primary cycle) and then spreads in vineyards (Secondary cycle).
- For new infection presence of free moisture is required at-least for 2 to 3 hours during day light

Model in brief

Step 1 : Initiation of primary cycle

After the onset of monsoon, if following weather is recorded it will be considered that primary cycle has initiated

- Three rainy days (4.0 mm rain/day) in a week

- Maximum temperature drops below 30°C immediately after the rains
- RH is continuously above 65 per cent

Action : First preventive spray should be given immediately after initiation of primary cycle

Step 2 : Estimation of downy mildew risk for deciding time of subsequent sprays

Values of daily minimum and maximum temperature and RH are used. Each recorded value is given ratings on 0 to 2 scale. Summation of daily ratings on all parameters are calculated and cumulative totals of the daily summation is used for estimation of downy mildew risk. Downy mildew risk starts when cumulative total is above 24. Number of days required to reach cumulative total above 24 decide the level of risk as described below.

Days required to accumulate 24 rating	Disease Risk	Action
3	High	Immediate spray
4-5	Medium	Spray within a day of start of risk
6-7	Low	Spray if symptoms seen
>= 8	Nil	No spray needed

Normal recommended spray interval during June to September is 10 to 15 days. Three to five sprays of copper based fungicides are given during this period depending upon rain pattern. Above estimated risk will be used for deciding interval between two successive sprays.

The first 50 days after forward pruning are considered a high risk period for damage due to downy mildew. Sprays of systemic fungicides for downy mildew are normally recommended at 5 days interval starting from 10-12 days of pruning. Sprays interval is preponed or postponed after observing duration of leaf wetness up to 10 A.M. Spray is recommended if morning leaf wetness is more than 3 hours and if during last 3-5 days spray of systemic fungicide was not given.

Estimated downy mildew risk in this model will be useful only to postpone the spray beyond 5 days when morning leaf wetness is not present for long duration.

Above mentioned model is framed in a Excel sheet, which estimates downy mildew risk automatically when daily data on temperature and RH is entered. Weather data and incidence of downy mildew recorded during 2008-09 and 2009-10 in centre's farm were used for determining the correctness of the model. In most cases the estimated risk of downy mildew and actual downy mildew recorded were reasonably correct. The model will be used for demonstration of downy mildew management in vineyard during 2010-11.

11.2 Studies on bio-efficacy of fungicides and products with safer environmental profiles for management of grape diseases

Following fungicides were tested in field trials for their bio-efficacy for the management of grape diseases either after foundation or forward pruning. Optimum doses of the formulation as indicated by the results are also given in the table 12. For the control of anthracnose and powdery mildew after

back pruning, about 4 to 6 sprays were needed depending upon the rainfall pattern. Similarly for the control of powdery mildew disease after fruit pruning about 6 sprays were needed. Bio-efficacy trials on downy mildew were conducted at three locations (Walwa, Pandharpur and Kannur in Sangli, Solapur, and Bijapur districts). Due to rains during November and December 2009, about 8 to 9 sprays were needed for effective control of downy mildew on leaves and bunches.

Table 12. Fungicides tested with their effective doses for the control of grape diseases

Sr. No.	Name of fungicide or its formulation	Type of disease managed	Optimum dose of fungicide
A. Fungicides tested after foundation pruning (April to October 2009)			
1.	Milastin-K (Formulation of bacterium *Bacillus subtilis* strain KTSB)	Powdery mildew	The bacterial formulation and 'activator' is mixed in 1:10 proportion just before use and mixture is used @1.0 ml / L
2.	Trifumizole (Procure 480SC)	Powdery mildew	0.423 – 0.563 ml / L
3.	Sporekiller (A fungicide based on natural extract taken from plants like *Laminaria* and *Curcuma longa*)	Powdery mildew	3 – 4 ml / L
4.	Thiophanate Methyl (Roko 70WP)	Anthracnose	0.715 – 0.89 g / L
5.	Cuprous Oxide 75WG	Anthracnose	1.5 – 2.0 g / L
B. Fungicide tested after forward pruning (October 2009 to April 2010)			
7.	Fluopyram (20%) + Tebuconazole (20%) 400SC	Powdery mildew	0.47 to 0.56 ml / L
8.	Tebuconazole 25WG	Powdery mildew	0.5 ml / L
9.	Penconazole 10 EC	Powdery mildew	0.5 ml / L
10.	Trifumizole (Procure 480 SC)	Powdery mildew	0.563 ml / L
11.	Milastin-K	Powdery mildew	1.0 ml / L
12.	Sporekiller	Powdery mildew	3-4 ml / L
13.	Silixol (1.5% Silicic acid)	Powdery mildew	Not effective
B. Tested after fruit pruning at 3 locations at Walwa, Pandharpur and Kannur (October 2009 to April 2010)			
14.	BASF-651	Downy mildew	0.8 to 1.0 g/ L
15.	Metominostrobin 20SC	Downy mildew	0.6 to 0.8 ml / L
16.	Picoxystrobin 25SC (Acanto)	Downy mildew	0.3 to 0.4 ml / L

11.3 Studies on the biology and control of the fungi causing anthracnose disease in grapes (Partly funded under ICAR-ORP on diagnosis and management of leaf spot diseases of field and horticultural crops)

Grape leaves and shoots infected with anthracnose disease were collected from 25 commercial vineyards of different cultivars from Maharashtra and Karnataka. The location (Altitude, Latitude and Longitude) of each vine was noted using GPS 76 marine navigator. It varied from Latitude 16° 46.359' N (Miraj) to 20° 28. 557' N (Kalwan); and 73° 59.052' E (Pune) to 75° 56.883' E (Solapur). Two types of symptoms were noticed, the most common being circular spots with dark brown margins and light brown center and a yellow halo around the spot and the second symptom being angular dark brown spots resembling bacterial spots. Total three hundred and sixty-seven isolates were obtained and purified.

Majority of the isolates seem to belong to *Colletotrichum gloeosporoides* and few isolates to *C. capsici*. None seemed to belong to *Sphaceloma gloeosporoide* (*Elsinoe ampelina*) the reported pathogen of the disease. Seven representative cultures were sent to Dr. P. Chowdappa, IIHR, Bangalore for confirmation of identification using species specific primers and to NBAIM, Mau for analysis and preservation. *C. capsici* is probably a new report on grapes.

Out of the 13 *C. capsici* isolates, setae were found in all thirteen isolates. However, among the 354 *C. gloeosporoides* isolates, setae were found in the acervuli of 5 isolates and absent from the rest. Further, among *C. gloeosporoides* isolates seventeen morphological groups were formed based on colony characteristics. The spore shape of different isolates was straight cylindrical or straight dumbbell and the size varied from approximately 10 x 5 µ to 20 x 7.3 µ. The growth rate of all 367 isolates was studied at 30°C.

11.4 Bioprospecting for viticulturally important micro-organisms (Partly funded under ICAR - AMAAS project)

To isolate endophytic microorganisms with potential for bio-control of important grape diseases, vineyards of the main commercial and recently introduced promising table and grape cultivars from the research farms of this Centre and Maharashtra State Grape Growers' Association's farm at Manjri, Pune, and Private vineyards in Pune, Solapur, Bijapur, Dindigal and Odiapatty areas were surveyed to identify healthy vines. Survey was conducted during monsoon, which is the time when all the three diseases occur in the field. More than 5000 vines were observed. No vine was found completely free from any of the three diseases. Therefore, vines or individual shoots exhibiting low incidence of the three diseases were selected for sampling.

Isolations for endophytes were done from shoot, lamina, petiole and root sections following standard procedures. Isolations were also done from phyllosphere and rhizosphere and non-rhizosphere soils. Two hundred and ninety three bacteria were isolated from the 45 samples collected during the year. The isolates were tested *in vitro* against Colletotrichum gloeosporoides and *Plasmopara viticola* (on infected, sporulating leaves).

11.5 Studies on grape viruses

11.5.1 DAS-ELISA testing

Twenty seven vines of promising table and wine grape cultivars viz. Fantasy Seedless, Crimson Seedless, Sharad Seedless, Sharad Seedless (Jumbo), Thompson Seedless, Tas-A-Ganesh, Manjri Naveen, Pinot Noir, Merlot, Shiraz, Syrah, Cinsaut, Chardonnay, Viognier, Similion and Sauvignon were tested for presence of Grapevine Leaf Roll associated Virus 1 and 3 (GLRaV-1 and GLRaV-3) using commercially available DAS-ELISA kits from Bioreba (Switzerland). Twenty-four vines that were free from both GLRaV-1 and GLRaV-3 were identified as suitable for use as mother trees for nursery propagation.

Among table grapes, Thompson Seedless which was found positive to GLRaV-3 did not show any symptom of the virus on the leaves and was considered as symptomless carrier. Young grafted plants of Sharad Seedless 'Jumbo' showed typical symptoms of the GLRaV viruses and showed positive reaction in DAS-ELISA for GLRaV-3.

B. RT-PCR based method for detection of GLRaV-3

The RT-PCR based method for detection of GLRaV-3 was validated using samples showing consistent positive or negative results for the presence of GLRaV-3 from DAS-ELISA tests. Samples from leaf and petiole were used. The validation was successful and the PCR products showed bands between 500-600 bp on electrophoresis gel in case of both plants (Fig. 16). Vines, which gave inconsistent results for presence of GLRaV-3 from DAS-ELISA tests (sample 1, 2 5 and 6) were also tested positive by RT-PCR based method. Similarly Sharad Seedless (Sample 3 and 7) and Tas-A-Ganesh (Sample 4 and 8) plants which were consistently negative for GLRaV-3 in DAS-ELISA test showed negative result in RT-PCR detection method.

The Thompson Seedless vine (Sample 2 and 6) has consistently given positive to GLRaV-3 in DAS-ELISA and also showed amplification by RT-PCR. This plant does not show any visual symptom of GLRaV virus and hence is a symptomless carrier.

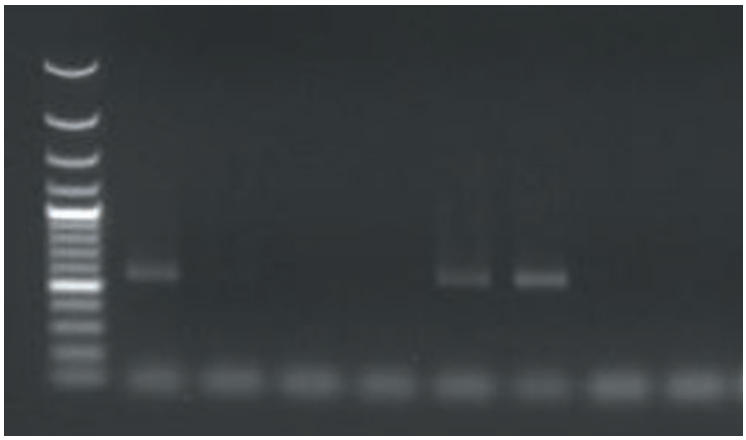


Fig. 16. Sample 1 and 5 (Pinot Noir leaf and petiole), 2 and 6 (Thompson Seedless leaf and petiole) showed positive to GLRaV-3. Amplifications was better in petiole samples (5 and 6). Thompson Seedless as symptomless carrier was confirmed (Sample 2 and 6)

Programme 12. Integrated insect and mite pest management in grapes

12.1 Seasonal incidence of insect pests in grape vineyards and their correlation with weather-parameters

A steady build up of thrips population was observed from 1.9 thrips per shoot in third week of October to 7 thrips per shoot during first week of November. During second week of November, the thrips population declined to 3.1 thrips per shoot, increased in December up to 9.46 thrips per shoot and again started declining from January onwards in Pune. Further the studies have shown that increase in the thrips population coincided with the flowering period and absence of rains.

Mite population was found to increase from 0.36 mites per leaf in the second fortnight of November and reached a peak of 43.30 mites per leaf in January at Pune. Mites were also a problem in those plots where the foundation pruning was undertaken early i.e. in the month of January or February. Population build up was attributed to increase in temperature, decrease in humidity and absence of rains.

