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वार्षिक प्रतिवेदन | Annual Report 2007-08

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NRCG

राष्ट्रीय अंगूर अनुसंधान केन्द्र, पुणे
National Research Centre for Grapes, Pune

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राष्ट्रीय अंगूर अनुसंधान केन्द्र
(भारतीय कृषि अनुसंधान परिषद)

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Cover Page :
A hybrid of Pusa Navrang x Thompson Seedless, Double stem with two cordons placed horizontally, Yellow sticky trap, Weather station, Meeting with Raisin Grape Growers

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Contents

Preface

Growth, area, quality production, trade and commerce is increasing steadily in respect of grapes which is the indication of the growth of this sector in respect of all areas. The growth of wine sector is increasing with fast rate. Keeping all this in view, the experimentation both on wine grape and table grapes and its processed products viz. wine and quality raisins are being emphasized. To do more efficiently and also follow with the most modern and lab and farm validated method for experiments, the infrastructure in respect of equipments, instruments, new structures and vineyards was developed further during this period.

The Institute has progressed by leaps and bounds during the last 11 years. Most modern equipments have been obtained and commissioned to do research in all areas of viticulture and enology. Organisations like Agricultural and Processed Food Products Export Development Authority (APEDA), Department of Biotechnology (DBT) and Bhabha Atomic Research Centre (BARC) have also funded few projects in the areas of food safety and quality, biotechnology and quality plant propagation, respectively. With ours and external fundings, Institute has come out with various achievements in the areas of development of new clonal selections of better economic traits, new molecules for the management of insect pests and diseases, better canopy management, use of bioregulators for increasing quality and shelf life. Monitoring of pesticide residues and other contaminants in final produce has resulted in improving food safety and quality both in grapes and processed products for export and domestic market. Our non-compliance in pesticide residues in table grapes for export to EU countries at preharvest level has been reduced to 3.1 per cent as compared to 23.7 per cent when the programme was initiated by the Institute in 2003-04 with support of APEDA. Salient work achievements during the period are listed below:

During the period, twenty-nine accessions were introduced totalling cumulative collection to 444 accessions in germplasm collection. A mother block of 12 table/raisin varieties, six wine varieties and nine rootstocks was established for the production of quality planting material. Introduced / collected varieties in the germplasm, crosses made of both table and wine varieties were evaluated for their various desirable attributes including their rating for disease resistance/tolerance both *in vitro* and *in vivo* conditions. In the area of biotechnology, 41 varieties were analysed for their DNA with 32 microsatellite primers. Further work on sequence data and other areas is in progress.

Ongoing long term field experimentation on performance of Thompson Seedless grafted on 110R, 1103 P, 99R and own rooted vines resulted early and uniform sprouting. More yield was obtained on 110R and 1103P. However, this attribute along with quality was affected by various levels of salinity and moisture stress. Data on levels of phenolic compounds and polyphenolic enzyme was also collected in this study and its relation with rooting and effect of other characters of scion varieties. Study on training system and its performance on yield and quality of produce revealed that flat roof gable training system with double cordon and shoots positioned vertically on the cordon produced more yield with better quality in case of Thompson Seedless grafted on Dogridge rootstock.

Cumulative total uptake of sodium in cane, lamina and petiole was more in Thompson Seedless grafted on Dogridge as compared to 110R. However, the trend of chloride was different and found maximum in lamina followed by cane and petiole. Intensity of leaf blackening symptom was found varied in different rootstocks and it was severe in Salt Creek and own rooted vines. However, these symptoms were not observed in case of vines grafted on 110R rootstock. Thus, 110R rootstock is showing prominence to overcome saline condition in the soil and water.

Pink berry has become serious quality and yield problem in Thompson Seedless variety. Experiments using various bioregulators and effect of light were planned and executed during the period. However, no definite trend in confirming this problem was found and therefore, further experiment using modern techniques is continued. In the areas of management of various insect pests and diseases, further experiments were continued using various new chemicals and biocontrol agents. Data on bioefficacy and residues was collected to arrive at right dose and safety use of these pesticides. Results came out in this area so far has proved to be beneficial to growers in containing the incidence of insect pests and diseases and thus reduced considerably the economic loss to the crop. This has also reflected in increasing the total volume of export grapes to EU countries and over a period of time. Monitoring of incidence of new insect pests, diseases and viruses continued further during the period of report. A representative sample technology protocol was developed by experimentation to have more homogenecity in collected samples.