Mealy bugs appeared in the last week of November at a very low level. The population did not build up and was confined mostly to the aerial roots and new buds because of the unfavourable climatic conditions. Again during the last week of December appeared as slight mealy secretions with very few colonies, remained in the plant and later on started migrating to the bunches once the bunch development had started. During the second week of January, the population slowly raised and reached peak population of 7-8 colonies/plant by the last week of February. Even though mealy bug population coincided with the increase in temperature, they do prefer slight humid condition to multiply.

12.2 Survey for incidence of insect pests and their natural enemies in important grape growing areas

Two species of thrips viz., *Scirtothrips dorsalis* and *Retithrips syriacus* (Fig. 17) were found during survey. Berry scarring due to thrips feeding was more in Sangli (15%) than Nasik (6%) during 2009-10.

Fig. 17. *Retithrips* syriacus

The mite causing the damage to grapes was identified as red spider mite *Tetranychus urticae*. More than 50% of the leaves were found infested with mites at some pockets in Centre's farm during January-February 2010, especially in those vineyards which were already harvested and not given any pesticide applications after harvest. The population remained at this level till foundation pruning. The incidence of mite was noticed more in and around Nasik (upto 9.1 mites per shoot per vine) than Sangli during February 2010.

Parasitoids of mealy bugs were collected from the field. They are very small wasps of 2-3 mm size and possibly belong to the genera *Anagyrus* sp. and *Allotropa* sp. They are yet to be identified. They very actively search out the mealy bugs

Fig. 18. Grape stem borer adult beetle

and oviposit. The young ones developed internally in the mealy bugs and resulted in mummified mealy bugs. The mummified mealy bugs body resembled a rice grain but its legs were seen clearly attached at the ventral side.

Stem borer was found causing damage in and around Sangli, Solapur, Pune and Nasik region. The cerambycid beetles are yet to be identified. The collected beetles were black in colour (Fig. 18), some with their antennal length equal to the size of the body and others with antennae longer than their body. Several exit holes were found in a single plant. Eggs are white in colour with human eye-shaped and with both ends pointed (Fig. 19). Grubs of stem borer were creamy-white in colour (Fig 20). One parasitoid that emerged from one of the stem borer pupae collected from Sangli, was identified as a braconid.

Fig. 19. Grape stem borer egg

Fig. 20. Grape stem borer grub

Jassids (leafhoppers) were found causing damage in Centre's farm especially when the new flushes emerged after pruning. The major species was identified as *Amrasca biggutula biggutula* (Ishida), and the other species as *Neodartus acocephaloides* (Melichar), *Uzeldikra citrina* (Melichar) etc. The help rendered for identification of leafhoppers and other pests by Dr. C. A. Viraktamath, UAS, GKVK, Bangalore and thrips by Dr. Ranga Reddy, IIHR, Bangalore is gratefully acknowledged.

12.3 Evaluation of promising physical and cultural methods of insect pest management

Evaluation of blue and yellow sticky traps for the management of thrips and jassids, removal of loose bark and dead woods, destruction of infected pruned material, removal of weeds and alternate host plants for the management of mealy bugs is under progress with a view to incorporate these components in their respective IPM schedule.

12.4 Evaluation and utilization of parasites and predators

Parasitoids of mealy bugs belonging to genera *Anagyrus* and *Allotropa* were collected during survey which have been reported to be effective in controlling pink mealy bug, *Maconellicoccus hirsutus* in Mariana Islands. Species level identification of collected parasitoids is under progress.

12.5 Evaluation and utilization of different botanicals

Different botanicals were tested for their bio-efficacy against grape insect pests (Table 13). Mealy Quit and Mealy Kill @ 8 and 10 ml/L were found to be effective against crawler stage of mealy bugs. Azadirachtin 10000 ppm @ 2 ml/L was effective against thrips and mites.

Table 13. Botanicals tested for their bio-efficacy against grape insect pests

Sl. No	Name of the botanical	Major ingredients in the formulation	Target insect pests	Dose (ml/L)
1.	TERI-DBT Bollcure	Plant extract of *Eucalyptus*	Thrips and Mealy bugs	2.5, 5.0, 7.5, 10.0
2.	TERI-DBT Bollcure crude	Plant extract of *Eucalyptus*	Thrips and Mealy bugs	5.00,10.0, 20.0
3.	Mealy Quit	Soap-nut based	Thrips	5.0
			Mealy bugs	3.0
4.	Mealy Kill	Soap-nut based	Thrips	5.0
			Mealy bugs	3.0
5.	Azadirachtin 300 ppm	Neem based EC formulation	Thrips, Mites and Mealy bugs	5.0
6.	Azadirachtin 1500 ppm	Neem based EC formulation	Thrips, Mites and Mealy bugs	3.0
7.	Azadirachtin 10000 ppm	Neem based EC formulation	Thrips, Mites and Mealy bugs	2.0

12.6 Safety of new generation insecticides for Australian ladybird beetle *Cryptolaemus montrouzieri*

Several new generation insecticides like Floramite, propargite, fenpyroximate and abamectin were tested for their toxicity against *C. montrouzieri* under laboratory conditions. Propargite and Abamectin were found to be highly toxic causing 88.9% and 66.7% mortality of the beetles and Fenpyroximate was moderately toxic (33.3% mortality). Floramite, a new acaricidal molecule under trial, was found to be safer (11.11% mortality).

12.7 Testing new molecules for their bio-efficacy, effect on natural enemies and phytotoxicity in grapes

Two new generation insecticides viz. Bifenazate 240 SC and HGW 80 10% OD were tested on various insect pests like mealy bugs, mites and thrips. Both Bifenazate and HGW 80 did not cause any phytotoxicity during the field experiment. Bifenazate 240 SC @ 1 ml/l was found to be effective against mites (Table 14).

Table 14. Details of insecticides tested for their bio-efficacy, phytotoxicity and effect on natural enemies

Sl. No	Target pest	Insecticide used and brand name	Dose
1.	Thrips, flea beetles and mealy bugs	HGW 80 10% OD (Renaxypyr)	30, 40, 50, 60, 70 g a.i./ha
2.	Mites	Bifenazate 240 SC (Floramite)	0.25, 0.50 and 1.00 ml/l

Programme 13. Management of agrochemical residues and environmental contaminants in grapes

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

13.1.1 Persistence and dissipation study of Aureofungin

An UPLC-DAD analysis method based on ethanol extraction was developed for the residue analysis for Aureofungin in grapes. The residue kinetics followed first order non linear model with half life period of 2.5 days for single dose and 2.0 days for double dose. No residue was found in the harvest samples (20 day after the last spray) above the limit of detection (0.1 mg/kg).

13.1.2 Persistence and dissipation study of Fluopicolide and fosetyl-Al

A field trial study was conducted at four locations viz. Indian Institute of Horticultural Research (Bangalore), ANGRAU Rajendranagar (Hyderabad), Tamil Nadu Agricultural University (Coimbatore) and NRC Grapes (Pune). The samples were analysed for two separate methods of analysis developed and validated at NRL. Fosetyl-Al residues were estimated by LC-MS/MS with aqueous extraction of samples and Fluopicolide residues were estimated by GC-MS by ethyl acetate based method. Fluopicolide was persistent up to 15 days with half-life of 4.5 days at single dose and 5 days at double dose. Fosetyl Al residues were detected up to 3 days with half-life of 1.5 days.

13.2 Monitoring of agrochemical residues in grape and grape produce

13.2.1 Development of multiresidue method

A multiresidue analysis method was optimised and validated based on gas chromatography-time of flight mass spectrometry (GC-TOFMS) for the determination of 135 pesticides, 12 dioxin-like polychlorinated biphenyls (PCBs), 12 polyaromatic hydrocarbons (PAHs) and bisphenol A in grape and wine in a total run time of 48 min. An average recovery of 80-120 % with RSD < 10 % could be attained for most analytes. Limits of quantification (LOQ) ranged within 10-50 ng/g with <20% expanded uncertainties for most compounds in both grape and wine. The multiresidue method was successful for the analysis of 135 pesticides and 25 organic contaminants in grape and wine with satisfactory precision and accuracy at residue levels as low as 10 ng/g. As evident from the low measurement uncertainties for most compounds the method is suitable over a wide concentration range.

13.2.2 Development of single residue method for meptyldinocap

An improved method for the sensitive and selective determination of residues of meptyldinocap [2-(1-methylheptyl)-4,6-dinitrophenyl (2E)-2-butenoate] in grape, mango and pomegranate by LC-MS/MS was developed and validated. The hydrolysis reaction followed pseudo-first order kinetics and the reaction product was spectroscopically confirmed as 2-(1-methylheptyl)-4,6-dinitrophenol. Considering first-order rate kinetics, activation energy (Ea), enthalpy of activation (H‡) and entropy of activation (S‡) varied as solvent > mango > grape > pomegranate. Free energy of activation (G‡) at 298 K was higher than at 280 K. G‡ was similar for solvent and three matrices at both temperatures. The method provided good linearity in the concentration range of 5-100 ng/g (r^2 >0.99) with >80% recovery at

the limit of quantification (LOQ) of 10 ng/g in case of grape and mango and 25 ng/g for pomegranate, which are well below the European Union maximum residue limit (MRL) of 50 ng/g. The method was rugged with intra-laboratory Horwitz ratio of less than 0.5 (n=8) and measurement uncertainties <15% at the LOQ levels in all the test commodities.

13.2.3 Monitoring of agrochemical residues in exportable and domestic samples

Almost 500 export grape samples were assessed for their compliance to the EU-MRL. The samples were collected from export pack houses, farms and nominated testing laboratories and screened for 98 test pesticides as per the CIB guidelines of the Government of India. In all samples, the residues were found to be below their respective MRLs indicating the successful implementation of the pre-harvest residue monitoring program at the country level.

More than 50 domestic samples were collected from farm gates, local markets and super markets and evaluated with respect to the MRLs specified under the Prevention of Food Adulteration Act of the Government of India and in all samples, the residues were found to be below the PFA MRL.

13.2.4 Monitoring of agrochemical residues in Indian wine

Samples collected from different Indian wineries were mostly free from pesticide residues. In case of any detection, the residue levels were within 1-5 ppb, which is much below the tolerance limit. Around 60 samples of red and white wines were evaluated as a part of the initiative to establish the quality standards of Indian wines.

13.2.5 FAPAS® residues in Grape Puree 19103

An international proficiency testing program was conducted by FAPAS® The Food and Environmental Research Agency in March 2010 amongst 118 laboratories from 30 different countries from a list of 73 pesticides. Z-scores are considered satisfactory if -2 z +2. The z score for Buprofezin, pp'-DDD and Propargite was -1.4, -1.2 and -1.8 respectively.

13.3 Persistence studies of agrochemical residues in soil

Degradation of Azoxystrobin and Metominostrobin was explored in detail in three major soil types of India viz. silty-clay, clay and sandy-loam. The degradation of two strobilurin pesticides was studied in soil at single and double field application rates. Degradation of azoxystrobin and metominostrobin followed 1^{st} + 1^{st} order kinetics in three soils under biotic and abiotic coinditions. In all soils azoxystrobin degraded with in 7 days from the date of application. Degradation was faster in clay soil compared to other two soils in both abiotic and biotic conditions. Degradation was faster in single dose (3.8, 5.75, and 6.25 days in clay, silty-clay and sandy-loam soils respectively) than in double dose (5.75, 6.6, and 7.5 days in clay, silty-clay and sandy-loam soils respectively) applications. Furthermore, azoxystrobin degraded faster than metaminostrobin.

Effects of the two chemicals on some selected soil enzyme activities were also studied. FDA hydrolyzing activities of soils were reduced drastically on the 1^{st} day from application of azoxystrobin and metominostrobin followed by stabilization thereafter. Contrary results were however obtained for dehydrogenase activities. No significant effect on -glucosidase activities was observed. In general the enzyme activities did not vary linearly with time and were short-lived with transitory effect. It could thus

be concluded that although short term or intermittent changes were observed, no permanent deleterious effect on the selected soil enzyme activities resulted from application of azoxystrobin and metominostrobin at field application rates.

Programme 14. Development of post-harvest technologies

14.1 Studies on wine

14.1.1 Effect of crop load on white wine quality

An experiment was conducted to study the effect of crop load on wine quality of Sauvignon Blanc. The juice was inoculated with RS-3 (local yeast strain) and placed at 18± 1°C for fermentation. After 12 days of inoculation, yeast was separated and young wines were placed at low temperature. These wines were analyzed after first racking. The results indicated that the wine made from lower bunch load i.e. 10 bunch/vine contained higher total titrable acidity (TTA), total sugars and reducing sugars as compared to the wine prepared from higher bunch load (20 and 30 bunches/vine).

14.1.2 Effect of yeast strains on quality of red wines

Bunches of Cabernet Sauvignon having TSS value of about 21°B were collected to study the influence of yeast strains on wine quality. The SC strain utilized maximum sugars and wine made from this strain contained minimum content of reducing sugars i.e. 3.58 g/L followed by Premier Curve (PC). Wine from spontaneous fermentation contained maximum reducing sugars (5.87 g/L), phenols and total titratable acidity (TTA) in comparison to other studied strains. Lower colour intensity was noted in wine from spontaneous fermentation.

14.4 Studies on raisins

14.4.1 Standardization of techniques for minimization of browning in raisins

14.4.1.1 Effect of combination of ethyl oleate and potassium carbonate on grape drying

Various combinations of ethyl oleate and potassium carbonate were used for bunch treatment before drying. The treatment details are given in table 15.

Drying was performed under raisin shed. Moisture loss was significantly affected by treatment of bunches with combination of ethyl oleate and potassium carbonate. The physico-chemical parameters of raisins were also affected by treatment of bunches with various combinations of ethyl oleate and potassium carbonate. Bunch treatment with 15 ml ethyl oleate + 30 g potassium carbonate/L recorded

Table 15. Details of ethyl oleate and potassium carbonate treatments

Treatment	Ethyl oleate and potassium carbonate
A_1	10 ml ethyl oleate+ 20 g Potassium carbonate
A_2	10 ml ethyl oleate+ 25 g Potassium carbonate
A_3	10 ml ethyl oleate+ 30 g Potassium carbonate
B_1	12.5 ml ethyl oleate+ 20 g Potassium carbonate
B_2	12.5 ml ethyl oleate+ 25 g Potassium carbonate
B_3	12.5 ml ethyl oleate+ 30 g Potassium carbonate
C_1	15 ml ethyl oleate+ 20 g Potassium carbonate
C_2	15 ml ethyl oleate+ 25 g Potassium carbonate
C_3	15 ml ethyl oleate+ 30 g Potassium carbonate

Table 16. Physico-chemical parameters of raisins as affected by bunch treatment with combinations of ethyl oleate and potassium carbonate

Treatments	Moisture (%)	Phenols (mg/ml)	Colour intensity	Total flavanols (mg/ml)	Total flavanoids (mg/ml)	Total Flavan 3 ols (mg/ml)
A1	18.6	14.62	22.6	4.08	11.1	0.24
A2	20.4	16.10	17.7	4.01	9.3	0.15
A3	17.9	17.04	17.4	2.76	9.0	0.14
B1	20.6	14.72	17.1	3.00	9.0	0.35
B2	17.8	15.19	16.4	2.65	9.3	0.19
B3	17.5	17.28	16.0	2.64	10.8	0.21
C1	17.0	16.22	17.0	3.93	9.7	0.23
C2	16.9	19.31	15.6	3.32	8.4	0.21
C3	15.9	20.45	15.0	3.17	8.7	0.18
SEM±	0.045	0.818	0.262	0.043	0.130	0.028
CD at 5%	0.13	2.399	0.769	0.126	0.381	0.083

14.4.1.2 Effect of bunch covering on quality parameters of raisin

The bunches of Tas-A-Ganesh were covered with paper bags at veraison stage. When bunches attained TSS of 22 °B, paper bags were removed and bunches were harvested. These bunches were dipped in solution of 15 ml ethyl oleate and 25 g potassium carbonate/L for 2 minutes. The treated bunches were dried in drying shed and tray dryer. The results showed that the low colour intensity was noted in covered bunches than uncovered. Quantity of other studied parameters which affect the colour intensity, like phenolics, flvanols, flavonoids, flavon-3-ols was more in raisin produced from covered bunches.

14.4.1.3 Effect of dipping duration on colour and colour contributing parameters of raisins

The bunches of Tas-A-Ganesh were dipped in a solution of 15 ml ethyl oleate + 25 g potassium carbonate for 2, 4 and 6 minutes. After dipping bunches were placed in raisin drying shed for drying. After 10 days, raisin samples were collected and analyzed. The data presented in table 17 revealed that the dipping duration affected moisture content in raisins. Raisins obtained from treatment of longer duration resulted in lesser moisture content. Higher colour i. e. 18.50 intensity was noted in the raisins from 2 minutes treatment and it was reduced to 12.56 in the raisins from bunches dipped for 6 minutes. Other colour contributing parameters like phenolics, total flavonols, total flavonoids and total flavan-3-ols were also significantly affected by dipping durations. The content of total flavonoids and total flavan-3-ols was reduced with increase in dipping duration, whereas reverse trend was observed for phenolics and total flavonoids content increased with increment in treatment duration.

Table 17. Effect of dipping duration on colour intensity and colour contributing parameters of raisins

Bunch dipping duration	Moisture (%)	Phenolics (mg/ml)	Colour intensity	Total flavanols (mg/ml)	Total flavanoids (mg/ml)	Total Flavan -3 -ols (mg/ml)
2 min	16.65	12.34	18.50	2.82	11.18	0.26
4 min	16.15	15.33	13.39	3.12	10.23	0.21
6 min	14.94	23.36	12.56	3.25	9.75	0.20
SEM±	0.008	2.020	0.187	0.098	0.166	0.004
CD at 5%	0.41	4.40	0.41	0.21	0.36	0.01

Programme 15. Development of information and documentation systems

15.1.2 Development of data bank on grape

A format for data collection was prepared and correspondence was made with grower associations and state department of horticulture of different states. Data has been received from a few state horticulture departments only. Data on total grape area and production of the country and state wise grape area and production data for the year 2007-08 (NHB), trade data of grapes and its processed products (APEDA website), district wise data on area and production of grapes for Karnataka State from year1998-99 to 2007-08, Taluka wise data on approximate area and production of grape crop for Nasik district (district superintending agriculture officer, Nasik), Wine data (MIDC and Agri-industry Development Corporation), Approximate data for raisin (Grape Growers' Association), area, production and trade data of major grape growing countries (FAO website) has been collected. A Database program to store and retrieve data on grape production statistics was developed in MS Access.

A database on varieties/accessions distributed by the Centre under material transfer agreement was created along with the facility to store and retrieve the data reports.

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

Information on eight important grapevine diseases and nine postharvest grape diseases were compiled The information on important aspects of grapevine diseases like causal organism/pathogen, diagnostic symptoms, disease/life cycle of the disease, economic loss, favorable conditions (climatic and others) for outbreak and spread, susceptible crop growth stages, disease monitoring and management was compiled and displayed by creating web pages using HTML.

GUI design, functional design and coding for the e-book on grapevine diseases in India were developed. The system is designed to allow access to the disease related information by clicking on the links arranged in the form of a menu and displayed on easily visible part of the screen. The navigation structure is formatted to present the information from different locations. Pictures support the textual information wherever required.

Collaborative, Externally Funded, Contract Research and Consultancy Projects

Collaborative and externally funded projects

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

This was the Seventh year of the Residue Monitoring Plan, initiated by the APEDA, Ministry of Commerce, Government of India in 2003-04 with National Research Centre for Grapes, Pune through the National Referral Laboratory (NRL) setup under this institute. The NRL was initially set up for monitoring of pesticide residues in table grapes. From this year, its scope was expanded to cover all important fruits and vegetables.

Presently three state Governments viz. Maharashtra, Andhra Pradesh and Karnataka are covered under this plan since exportable grapes are produced in these states. The farms from where table grapes are to be exported are registered with the Agricultural Departments of the respective grape growing states. The total registered farms for export of table grapes as per our records in these states were 14930. Out of these farms, 14704 farms were from Maharashtra alone. The total area registered for export of table grapes was about 10189.585 hectares as against the estimated acreage of 64,300 hectare in the country.

Under the Pesticide Residue Monitoring Plan, ten APEDA-nominated laboratories viz. Vimta Labs Ltd. (Hyderabad), Reliable Laboratories (Thane), Geo-Chem Laboratories (Mumbai), Doctors Analytical Laboratories Pvt. Ltd. (Pune), Shriram Institute for Industrial Research (Bangalore), SGS laboratories (Chennai), National Horticulture Research and Development Foundation (NHRDF, Nashik), Delhi Test House (Delhi), Interfield Laboratories (Kochi), Arbro Pharmaceuticals Ltd. (Delhi) actively participated in drawing of samples and residue monitoring. In addition, four more nominated laboratories viz. Pesticide Residue Testing Laboratory (Pune), True Analytica (Chennai), Sargam Laboratory (Chennai), Shiva Analyticals (Bangalore) participated in the proficiency test (PT) rounds organized by the NRL, but they did not analyze any export grape samples under the Grapenet in this year.

Proficiency test

The first Proficiency Testing (PT) round among the nominated laboratories was organized on three commodities viz. grape, tomato and pomegranate. In the first PT round the performance of only six laboratories was satisfactory in terms of identification of spiked pesticides and the corresponding 'Z'-scores and they were immediately allowed by the NRL for access into the Grapenet software system. A second PT round was organized and in this PT, the performance of all the laboratories were overall satisfactory, with few exceptions where specific laboratories failed to result in satisfactory 'Z' score within the prescribed limit of -2 to +2. The failure of a few laboratories in this test also was found to be due to inaccurate calibration standards and corresponding erroneous calibration graphs used by the laboratories for calculation of the PT results. These laboratories were asked to re-validate the entire methodology with fresh matrix-matched. The nominated laboratories were only allowed to participate in residue monitoring in registered field samples once the NRL got satisfied with their validation results.

FAPAS proficiency testing program

During this year, the NRL initiated the participation of the nominated laboratories in International proficiency testing program on grape puree organized by the FAPAS (Food Analysis Performance Assessment Scheme), Government of UK. All the 14 nominated laboratories and the NRL participated

in this PT round. All the nominated laboratories could successfully identify each target analyte. The results in terms of "Z-score" were satisfactory for all the target pesticides except for few deviations for propargite, which could have happened due to its degradation during long transit time between UK and India.

Research activities

In last one year, the NRL could expand the scope of the multiresidue analysis method to cover testing of more than 200 pesticides in various fruits and vegetable matrices viz. grape, pomegranate, mango, apple, orange, onion, etc. on GC-MS and LC-MS/MS. A simple single residue method has been developed and validated for the analysis of the fungicide dinocap (and meptyldinocap) and the antibiotic viz. aureofungin. The tandem mass spectrometric method on GC-MS/MS for high sensitivity analysis of synthetic pyrethroid group of pesticides was standardized. Besides, the NRL developed an effective technique of residue analysis of problematic pesticides like captan captafol, iprodione, etc, which avoided expensive cryogenic crushing as practiced in Europe and the results were comparable to cryogenic crushing. The NRL also standardized a sensitive LC-MS/MS based multiresidue method for estimation of plant growth regulators including gibberellic acid, NAA, Chlormequat chloride, etc.

Monitoring results

A total of 5009 table grape samples were tested in the 2009-10 season by ten nominated laboratories, which include first sample as well as resample. Out of the 5009 total analyzed samples, 501 samples failed for EU-MRL compliance. Thus, a total 501 internal alerts were issued. On re-sampling after the recommended pre-harvest intervals, 187 alerts were subsequently revoked on the basis of the MRL compliance in analyses reports.

In totality, there were 34 pesticides for which MRL exceedances were recorded in the 2010 season. Most frequently detected insecticide was Captan with 150 detections. The other major insecticides that got detected in this season include abamectin with 76 detections and the other pesticides viz. lambda-Cyhalothrin and chlorpyriphos which were detected in 50 and 47 samples, respectively. In case of the fungicides, highest detected chemical was flusilazole with 59 detections followed by carbendazim with 31 detections.