In the area of post-harvest technology, harvesting of Thompson Seedless bunches with their knot above, had found to have less physiological loss in weight (PLW) during storage as compared to bunches without knot. Raisin samples to the extent of 30 per cent collected from Sangli region did not comply to Codex standards in respect of number of cap stems per kg of produce.

During this period, technical work of grape crop in All Iindia Coordinated Research Project Centers (AICRP) of subtropical fruits with Central Institute of Subtropical Horticulture (CISH), Lucknow was also supervised and guided from time to time. The work reports were compiled to deliberate in the workshop in June 2008.

Institute organized various programmes at the campus and off the campus to transfer various techniques developed during the period and also participated in programmes organized by the 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.

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, Secretary, DARE and Director General, ICAR and Dr. H.P. Singh, Dy. Director General, 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 : October, 2008

(P. G. ADSULE)
Director

कार्यकारी सारांश

राष्ट्रीय अंगूर अनुसंधान केन्द्र की स्थापना 1997 में हुई। केन्द्र का उद्देश्य अंगूर उत्पादन, उत्पादकता और उपयोग को प्रभावित करने वाले जैविक और अजैविक नियामकों को सुलझाने हेतु मौलिक और सामरिक महत्व का अनुसंधान है। इन उद्देश्यों की पूर्ति के लिए फसल सुधार, फसल उत्पादन, फसल संरक्षण एवं फसलोपरांत प्रौद्योगिकी के क्षेत्रों में अनुसंधान किया जा रहा है।

विगत 11 वर्षों में केन्द्र ने चहुँमुखी विकास किया है। पिछले छह वर्षों में उत्कृष्ट बुनियादी ढाँचा विकसित किया गया है। सभी प्रयोगशालाएँ नवीनतम और परिष्कृत उपकरणों से लैस हैं। विभिन्न एजेन्सियों जैसे कृषि और प्रसंस्कृत खाद्य उत्पाद निर्यात विकास प्राधिकरण (एपीडा), जैव प्रौद्योगिकी विभाग (डीबीटी) तथा भाभा परमाणु अनुसंधान केन्द्र (बीएआरसी) ने कई अनुसंधान परियोजनाओं को सहायता दी है। देश में अंगूर उद्योग के विकास में केन्द्र के सहयोग को कई मंचों पर सराहा गया है। राष्ट्रीय संदर्भ प्रयोगशाला के रूप में केन्द्र के उत्कृष्ट प्रयासों के फलस्वरूप पिछले पाँच वर्षों में निर्यातित अंगूर में कीटनाशक अवशेषों की मात्रा में वर्ष 2003-04 के मुकाबले महत्वपूर्ण कमी हुई है। इससे घरेलू उत्पादन में कीटनाशकों के प्रयोग में भी कमी हो रही है।

पंद्रह संस्थानीय कार्यक्रमों, जो कि उत्पादकों की आवश्यकताओं तथा अनुसंधान सलाहकार समिति एवं संस्थान अनुसंधान समिति की सिफारिशों से विकसित किये गए है, के अलावा डीबीटी, एपीडा, बीएआरसी और नेटवर्क परियोजनाओं पर भी काम हुआ। वर्ष के दौरान केन्द्र की उल्लेखनीय उपलब्धियाँ निम्न हैं।

फसल सुधार

उनतीस आयातित अभिगमनों के संकलन के साथ राष्ट्रीय सक्रिय जननद्रव्य साइट पर कुल संख्या 444 पहुँच चुकी है। गुणवत्ता रोपण सामग्री के लिए एक मातृक्षेत्र स्थापित किया गया जिसमें 12 अंगूर / किशमिश किस्में, छह शराब किस्में और 9 मूलवृंत शामिल हैं। एक सौ पंद्रह जिसमें 28 शराब / रस और 25 क्रॉसेस शामिल हैं, का विभिन्न वांछनीय विशेषताओं के लिए मूल्यांकन किया गया। केन्द्र में विकसित क्रौसेस का भी मूल्यांकन किया गया।