Out of the 314 effective alerts, which accounts for 7.46% of the samples analyzed, most of the cases correspond to those pesticides, which are mostly used during the last two months before harvest. Hence, the management of these pests before harvest will certainly play a key role in minimizing the residues of pesticides in next grape season of 2010-11. The detections of the non-recommended chemicals indicate increasing awareness among the grape growers to use the non-recommended chemicals for pest management.

Detection of Chlormequat chloride residues in Indian grapes for export to EU

The residues of the plant growth retardant viz. Chlormequat chloride (CCC) was reported in Indian grapes from Europe in this season, which emerged as a major issue at the end of the current grape season. On receipt of the information regarding detection of CCC in Indian grapes at above the EU MRL of 0.05 mg/kg in a laboratory of Sweden on 12th April, extensive monitoring of CCC residues in India was initiated under the leadership of the NRL since 15th April. All the grape consignments yet to be exported were screened compulsorily for CCC residues.

A total 454 export grape samples were thus tested for the residues of Chlormequat chloride during April-May 2010 by the nominated laboratories and the NRL. Out of the tested samples, 306 samples conformed to the EU-MRL of 0.05 mg/kg, while 148 samples failed for EU-MRL compliance which accounts for a failure percentage of 32.6%. On domestic front, in comparison to the MRL specified under the PFA Act of the Ministry of Health and Family Welfare, Govt. of India, however, 450 out of the total 454 tested samples complied with the Indian food safety regulations.

ii. Identification of drought and salt stress inducible genes in grape rootstocks and their role in physio-biochemical responses under abiotic stresses (funded by BARC-BRNS)

In a pot study, four rootstocks viz. Dogridge, 110-R, 1613 C and Salt Creek were subjected to combined salinity and moisture stress. Two levels of salt stress viz. 2 EC and 4 EC were used either at 100% or 50% field capacity.

Different biochemical parameters viz. total protein, total sugar, total phenols, proline and glycine betain were estimated. Total protein content varied significantly in response to salinity as well as combined stress among different rootstocks. Salinity and combined stress both had significant effect on total sugar and phenolics accumulation in these rootstocks.

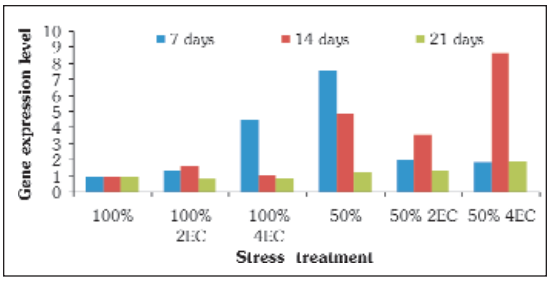


Fig. 21. Expression of Na^+/H^+ antiporter gene in 110R

Proline accumulation pattern varied in different rootstocks in response to stress. In 110R there was no significant difference in proline accumulation under salinity stress, whereas proline content increased in response to water and combined stress. On the other hand in Dogridge, increase in proline content was observed under salinity stress as well at later stages. Glycine betain accumulation did not follow any particular trend in any of the rootstock and in general maximum glycine betain content was obtained in control vines.

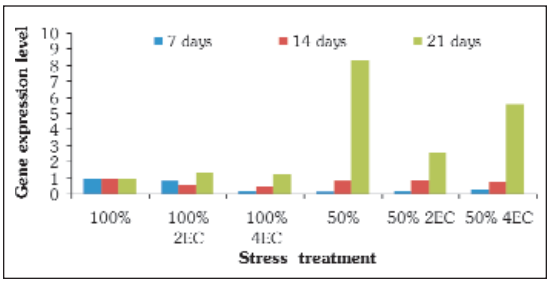


Fig. 22. Expression of Na^+/H^+ antiporter gene in 1613 C

Water potential in different rootstocks in response to different treatments was recorded on 21 and 28 days of experiment. There was differential change in leaf water potential of different rootstocks. At the end of experiment, in 110R the leaf water potential of stressed vines treated with 2EC saline water was more than the control vine while at 4EC level it was equal to control.

RNA was extracted from young leaves of 110R and 1613C from all the treatments. Based on the sequence information available in online grape gene index database, primers were designed to study the expression of Na^+/H^+ antiporter gene, a gene known to be involved in salinity tolerance. The real time PCR was used for relative quantification of gene expression in different treatments. The expression of Na^+/H^+ antiporter gene was found to be upregulated in 110R in response to salinity, moisture as well as combined stress (Fig.21). Within seven days, the expression increased 4.5 and 7.5

fold under saline stress (4EC) and moisture stress (50% field capacity) respectively. However in 1613 no effect on gene expression levels of this gene was observed in response to salinity. Increased expression was observed in response to moisture and combined stress at 21 days (Fig. 22).

RNA from 110R was used for DDRT-PCR. Several transcripts were identified which were either up regulated or down regulated in response to salinity, moisture and combined stress. Fig 23 shows differential gene expression in 110R under stress.

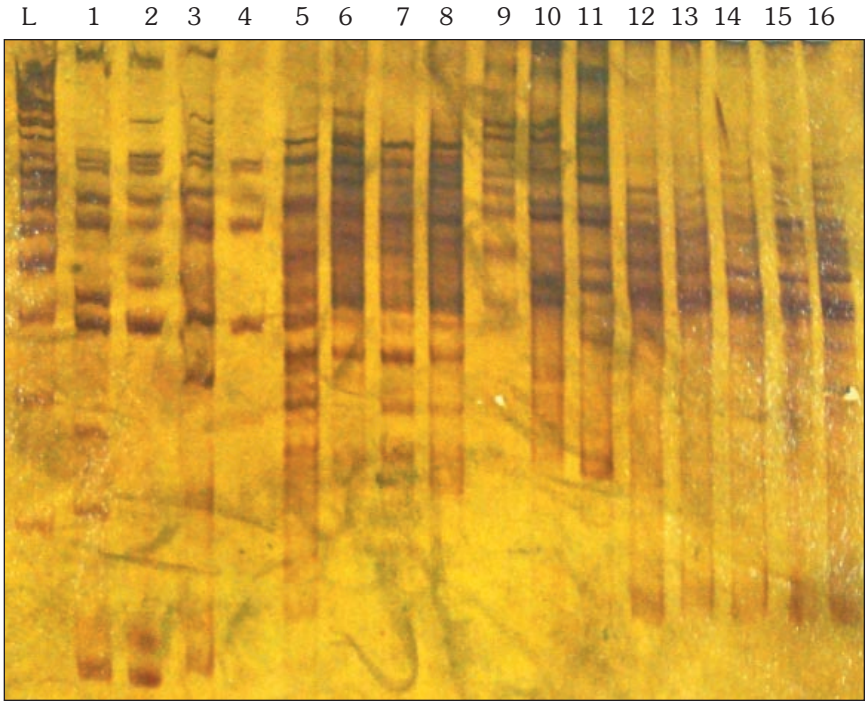


Fig. 23. DDRT PCR of 110 R with GA anchored primer in combination with arbitrary primers AP1 (Lane1-4), AP2 (Lane 5-8), AP3 (Lane 9-12) and AP4 (Lane13-16). L - size marker, Lane 1,5,9,13 - Control; Lane 2,6,10,14 - 4% EC (Salt Stress), Lane 3,7,11,15 - 50% irrigation (water stress), Lane 4,8,12,16 - combined stress (50% irrigation + 4EC). Arrows indicate differentially expressed transcripts.

Sodium content in the leaf blade increased with increasing salinity levels in the rootstocks 1613C, Dogridge and Salt Creek. Na content remained low in 110R even at high salinity levels. Under combined stress also Na content remained lower in 110R as compared to other rootstocks. All the rootstocks except 1613C maintained potassium content 1% or above in the leaf blade. In all the rootstocks, increased potassium and sodium content were observed in leaf blades under combined stress as compared to control vines

iii. Molecular characterization and creation of molecular database for Indian grape germplasm (funded by DBT)

Report presented under 3.1.

Technology Assessed and Transferred

Demonstration of technology on pesticide schedule in viticulture

Optimum use of agrochemicals is one of the most important components for successful viticulture. It reduces input cost and risk of pesticide residues in the product substantially. The grape growers especially from Maharashtra, Karnataka and Andhra Pradesh, have taken the lead in following good agricultural practices with regard to pesticide MRL (minimum residue limit) and their pre-harvest interval (PHI). However, downy and powdery mildews among diseases and mealy bugs and thrips among insect pests pose serious threat to grape production. Therefore, due to apprehensions of losses many grape growers resort to use of pesticides as a preventive measure to protect the crop. It increases cost of inputs, gives improper control of the pests, and posed risk of pesticide residues at harvest. It may also be detrimental to the grape ecosystem and environment as a whole. Hence, focusing on these important diseases and insect pests, a schedule of pesticide applications in vineyards was prepared taking in to consideration various pesticide recommendations of NRCG and the European Union guidelines on maximum permissible residue limits of pesticides. This schedule was demonstrated in different areas for its effectiveness. Eight vineyards, 4 in Sangli district and 4 in Nasik district, were selected for the demonstration. Each vineyard was of 1 acre area and registered for production of exportable grapes with Department of Horticulture, Government of Maharashtra. At each of the locations, an adjacent vineyard owned by same farmer and under his spray schedule was kept as a comparison for efficacy of the schedules. These sites were visited during flowering stage, fruit set and veraison stages for observations on success of the programme. At farmers' locations full time technical persons were appointed who undertook sprayings after day to day interactions with scientists on the basis of ground reality.

All the demo vineyards showed excellent control of most of the diseases including downy mildew and insect pests including mealy bugs. Downy mildew was less than 1.0 per cent in all demo plots and was found primarily on leaves and not on bunches. Mealy bug was found in 0.0 to 2.0 per cent vines in most of the demo plots except Bopegaon demo plot where mealy bug was found in 10.0 per cent of vines but with successful intervention it was brought down to 5 per cent within 20 days. Excellent control of thrips was achieved in all Nasik demo plots where berry scarring was found in only 0.2 to 3.0 per cent bunches in comparison with farmer practice plots where berry scarring was in 0.5 to 6.0 per cent bunches. However, in Sangli demo plots berry scarring was found in 7.0 to 15.0 per cent bunches in comparison with 1.5 to 10 per cent in farmer practice plots. It was due to the fact that inadvertently lower dose of insecticide was used than recommended during peak infestation of thrips. Therefore, farmers were guided in the final concluding meeting to follow the recommended doses of insecticides.

Another major breakthrough was that total number of pesticide applications were reduced in demo plots in comparison with farmer practice plots. Total number of pesticides applications in demo plots were 134 and 131 in comparison with farmer practice plots where it was 225 and 199 at Sangli and Nasik, respectively. Residue analysis of the grapes showed no residue of pesticides above MRL. This demonstration installed confidence in farmers that optimum dose of pesticides given at right time can manage the pests with less number of pesticide applications. And finally, all the vineyards under demonstration could produce over 10 tones of export quality grapes per acre. It is proposed to further improve and demonstrate the schedule during 2010-11 fruiting season again.

The demonstration was carried out in public-private-partnership (PPP) mode with M/s E. I. Dupont India Ltd.

Besides several other technologies which are 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 during last 50 days before harvest.
6. Use of biocontrol agents
7. Disease forecasting

Farm Visits

- Dr. P. G. Adsule visited few vineyards in Kolhapur and Sangli region under the Pesticide Residue Monitoring of APEDA-NRL project on 11th April 2009 and guided the grape growers.
- Dr. R. G. Somkuwar as a member of Nursery Rating Committee along with Sh. Dharam Singh, Assistant Director, National Horticulture Board visited Mahatma Phule Krishi Vidyapeeth Nursery on 1st May 2009. The purpose of visit was to assess the nursery cultural practices being followed to meet the quality standards and to decide the rating of the nursery.
- Dr. P. G. Adsule visited Sangli on 16th May 2009 and organized training programme for manufacture of raisins for export for grape the growers of Sangli region.
- Dr. S. D. Ramteke visited grape vineyards affected by hailstorm and heavy wind at Sangli on 19th May 2009. The grape growers were given appropriate advice.
- Dr. R.G. Somkuwar visited Manjarde on 23rd May 2009 for assessing the hailstorm affected vineyards and provided necessary guidance in the areas of appropriate food storage, nutrition, use of growth regulators, crop load, etc. for taking forthcoming crops.
- Dr. P. G. Adsule, Dr. G. S. Karibasappa, Dr. R. G. Somkuwar and Dr. A. K. Upadhyay visited College of Horticulture, Mandsaur under Rajmata Vijayaraje Sindhiya Vishvavidyalaya, Gwalior, Madhya Pradesh and also some of the vineyards and winery units in Ratlam during 3-5th July 2009. The team had meeting with Vice-chancellor, and officials of the college for selection of site for the approved Centre under AICRP-Subtropical Fruits (Grapes). Technical program was finalized after selection of site and necessary guidelines were given to take action for undertaking AICRP trials of grapes. The planting material was also provided to the concern scientist after the visit.

- Dr. S. D. Ramteke visited Nasik, Sangli, Solapur and Pandharpur on 25th July, 6th August, 7th August and 8th August 2009 respectively to deliver a lecture on 'Use of hydrogen cyanamide (H_2CN_2) in grapes'.
- Dr. S. D. Ramteke visited grape gardens affected by heavy rains in Indapur, Phaltan and Baramati area of Pune district on 21st December 2009. The visit was organized by Maharashtra State Grape Growers' Association, Pune. The grape growers were advised for corrective measures.
- Dr. G. S. Karibasappa visited M/s Bafna Farms, Deokarwadi Phata, Near Rohu, Tal. Daund to study growth and yield performance of Manjri Naveen, Fantasy Seedless and NRCG hybrids on 25th December 2009, 18th February and 18th March 2010. Over bearing was observed in hybrid AH 2-8. Growers were recommended cane girdling and spray of SOP at the rate of 5g/L thrice in the fruiting season. Bunch regulation in hybrid AH 2-8 (Spin Sahebi x Black Monukka) was recommended.
- Dr. S. D. Ramteke visited vineyards in and around Nasik and Sangli region on 1-2nd and 5-6th January 2010 respectively to discuss the issues on 'Use of bioregulators in grapes' under DuPonts Smooth Trade project and also to conduct the experiment of paper cover to avoid pink berry formation.
- Dr. P. G. Adsule, Dr. S. D. Sawant, Dr. J. Sharma, Dr. D. S. Yadav and Mrs. S. Shalini visited vineyards and had discussions with growers under the consultancy project entitled 'Smooth trade of pesticides for the management of various diseases and insect pests in grapes' sponsored by M/s Du Pont, Gurgaon on 15th January, 5-6th February and 30th March 2010 at Sangli and on 12th January and 1st-2nd February at Nasik. About 100 growers participated in each programme.
- Dr. S. D. Ramteke visited vineyards in and around Nasik region to discuss the issues on 'Use of bioregulators in grapes' under DuPonts Smooth Trade project on 12th January 2010.
- Dr. Indu S. Sawant and Dr. S. D. Sawant surveyed vineyards of Thompson Seedless and Gulabi varieties at Dindigal, Cumbum and Odiapatty from 24-26th January 2010, discussed the problems with grape growers and Directors of the State Department of Horticulture and collected grape and soil samples for analysis.
- Dr. D. S. Yadav and Mrs. S. Shalini visited vineyards at Solapur and Tuljapur on 5-6th March 2010. Low to moderate level of mealy bug and stem borer infestation was observed. Field sanitation like removal of weeds, pruned parts of plants etc. harbouring the pest stages to reduce the pest population were advised besides use of Imidacloprid drenching to manage mealybugs.
- Dr. D.S. Yadav and Mrs. S. Shalini visited Mr. Bafna, a progressive farmer's vineyard on 26th March 2010. There was a severe infestation by *Spodoptera litura* and Buch webbar in some of the grape plots. Pest control programmes with biocontrol formulations and chemicals are used in the vineyard.

Participation in Growers' Seminar

- Dr. S. D. Ramteke delivered a lecture on spraying technology in relation to bioregulators to the grape growers of Narayangaon on 15th July 2009. Grape Growers Society at Narayangaon organized the seminar.

- Dr. S. D. Ramteke delivered lecture on 'Use of hydrogen cyanamide in grapes' in seminars organized by Maharashtra State Grape Growers' Association on 25th July, 6th August, 7th August and 8th August 2009 at Nasik, Sangli, Solapur and Pandharpur respectively. Approximately 1800 grape growers attended the lecture.
- Scientists of the Institute viz. Dr. S. D. Sawant, Dr. R. G. Somkuwar Dr. S. D. Ramteke and Dr. J. Sharma delivered lectures in the seminars organized by Maharashtra State Grape Growers' Association in their respective research areas to guide grape growers in the management of diseases, canopy management and irrigation and nutrition at Nasik, Sangli, Solapur, Baramati and Bableshwar in May and September 2009 after foundation and fruit pruning.
- Dr. J. Sharma participated in growers' seminars and field visits organized by Maharashtra State Grape Growers' Association at various places in Solapur, Oosmanabad, Latur region during 2-3rd October, Sangli region during 9-11th October and Nasik region during 22-23rd October 2009. Approximately 1900 growers participated in these seminars. He educated farmers on nutrient and disease interactions and water use efficiency.
- Dr. J. Sharma participated in growers' seminar and field visits and delivered lecture on 'Nutrient and irrigation management in grapes' organized by M/s Deepak Fertilizers and Petrochemicals Corporation Ltd. at Guar (Belgium) on 14th October 2009. About 350 growers participated.
- Dr. S. D. Ramteke participated in APEDA's one day awareness programme on grape pre-harvest treatments and pesticide monitoring grapenet plan at Sangli and answered the queries of grape growers on 28th October 2009.
- Dr. S. D. Ramteke and Dr. J. Sharma delivered lectures on 'Judicious use of bioregulators in grapes' and 'Nutrient management in grapes' respectively in growers' seminar organized by Gaonkari in 'Krishi 2009' at Nasik on 27th November 2009. About 500 growers participated.
- Dr. S.D. Ramteke visited vineyards in and around Tasgaon (Sangali) on 16th December 2009 and delivered a lecture on "Judicious use of bioregulators in grapes" in the grape growers seminar organised by Dipak Fertilizers Ltd.
- Dr. D. S. Yadav delivered a lecture on 'Pest Management in Grapes' during programme 'Technical guidance to the grape growers by NRCG experts' at Palsi, Tasgaon, Subhashnagar and Nasik on 21st December, 22nd December 2009 and 11th January 2010 respectively.
- Dr. S. D. Ramteke delivered a lecture on 'Judicious use of bioregulators in grapes' in a seminar at Nashik organized by State Agriculture Department on 11-12th January 2010.
- Dr. S. D. Ramteke, Dr. A.K. Sharma and Mrs. S. Shalini participated in annual program of Vasant Rao Arve Foundation at Sangli on 16th January 2010 and delivered lectures on their field of specialization.

Participation in Exhibition

The Centre exhibited its technologies at 'Showcasing of agricultural technologies/innovations through exhibition' under NAIP sub-project on 24th and 25th February 2010 at CISH, Lucknow. On 24th

February 2010, the inaugural function started with Welcome address by Dr. H. Ravishankar, Director, CISH. Dr. T. P. Trivedi, Project Director, DIPA, New Delhi gave information about objectives of NAIP Sub-project. Shri Inshram Ali, President, Mango Growers Association, Lucknow was the Guest of Honour. Shri Kamil Khan, a progressive farmer form Malihabad, Lucknow also addressed the gathering of scientists and farmers from various parts of the country during the inaugural function. Honourable Dr H P Singh, DDG (Hort.) was the Chief Guest at the function. He congratulated all the farmers of Malihabad for Malihabad Dusheri mango getting Geographical Indicator (G.I.) status.

At the exhibition, NRCG displayed technologies developed through various posters, publications, CDs and grapes of different varieties. Many visitors inquired about the possibilities of establishing vineyards in Uttar Pradesh state. They were informed about the climate conditions of Uttar Pradesh and thus suitable technologies and varieties for the region. The grape varieties displayed by the NRCG at the exhibition were the major centre of attraction of the exhibition. Most of the farmers visiting the stall were mainly mango and guava growers. They were inspired by the NRCG exhibition and developed interest in grape cultivation. The NRCG was represented at the exhibition by Dr. D. S. Yadav, Scientist (Entomology), Mr. B. J. Phalke and Mr. S. S. Bhoite.

TV Programmes

- Dr. S. D. Ramteke appeared on three different TV channel programmes on Foundation pruning, Weed management and Management of grape vineyards during rainy season telecasted on 2nd April, 16th July and 20th August 2009 respectively.
- Dr. R.G. Somkuwar appeared on two different TV channel programmes on Back pruning in grapes and practices followed for cane maturity in late pruned vineyards telecasted on 27th April and 2nd August 2009 respectively.

In house discussions

- Approximately 800 farmers visited the Institute during this year to seek advice, consultancy for their problems being faced in the grape vineyard from the scientists of this Institute apart from collection of improved plant varieties / rootstocks.

Education and Training

Deputation Abroad

- Dr. P. G. Adsule and Dr. K. Banerjee were deputed to participate in the 2nd Latin American Pesticide Residue Workshop 'Food and Environment' during 6-19th June 2009 and to present a lead technical paper on 'Monitoring of pesticides in Indian table grapes'. They also visited Viticulture and Enology Technological Scientific Centre of the Mendoza University in Argentina.

- Dr. A. K. Sharma attended three months training programme on 'Fermentation technology in horticulture (winemaking)' during 1st October to 31st December 2009 at Research Centre Geisenheim (Forschungsanstalt Geisenheim), Germany. This training was sponsored by NAIP under the HRD programme of Component I.

Training Acquired

- Dr. A. K. Sharma and Dr. J. Sharma attended the training on "X SERIES 2 ICP-MS operators training course" at Thermo Fisher Scientific, Bremen, Germany during 14th -21st June 2009.

- Dr. G. S. Karibasappa attended training-cum-workshop of ZITMC held at Central Institute of Cotton Research, Nagpur on 5-6th March 2010.

Training Programmes Organized

- A 5 days training programme entitled 'Transfer of technology for production of export quality grapes' was organized at the Institute during 8-12th September 2009. Eighteen participants participated in the programme. This programme was sponsored by National Horticulture Board. Dr. S.D. Ramteke and Dr. R.G. Somkuwar coordinated the training programme.

- A 7 day training programme on 'Grafting and budding techniques in grapes' was organized on 3-9th November 2009. Four participants were benefited by the programme. The programme was sponsored by National Horticulture Board. Dr. R.G. Somkuwar coordinated the programme.

- A training programme on 'Transfer of technology for production of export quality grapes' was organized on 12-13th November 2009. Fifteen participants were benefited by the programme. The programme was sponsored by M/s Mahindra Shubhlabh Services Ltd., Pune. Dr. S.D. Ramteke coordinated the programme.

Training Given / Summer training

- The Scientists of the Institute were the resource persons for the training programme organized by Maharashtra State Grape Growers' Association during 9-23rd July 2009 at Pune. Forty-two grape growers were benefited by this training programme.

- Dr. S. D. Ramteke delivered a lecture on 'Judicious use of bioregulators in grapes' at Yashwantrao Chavan College of Science, Karad on the occasion of Science Seminar Day on 8th January 2010.

- Dr. Indu S Sawant and Dr. S. D. Sawant delivered invited lectures on 'Problems and Prospects of use of *Trichoderma* in management of diseases in fruit crops' and 'Disease forecasting based management of diseases of horticultural crops with special reference to grapes' respectively, on

13th February 2010 to the participants of Summer School training on 'Integrated pest and disease management in fruit crops in coastal ecosystem' at BSKKV, Dapoli.

- Dr. Indu S. Sawant and Dr. S.D. Sawant delivered guest lectures on 'Biological control by *Trichoderma* in horticultural crops- success stories' and 'Disease management in horticulture crops' respectively, to M. Sc. students of Shivaji University, Kolhapur on 22nd February 2010.

Post Graduate Project Work

Name of Scientist	Title of the project	Duration	No. of students	Institution
Dr. G.S. Karibasappa	Karyotype analysis in some grape varieties	Four months	1	Department of Botany, University of Pune
Dr. Indu S Sawant	In vitro screening of grape germplasm against Colletotrichum gloeosporioides and molecular characterization of few isolates.	- do -	1	- do -
Dr. S.D. Sawant	Effect of powdery mildew on quality of wine grapes	- do -	1	- do -
Dr. Anuradha Upadhyay	Gene expression analysis of grape rootstock in response to abiotic stress	- do -	1	- do -
	Molecular characterization of grape accessions	Six months	1	Padmashree Dr. D.Y. Patil University
	Molecular characterization of grape accessions	Four months	1	Lovely Professional University, Phagwara, Punjab
Dr. S.D. Ramteke	Physiological basis of drought tolerance in grape genotypes	Four months	1	Department of Botany, Univeristy of Pune
Dr. A.K. Sharma	i. Studies on wine making ii. Studies on changes in grapes during drying process	Four-six months	2	Jamia Hamdard University, New Delhi
	i. A study on changes in quality parameters during winemaking ii. Changes in biochemical parameters during grape fermentation	Six months	2	Dr. D. Y. Patil Biotechnology and Bioinformatics Institute, Pune

Awards and Recognitions

1. A National Horticulture Board's assessment team visited the Institute and inspected the nursery on 30th April 2009 for rating and accreditation of Institute nursery. The following were the members:

   - Dr. Jagmohan Singh, Ex Vice-chancellor of YSPAUH & F, Solan,
   - Dr. P. K. Singh, Dy. Director, NHB, Gurgaon,
   - Dr. B. D. Badge, Dy. Director of Agriculture of Govt. of Maharashtra,
   - Dr. S. B. Gurao, Associate Director of Research, Mahatma Phule Krishi Vidyapeeth, Rahuri,
   - Sh. Dharam Singh, Assistant Director, NHB,
   - Dr. R. G. Somkuwar, Pr. Scientist, NRCG, Pune.

The team has recommended 3 star rating to Institute Nursery on the scale of one to five star rating system. The team specially appreciated high quality technical supervision, excellent infrastructure and application of advance techniques. The team also put forth suggestions for improving the rating further in subsequent years.

2. Dr. R. G. Somkuwar received Krushiratna Dr. Punjabrao Deshmukh Memorial Krishi Puraskar-2009 from Bhartiya Krushak Samaj at Nasik on 27th December 2009 for the contribution in the field of viticulture.

3. Dr. R. G. Somkuwar received 'Sahyadri Krishi Sanman – 2010' for contribution in field of agriculture extension in relation to grapes.

4. Dr. P. G. Adsule chaired the session on 'Regeneration and genetic transformation' in National Seminar on 'Horticulture biotechnology' held during 28-29th October 2009 at IIHR, Bangalore.

5. Dr. Anuradha Upadhyay was rapporteur for the session on 'Bioinformatics' in National Seminar on 'Horticulture biotechnology' held during 28-29th October 2009 at IIHR, Bangalore.

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. Identification of drought and salt stress inducible genes in grape rootstocks and their role in physio-biochemical responses under abiotic stresses (BARC).

iii. Molecular characterization and creation of molecular database for grape germplasm in India (DBT).

Publications

Research Articles

1. Bhat S. K., Sharma A. K., Ahmad M. F., Sundouri A .S. and Sharma M. K. 2009. Study of physicochemical parameters of Starkrimson apple. *Indian Journal of Ecology*, **36(2):** 190-193.

2. Sharma A.K., Sawant S.D., Adsule P.G. and Rajguru Y.R. 2009. Comparison of commercial and locally identified yeast strains in relation to young wine quality of Cabernet Sauvignon. *S. Afr. J. Enol. Vitic*. **30(2):** 148-150.

3. Sharma Jagdev, Upadhyay A.K., Sawant Indu S. and Sawant S.D. 2009. Association of mineral nutrients with vein reddening and necrosis in Thompson Seedless grapes. *Indian J. Hort.* **66(2):**154-162.

4. Singh S.R., Sharma A.K. and Sharma M.K. 2009. Influence of NPK combinations at different altitudes and aspects on fruit yield, quality and leaf nutrient status of apple cv. Red Delicious. *Indian Journal of Horticulture*, **66 (2):** 175-182.

5. Somkuwar R.G., Satisha J. and Ramteke S.D. 2009. Graft performance of Thompson Seedless through wedge grafting on different rootstocks. *Indian J. Hort*. **66(3):** 383-384.

6. Somkuwar R.G., Satisha J., Ramteke S.D. and Sharma J. 2009. Root distribution, partitioning of dry matter and nutrient uptake in Thompson Seedless grapes (*Vitis vinifera* L.) grafted on different rootstocks. *Indian J. Agril.* Sci. **79(9):** 669 – 673.

7. Upadhyay Anuradha, Kadam U.S., Chako P.M. and Karibasappa G.S. 2010. Microsatellite and RAPD analysis of grape (*Vitis* spp.) accessions and identification of duplicates / misnomers in germplasm collection. *Indian J. of Hort*. **67(1):**8-15.

Technical Articles

1. Mundankar K. Y., Sawant S. D., Sawant Indu S., Sharma J., and Adsule P. G. 2009. ''NRCG-SKAI PMExpert': Software for management of powdery mildew disease in grapes. In 'Information technology applications in horticultural crops (Eds. PM Govindakrishnan, JP Singh, SS Lal, VK Dua, Shashi Rawat & SK Pandey). Central Potato Research Institute Shimla. Pp 133-138.

2. Mundankar K. Y., Karibasappa G. S. and Upadhyay Anuradha. 2009. Information Systems for morphological and molecular characterization data of Grape Germplasm in India. *Ibid*. pp196-200.

3. Mundankar K. Y., Sawant Indu S., and Adsule P. G. 2009. Miscellaneous IT initiatives at NRC, Grapes, *Ibid*. pp 315-136.

Papers Presented at Symposia / Workshops / Meetings

1. Ramteke S. D. 2009. Evaluation of bio-efficacy of UPH 707 against the complex weed flora in grapes and Bio-efficacy of GA_3 in grapes. Oral presentation in National Conference on 'Frontiers In Plant Physiology Towards Sustainable Agriculture' during 5–7th November 2009, organized by: Indian Society for plant Physiology, New Delhi and Assam Agricultural University, Jorhat.

2. Sharma A. K., Adsule P. G. and Banerjee K. 2009. A study on physico-chemical properties of Indian raisin samples. 9th ASC: June 22-24, 2009, Srinagar, SKUSAT & NAAS. Abstract book, p 240.

3. Sawant Indu S. 2010. Biological control of Phytophthora root rot in citrus and post-harvest decay in grapes by *Trichoderma harzianum* – success stories. In Symposium 'Advances in Plant Disease Management' on 12th March 2010 at IISR, Lucknow.

Extension / Technical Bulletin

1. Somkuwar R. G. 2010. Importance of training system in grape cultivation (in Marathi). Extension Bulletin No. 5.

2. Ramteke S. D. 2010. Judicious use of Bioregulators to increase productivity and quality in Grapes. Technical bulletin No. 10.

Technical / Extension Folders

1. Kulkarni N. S., Mani M. and Banerjee K. 2009. Management of Leafhopper on grapes. Extension Folder No. 27.

2. Kulkarni N. S., Mani M., Sarika Gawde and Banerjee K. 2009. द्राक्षपिकावरील तुडतुडे व त्यांचे व्यवस्थापन. Extension Folder No. 28.

3. Ramteke S. D., Somkuwar R. G. and Adsule P.G. 2009. द्राक्षगुणवत्तेसाठी संजीवकांचा व इतर गोष्टींचा वापर. Extension Folder No. 29.

4. Ramteke S. D., Somkuwar R. G. and Adsule P. G. 2009. Use of bioregulators and other inputs for quality grape production. Extension Folder No. 30.
5. Kulkarni N .S., Mani M., Sarika Gawde and Banerjee K. 2009. क्रिप्टोलाइम्स भुंगेरेंचा उपयोग व उत्पादन. Extension Folder No. 31.
6. Somkuwar R.G. 2009. How to raise grape vineyard. (in Marathi). Extension Folder No. 32.
7. Somkuwar R. G., Taware P. B., Upadhyay A. K. and Adsule P.G. 2010. Preparation of nursery plants (in Marathi). Extension Folder No. 33.
8. Somkuwar R. G., Upadhyay A. K. Sharma J., Ramteke S .D., Sawant S. D., Kulkarni N. S., Adsule P. G. and Taware P. B. 2010. Back pruning in Grapes (in Marathi). Extension Folder No. 34.
9. Karibasappa G. S. 2010. Manjri Naveen. Extension Folder No. 35.
10. Karibasappa G.S. 2010. Red Globe. Extension Folder No. 36.

Video CDs

1. Somkuwar R. G. and Ramteke S. D. 2009. Role of canopy and Growth regulators in the production of exportable quality grapes". The CD was prepared by AGRO INDIA, Pune.

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

Research Advisory Committee (RAC) Meeting

Following are the members of RAC :

1.	Dr. K.L. Chadha, Ex DDG (Hort.), ICAR, New Delhi	Chairman
2.	Dr. Y.R. Chanana, Emeritus Scientist, Department of Hort, PAU, Ludhiana	Member
3.	Dr. D.V. Singh, Ex-Head & Emeritus Scientist, Divn. Pl. Path., IARI, New Delhi	Member
4.	Dr. B.D. Singh, Dean, College of Science, BHU, Varanasi, Uttar Pradesh	Member
5.	Dr. M.D. Awasthy, Ex-Head (Soil Sci. & Agril. Chem.), IIHR, Bangalore	Member
6.	Mr. Rajiv Samant, Chairman, Samant Soma Wines Ltd., Distt. Nasik	Member
7.	Assistant Director General (Hort.-I), ICAR, New Delhi	Member
8.	Dr. P.G. Adsule, Director, NRC for Grape, Pune	Member
9.	Mr. Mahendra S. Shahir, President, MRDBS,Pune	Member
10.	Mr. Ashok Vishnu Gaikwad, Chairman, N.D. Wines Private Limited, Nasik	Member
11.	Dr. Indu S. Sawant, Pr. Scientist (Pl. Path.), NRC for Grapes, Pune	Member Secretary

The twelfth meeting of the Research Advisory Committee was held on 17-18th March 2010 under the chairmanship of Dr. K.L. Chadha.

RAC committee

The Committee reviewed the progress of ongoing research projects along with the action taken report on the recommendations of previous RAC. The committee was satisfied with the direction of the ongoing research. They appreciated and complimented the work on grape breeding, standardization of grafting technique for sub-tropical conditions using omega grafting machine, weather and crop stage based disease forecasting, initiation of studies on life cycle of various insect pests in grape and pesticide residue monitoring work in different fruits and vegetables. They appreciated the role of APEDA in strengthening the Centre. They also had a round of the laboratories and farm to see the infrastructure and ongoing activities.

The Committee was taken to nearby M/s Bafna Farms to show the excellent performance of Manjri Naveen, a clone from Centennial Seedless which gets desired berry quality with minimum use of GA_3 as it is self thinning and has bold berries. They were also shown the performance of Fantasy Seedless, an introduced variety from USA, and found suitable for export. The Committee were shown the performance of both varieties on Dog Ridge and 110R rootstocks. They also interacted with some of the stakeholders on current issues.

Institute Research Committee (IRC) Meeting

The 14th meeting of the IRC of the Institute was convened on 25-26th June 2009 under the Chairmanship of Dr. P.G. Adsule, Director. In the meeting, reports covering the annual progress in respective ongoing projects and action taken on the points raised by the previous IRC, RAC were presented and deliberated by the members.

The mid-term meeting of Institute Research Committee of NRC Grapes, Pune was convened on 19-20th January 2010 under the Chairmanship of Dr. P. G. Adsule, Director. The progress of the research projects along with the action taken report on the recommendations of previous IRC and RAC was presented by the project leaders. New project proposals were also presented.

Institute Management Committee (IMC) Meeting

Following are the members of IMC:

1.	Dr. P.G. Adsule, Director, NRC for Grapes, Pune	Chairman
2.	Dr. M. Mani, Pr. Scientist & Head, IIHR, Bangalore	Member
3.	Dr. G.S. Karibasappa, Pr. Scientist, NRC for Grapes, Pune	Member
4.	Dr. Indu S. Sawant, Pr. Scientist, NRC for Grapes, Pune	Member
5.	Dr. Pious Thomas, Sr. Scientist, IIHR, Bangalore	Member
6.	Dr. P.V. Firke, Director of Horticulture, Commissionerate of Agriculture, Pune	Non official member
7.	Mr. Madhusudan Rao, Commissioner of Horticulture, Andhra Pradesh, Hyderabad	Non official member
8.	Dr. S.B. Gurav, Associate Director of Research, NARP Plain Zone, RFRS, Pune	Non official member
9.	Mr. Mahendra Shahir, President, MRDBS, Pune	Non official member
10.	Mr. Ashok Vishnu Gaikwad, N.D. Wines Private Limited, Distt. Nasik	Non official member
11.	Mr. Rajneesh Kumar, Finance & Accounts Officer, CIRCOT, Mumbai	Non official member
12.	Mr. O. Babu, Assistant Administrative Officer, NRC for Grapes, Pune	Member Secretary

27th IMC meeting was held on 25th February 2010 under the Chairmanship of Dr. P. G. Adsule, Director. Issues related to ongoing infrastructure activities and revenue generation were discussed.

Advisory Committee Meeting of NRL

Second Advisory Committee meeting of the APEDA-NRL was organized on 25th March 2010 under the Chairmanship of Dr C. D. Mayee, Chairman, ASRB. The other members who attended this meeting included Dr S.P. Ghosh (Former DDG (Hort.), ICAR; Dr A. G. Sawant (Former Chairman and Member ASRB) and Dr P. Dureja (Emeritus Scientist, Division of Agril. Chemicals, IARI). The Committee appreciated the time-bound implementation of the action points decided in the 1st meeting held on 4-5th August 2006.

Consultancy, Patents and Commercialization of Technology

Fifteen consultancy programmes on different aspects of grape cultivation were undertaken during the year. The consultancy was provided to the following organizations:

1. Sangli Grape Processing Association, Sangli
2. AV Agritech Inputes, New Delhi
3. Canpex India Ltd., Pune
4. DuPont Chemicals, Pune
5. KVK, Baramati
6. Maharashtra State Grape Growers' Association, Pune
7. Deepak Fertilizers, Pune
8. Gulbarga Grape Growers' Association, Gulbarga
9. Maharashtra Chamber of Commerce, Nasik
10. Chand Fruit Ltd., Sangli

Approved On-Going Institute Programmes

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

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

Seminars / Symposia / Conferences

Name of the scientists	Title of Seminars / Symposia / Conferences	Period	Organizer and place
Dr. S. D. Ramteke	National seminar on 'Weed management'	1-4th August 2009	Directorate of weed science and Tamil Nadu Agricultural University, Coimbatore
Dr. P. G. Adsule and Dr. Anuradha Upadhyay	National Seminar on 'Horticulture biotechnology'	28-29th October 2009	Indian Institute of Horticultural Research, Bangalore
Dr. S. D. Ramteke	National Conference on 'Frontiers In Plant Physiology Towards Sustainable Agriculture'	5–7th November 2009	Indian Society for Plant Physiology, New Delhi and Assam Agricultural University, Jorhat
Dr. A. K. Sharma	Seminar on 'Food Processing Opportunities'	24-25th February 2010	Ministry of Food Processing Industries, Confederation of Indian Industry (CII) and NIFTEM at Pune.
Dr. R. G. Somkuwar	National Conference on 'Production of Quality Seeds and Planting Material – Health Management in Horticultural Crops'	11-14th March 2010	Society for Promotion of Horticulture, Bangalore at New Delhi
Dr. Indu S. Sawant	Symposium on 'Advances in Plant Disease Management'	12th March 2010	Indian Institute of Sugarcane Research, Lucknow

Meetings

Name of the scientists	Title of meeting	Duration	Organizer and place
Dr. Anuradha Upadhyay	DBT Task Force meeting	15th April 2009	Department of Biotechnology, New Delhi
Dr. P. G. Adsule	Technical Workshop Meeting	28th May 2009	Abhinav Grape Growers' Cooperative Society, Junnar
Dr G. S. Karibasappa	First meeting of Zonal Institute Technology Management Committee - West on 'Intellectual Property Management and Transfer/ Commercialisation of Agricultural Technology'	7th August 2009	Central Institute for Research on Cotton Technology, Mumbai

Name of the scientists	Title of meeting	Duration	Organizer and place
Dr. G. S. Karibasappa and Mr. O. Babu	Interactive meeting to discuss the administrative and financial matters.	11th September 2009	National Academy of Agricultural Research Management, Hyderabad convened by Secretary, ICAR
Mrs. S. Shalini	—	28th and 31st October 2009	APEDA at Sangli and Mumbai
Dr. D.S. Yadav and Mrs. S. Shalini	Interactive meeting of mealybugs	5-6th December 2009	Indian Institute of Horticultural Research, Bangalore and National Bureau of Agriculturally Important Insects, Bangalore
Dr. P. G. Adsule, Dr. G. S. Karibasappa, Dr. S. D. Sawant, Dr. R. G. Somkuwar, Dr. A. K. Upadhyay, Dr. D. S. Yadav	XIXth Group Workers Meeting of AICRP on Subtropical Fruits (Grapes)	14-17th December 2009.	Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra
Dr. Indu S. Sawant	Two day interactive meeting on 'Tools and Machinery for Development of Horticulture'	18-19th December 2009	Central Plantation Crops Research Institute, Kasargod
Dr. Indu S. Sawant	AMAAS half yearly review meeting	9th January 2010	National Bureau of Agriculturally Important Microorganisms, Mau.
Dr. Indu S. Sawant and Dr. S.D. Sawant	Consultative meeting on 'Disease Diagnostics for Horticultural Crops'	22-24th January 2010	National Research Centre for Banana, Trichy
Dr. Indu S. Sawant	First annual progress review meeting of the Out Reach Programmes on 'Diagnosis and management of leaf spot diseases of field and horticultural crops' and '*Phytophthora, Fusarium* and *Ralstonia* diseases of horticultural and field crops'	15-16th March 2010	NASC Complex, New Delhi

Workshops

Name of the scientists	Title of meeting	Duration	Organizer and place
Dr. R.G. Somkuwar	'Information Technology Applications in Horticultural Crops'	24th August 2009	Central Potato Research Institute, Shimla.
Dr. G.S. Karibasappa, Dr. Indu S. Sawant and Mrs. S. Shalini	Leica Advanced Fluorescence Microscopy System for Live Cell Imaging	4th November 2009	Labindia Instruments Pvt. Ltd. at Rajeev Gandhi Infotech Park, Hinjawadi, Pune.
Dr. Anuradha Upadhyay	Workshop cum training on 'Bioinformatics applications in crop science'	21-23rd December 2009	Unit of Simulation and Informatics (USI), Indian Agricultural Research Institute, New Delhi

Distinguished Visitors

- Shri Sudhir Bhargava, Member, ICAR Governing Body visited NRC Grapes on 18th April 2009.
- Dr. H. P. Singh, Dy. Director General (Hort.), ICAR visited NRC Grapes on 27th April 2009.
- Shri Chaman Kumar, Addl. Secretary, DARE & Financial Advisor, ICAR visited NRC Grapes on 3rd May 2009.
- Dr. N. Shanmugham, Principal Investigator and Dr. S.B Pal, Manager, Zonal Technology Management and Business Planning & Development (ZTM BPD) of CIRCOT visited the Institute on September 2009.
- A team of France delegation visited the Institute on 14th January 2010 to assess the progress made in trial on 'Evaluation of Cabernet Sauvignon grafted on different rootstocks' and 'Evaluation different wine varieties under Indian condition', a collaborative project of INDO- FRANCE government.
- Mr. Rajiv Mehrishi, Additional Secretary, DARE and Secretary, ICAR, New Delhi visited the Institute on 27th January 2010.

अनुसंधान एंव प्रबंधन कर्मचारी वर्ग

निदेशक

डॉ. पां. गु. अडसुले

फसल सुधार

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फसल उत्पादन

डॉ. रा. गु. सोमकुंवर, प्रधान वैज्ञानिक (बागवानी) (07.08.2009 से)
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फसल संरक्षण

डॉ. इन्दु सं. सावंत, प्रधान वैज्ञानिक (पादप रोग विज्ञान)
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डॉ. एन्. एस्. कुलकर्णी, वैज्ञानिक वरिष्ठ पैमाना (कीट विज्ञान) (07.07.2009 तक)
डॉ. दी. सिं. यादव, वैज्ञानिक (कीट विज्ञान) (20.06.2009 से)
श्रीमती एस्. शालिनी, वैज्ञानिक (कीट विज्ञान) (28.08.2009 से)

कटाई उपरान्त प्रौद्योगिकी

डॉ. अजय कुमार शर्मा, वरिष्ठ वैज्ञानिक (बागवानी)

कृषि अनुसंधान सूचना प्रणाली

श्रीमती कविता मुंदनकर, वैज्ञानिक वरिष्ठ पैमाना (कृषि में कम्प्यूटर प्रयोग)

प्रशासन एवं वित्त

श्री. ओ. बाबू, सहायक प्रशासनिक अधिकारी
श्री. ए. श्रीनिवासमूर्ती, सहायक वित्त एवं लेखा अधिकारी (20.08.2009 तक)
श्री. बाबासाहेब मा. चव्हाण, कनिष्ठ लेखा अधिकारी (20.10.2009 से)

Infrastructure Development

Laboratory

During the period, equipments viz. Atomic Adsorption Spectrometer, Cold Centrifuge were procured and commissioned in various laboratories of the Institute.

Library

During the year, following new accessions were added to the library:

Sl. No.	Item	Gift	Purchased	Total
1.	Books	11	143	154
2.	Scientific journals	__	203	203

New Structures

Other Activities

हिंदी पखवाड़ा

राजभाषा हिन्दी के समुचित विकास को बढावा देने के लिए प्रत्येक वर्ष की तरह इस वर्ष भी दिनांक 15 सितंबर से 30 सितंबर 2009 तक केन्द्र में हिन्दी पखवाड़ा का आयोजन किया गया । पखवाड़ा के शुभारंभ के अवसर पर निदेशक महोदय ने सभी अधिकारियों एवं कर्मचारियों को ज्यादा से ज्यादा हिन्दी में काम करने की शपथ दिलाई और हिन्दी के प्रयोग को बढाने के लिए आवाहन किया ।

पखवाड़ा के दौरान विभिन्न प्रतियोगिताओं का आयोजन किया गया । इन प्रतियोगिताओं में अनुवाद लेखन, स्वरचित हिन्दी कविता पाठ, एक मिनट प्रतियोगिता, निबंध लेखन एवं कंप्यूटर पर हिन्दी टंकण आदि प्रतियोगिताओं का आयोजन किया गया । हिन्दी पखवाड़ा के शुभ अवसर पर संस्थान के प्रमुख वैज्ञानिक डॉ. जी. एस्. करीबसप्पा ने धार्मिक विचारों पर व्याख्यान दिया तथा योगगुरू पंडित जगन्नाथ देव ने योग विज्ञान पर व्याख्यान दिया ।

समारोह का समापन दिनांक 1 अक्तूबर 2009 को आयोजित किया गया । श्री. गोपाल वर्मा, हिन्दी अधिकारी (सी. डैक., पुणे) समापन समारोह के मुख्य अतिथि थे । इस दिन हिन्दी कार्यशाला का आयोजन किया गया । हिन्दी के प्रगति पर राजभाषा विभाग एवं सी. डैक., पुणे द्वारा विकसित विभिन्न सॉफ्टवेयर एवं नि:शुल्क हिन्दी सॉफ्टवेयर की जानकारी दी गयी । अंत में प्रतियोगिताओं में विजेता प्रतिभागियों को मुख्य अतिथि द्वारा नकद पुरस्कार प्रदान किया

गया ।

हिन्दी कार्यशाला

संस्थान में 29 जनवरी 2010 को एक दिवसीय हिन्दी कार्यशाला का आयोजन किया गया । श्री. आर. पी. वर्मा, सहायक निदेशक, हिन्दी शिक्षण योजना, ने हिन्दी कार्य के कंम्प्यूटरीकर से सम्बधित विभिन्न सॉफ्टवेयर की जानकारी दी ।

पत्रव्यवहार

केंन्द्र में प्राप्त हिन्दी पत्रों का उत्तर केवल हिन्दी में ही दिया जाता है । साथ ही साथ कुछ पत्रों के उत्तर द्विभाषी भी होते हैं । इस वर्ष केन्द्र से 1118 पत्र हिन्दी में प्रेषित किए गए ।

हिंदी पट्टिका

केन्द्र के प्रवेश कक्ष में एक पट्टिक स्थापित की गयी है । जिसका प्रयोग हिन्दी जानकारी के लिए किया जाता है । इस पर प्रतिदिन एक हिन्दी शब्द लिखा जाता है तथा उसका अंग्रेजी में अनुवाद लिखा जाता है । इस पट्टिका पर मौसम की जानकारी हिन्दी में ही लिखी जाती है ।

तिमाही प्रतिवेदन तथा बैठक

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

Personnel

Promotions / Transfer / New Joinings

- Dr. R. G. Somkuwar was selected for the post of Principal Scientist (Horticulture) at NRC for Grapes. He took over charge as Principal Scientist on 7th August 2009.
- Dr. N.S. Kulkarni was transferred to Indian Grassland and Fodder Research Institute, Jhansi subsequent to his selection as a Senior Scientist (Entomology) w.e.f. 7th July 2009.
- Mr. A. S. Murthy, Assistant Finance and Accounts Officer was transferred to Project Directorate of Animal Disease Monitoring and Surveillance, Bangalore from 21st August 2009.
- Dr. D. S. Yadav and Mrs. S. Shalini Scientists (Entomology) joined this Institute on 20th June and 28th August 2009 respectively after successful completion of foundation course for ARS at NAARM, Hyderabad.
- Mr. B. M. Chavan took over charge as Jr. Accounts Officer on 20th October 2009.

समारोह/Celebrations

स्वाधीनता दिवस

संस्थान में 15 अगस्त 2009 को स्वाधीनता दिवस हर्ष और उल्लास से मनाया गया । संस्थान के निदेशक डॉ. पां. गु.

अडसुले ने ध्वजारोहन से कार्यक्रम का शुभारम्भ किया । अपने भाषण में उन्होंने जलअभाव की परिस्थितियों में अंगूर पैदावार को बनाये रखने के लिए संस्थान द्वारा किए गए कार्य का वर्णन किया और भारत में अंगूर उपयोग को और सुधारने के लिए सामूहिक प्रयासों के लिए सभी कर्मचारियों का आहवान किया । देशभक्ति गीत गाकर और मिठाई बांट कर कार्यक्रम का समापन हुआ ।

सतर्कता सप्ताह

संस्थान में 3-7 नवंबर 2009 के दौरान सतर्कता सप्ताह मनाया गया । निदेशक ने सभी कर्मचारियों को ईमानदारी और निष्ठा की शपथ दिलायी और इस कार्यक्रम की महत्ता विशेषत: संस्थान के सभी क्रियाकलापों में सत्यनिष्ठा, पारदर्शिता लाने पर बल दिया । डॉ. संजय सावंत, सतर्कता अधिकारी ने सतर्कता से संबंधित दिशा निदेशक और अन्य महत्वपूर्ण सूचना जो उन्हें राष्ट्रीय कृषि अनुसंधान प्रबंध अकादमी, हैदराबाद में प्रशिक्षण कार्यक्रम के दौरान प्राप्त हुई थी, से सभी कर्मचारियों को अवगत कराया ।

गणतंत्र दिवस

हर वर्ष की तरह इस वर्ष भी संस्थान में 26 जनवरी 2010 को देश का गणतंत्र दिवस सउल्लास मनाया गया । निदेशक, डॉ. पां. गु. अडसुले ने ध्वजारोहण किया और सभी कर्मचारियों ने राष्ट्रध्वज को सलामी दी । निदेशक ने अपने भाषण में जलवायु परिवर्तन से कृषि विशेष:कर अंगूर उत्पादकता पर होनेवाले असर को कम करने के लिए आवश्यक कृषि पद्धति में बदलाव की जरूरत पर ध्यान आकर्षित किया । खाद्य प्रसंस्करण द्वारा मूल्यवृद्धि द्वारा किसानों की आर्थिक स्थिति में सुधार की संभावनाओं तथा अंगूर क्षेत्र के अन्य मुद्दों का उल्लेख किया ।

महिला शिकायत समिति

डॉ. इंदू सावंत, प्रधान वैज्ञानिक की अध्यक्षता में महिला शिकायत समिति की बैठक 17 नवम्बर 2009 को आयोजित हुई । समिति ने खुशी दिखाई कि पिछले एक वर्ष में किसी भी कर्मचारी से कोई शिकायत प्राप्त नहीं हुई, यह तथ्य संस्थान में सौहार्द पूर्ण वातावरण दर्शाता है । बैठक में संस्थान की महिला कर्मचारियों के व्यापक कल्याण के लिए आवश्यक उपायों पर चर्चा की और इस विषय में संस्थान के निदेशक को भी अवगत किया ।

Institute Committees

Various units and committees were formed to look after Technical Cell, Publication, Store Purchase, Farm Management, Library, Works, Photography, Sports, ARIS Cell, Internal Revenue Generation Section and Official Language Implementation.

Meteorological Data

Year & Month	Air temperature (°C)		Relative Humidity (%)		Pan evapo-ration (mm)	Sunshine duration (hr.)	Total rainfall (mm)	No. of rainy days	No. of rainy days with >4 mm rain
	Min.	Max.	Min.	Max.					
Apr 2009	21.09	39.27	17.37	70.20	7.06	11.78	0.00	0	0
May 2009	22.80	37.64	31.58	83.65	6.77	12.12	12.20	6	2
Jun 2009	22.80	34.35	52.87	94.57	5.20	11.64	74.40	15	3
Jul 2009	22.37	28.13	81.32	99.74	1.68	10.58	154.40	28	9
Aug 2009	22.34	29.80	71.58	98.77	2.65	11.20	174.40	20	5
Sep 2009	21.67	31.81	69.70	99.73	2.25	10.42	172.60	23	7
Oct 2009	17.33	32.14	52.81	100.00	3.53	10.50	65.20	27	4
Nov 2009	15.76	30.55	57.27	99.87	2.84	9.68	135.20	20	4
Dec 2009	12.08	30.95	46.84	99.97	3.02	9.92	49.00	30	1
Jan 2010	11.84	31.29	39.87	99.90	3.65	10.10	23.80	26	0
Feb 2010	13.28	35.36	28.79	96.57	4.47	10.68	2.8	7	0
Mar 2010	17.33	38.71	18.52	80.87	5.57	11.13	4.2	2	0
Total	--	--	--	--	--	129.75	868.2	204	35

Source : Weather station, NRC for Grapes, Pune

Abbreviations

AAS	:	Atomic Absorption Sepctrophotometer
AFLP	:	Amplified Fragment Length Polymorphism
AICRP	:	All India Coordinated Research Project
AMAAS	:	Application of Micro-organisms in Agricultural Allied Sectors
ANGRAU	:	Acharya N.G. Ranga Agricultural University
APEDA	:	Agricultural Processed Food Products Export Development Authority
ARIS	:	Agricultural Research Information System
ASRB	:	Agricultural Scientist's Recruitment Board
BARC	:	Bhabha Atomic Research Centre
BSKKV	:	Dr. Balasaheb Sawant Konkan Krishi Vidypeeth
CCC	:	Chlormequat Chloride
CD	:	Critical Difference
CIB	:	Central Insecticide Bureau
CIRCOT	:	Central Institute for Research on Cotton Technology
CISH	:	Central Institute of Subtropical Horticulture
CV	:	Coefficient of Variability
DARE	:	Department of Agricultural Research and Education
DAS-ELISA	:	Double Antibody Sandwich- Enzyme Linked Immune Sorbent Assay
DBT	:	Department of Biotechnology
DDRT-PCR	:	Differential Display of Reverse Transcript-PCR
DTPA	:	Diethylene Triamine Pente Acetic Acid
EC	:	Electrical Conductivity
EU	:	European Union
FAO	:	Food and Agriculture Organization
FAPAS	:	Food Analysis Performance Assessment Scheme
FDA	:	Fluorescein Diacetate
FRP	:	Fiberglass Reinforced Plastic
FS	:	Flowering Stage
GA3	:	Gibberellic Acid
GC-MS/ MS-TOF	:	Gas Chromatography - Mass Spectrometry/Mass Spectrometry
ICP-MS	:	Inductively Coupled Plasma- Mass Spectrometry
GC-TOFMS	:	Gas Chromatography-Time of Flight Mass Spectrometry
GCV	:	Genotypic Coefficient of Variation
GLRaV	:	Grape Leaf Roll Virus
GPS	:	Global Positioning System
GUI	:	Graphical User Interface
HTML	:	Hyper Text Markup Language
IARI	:	Indian Agricultural Research Institute
IBA	:	Indole Butyric Acid
ICAR	:	Indian Council of Agricultural Research
IIHR	:	Indian Institute of Horticultural Research
IMC	:	Institute Management Committee
IPM	:	Integrated Pest Management
IPR	:	Intellectual Property Right
IRC	:	Institute Research Committee
IRGA	:	Infra Red Gas Analyser
IRGS	:	Internal Revenue Generation Scheme
ITMU	:	Institute Technology Management Unit
KVK	:	Krishi Vigyan Kendra
LC-MS/MS	:	Liquid Chromatography- Mass Spectrometry/Mass Spectrometry
LOQ	:	Limit of Quantifications
MIDC	:	Maharashtra Industrial Development Corporation
MPKV	:	Mahatma Phule Krishi Vidyapeeth
MRDBS	:	Maharashtra Rajya Draksha Bagaitdar Sangh (Maharashtra State Grape Growers' Association)
MRL	:	Maximum Residue Limit
MTA	:	Material Transfer Agreement
NAA	:	Naphthalene Acetic Acid
NABARD	:	National Bank for Agriculture and Rural Development
NBAIM	:	National Bureau of Agriculturally Important Micro-organisms
NHB	:	National Horticulture Board
NHRDF	:	National Horticulture Research and Development Foundation
NRL	:	National Referral Laboratory
OLIC	:	Official Language Implementation Committee
ORP	:	Out Reach Programme
PAH	:	Polyaromatic Hydrocarbons
PCB	:	Polychlorinated Biphenyls
PCR	:	Polymerase Chain Reaction
PCV	:	Phenotypic Coefficient of Variation
PFA	:	Prevention of Food Adulteration
PHI	:	Post Harvest Interval
PLW	:	Physiological Loss in Weight
PME	:	Project Management and Evaluation
PPP	:	Public-Private-Partnership
PSB	:	Phosphate Solubilizing Bacteria
PT	:	Proficiency Test
QRT	:	Quinquennial Review Team
RAC	:	Research Advisory Committee
RNA	:	Ribonucleic Acid
RTI	:	Right To Information
RT-PCR	:	Reverse Transcriptive-Polymerase Chain Reaction
SEM	:	Standard Error of Mean
SSR	:	Simple Sequence Repeats
TSS	:	Total Soluble Solids
TTA	:	Total Titrable Acidity
UPLC-DAD	:	Ultra Performance Liquid Chromatography - Diode Array Detector
VAM	:	Vesicular Arbuscular Mycorrhiza