F1 संकरों फ्लेम सीडलैस x सिवय विलार्ड और थौम्पसन सीडलैस x सिवय विलार्ड को पादप गृह में रखा गया और कुछ संतति को खेत में स्थानांतरित किया गया। इन उपलब्ध F1 संकरों की इन विट्रो स्क्रीनिंग प्लाजमापोरा विटिकोला के विरूध्द की गयी। इस वर्ष के अवलोकन की स्थिति पिछले वर्ष की स्थिति की पुष्टि करती है। इकतालीस संकरों का डीएनए विश्लेषण 32 माइक्रोसेटेलाइट प्राइमरों के साथ किया गया। अब तक संकरों का 36 प्राइमरों के साथ विश्लेषण किया जाता था। अनुक्रम आँकडों के आधार पर तीन होनहार बैंड VVMD 21, VVI 52 और VVI बी 23 प्राइमरों के साथ प्राप्त हुए।

फसल उत्पादन

विभिन्न मूलवृंत्तों पर रोपित थौम्पसन सीडलैस पर किए गए दीर्घकालीन प्रयोग दर्शाते हैं कि 110 आर, 1103 पी, 99 आर तथा स्वमूल में जल्दी एवं समान स्फुटन पाया गया। डागरिज तथा एसओ 4 में देर से एवं लघुतम स्फुटन पाया गया। 110 आर, 99 आर तथा 1103 पी मूलवृंतों में अधिक उपज दर्ज की गयी।

मूलवृंतों पर कलमित थौम्पसन सीडलैस की उपज एवं गुणवत्ता मानक, लवणता तथा नमी के दबावों से प्रभावित होते हैं। मूलवृतों की मूलन प्रक्रिया से समय पौलीफिनॉल ऑक्सिडेज (पीपीओ) महत्वपूर्ण भूमिका निभाता है। जड़ प्रारम्भ तथा इसकी लम्बाई का पीपीओ गतिविधि के साथ सम्बध स्थापित किया गया।

विभिन्न मूलवृतों पर कलम की गई थौम्पसन सीडलैस में विभिन्न अवस्थाओं पर होने वाले भौतिक रासायनिक परिवर्तनों को दर्ज किया गया।

सभी मूलवृंतों में कुल फिनोल यौगिकों में गिरावट फलस्थापन से शुरू होकर तुड़ाई तक होती है तथा मणी की सभी विकास अवस्थाओं पर महत्वपूर्ण अंतर दर्ज किए गए। 110 आर एवं डागरिज पर कलमित थौम्पसन सीडलैस से अधिकतम किशमिश पायी गयी। 110 आर की अपेक्षा डागरिज पर कलमित थौम्पसन सीडलैस में पीपीओ प्रक्रिया अधिक पाया गयी।

डॉगरिज पर कलम की गयी तास-ए-गणेश जो कि छत के समान सपाट प्रणाली पर प्रशिक्षित थी पर अध्ययन दिखाता है कि फल गुच्छों की अधिक संख्या, गुच्छा वजन, 50 मणी वजन, मणी व्यास एवं उपज प्रति बेल द्वितना में एकल तना की अपेक्षा अधिक पायी गयी। क्षितिज समानांतर के मुकाबले उर्ध्वस्थिति में तना अधिक फलदार थे। दो या चार कॉर्डन की अपेक्षा एकल क्षैतिज कॉर्डन में अधिक गुच्छा वजन था। डॉगरिज पर कलमित तास-ए-गणेश में प्रति बेल गुच्छों की संख्या, गुच्छा वजन एवं उपज प्रति बेल, पंडाल विधि के अंतर्गत द्वितना में एकल की अपेक्षा अधिक दर्ज की गयी।

डॉगरिज पर कलमित तास-ए-गणेश में 110 आर की अपेक्षा केन, लेमिना तथा पर्णवृंट में कुल संचयी सोडियम महत्वपूर्ण रूप से अधिक था। कलमित अथवा अकलमित लताओं से प्राप्त पत्तियों में केन की अपेक्षा अधिक सोडियम था। लवणीय सिंचाई में डॉगरिज मूलवृंत सोडियम को प्रथक नहीं कर सकता है। दोनों प्रकार की कलमित तथा अकलमित लताओं के विभिन्न ऊतकों में क्लोराइड का कुल संचय लेमिना में सर्वाधिक तथा इसके बाद केन तथा पर्णवृंत में था।

हालांकि कलमित की अपेक्षा स्वमूल लताओं के तीनों हिस्सों में पोटेशियम सांद्रता कम थी। पत्ती के कालेपन से पत्ती के नुकसान के लिए मूलवृंतो में महत्वपूर्ण अंतर था। साल्ट क्रीक में लक्षण गम्भीर थे इसके बाद डॉगरिज तथा स्वमूल आते हैं। हालांकि 110 आर मूलवृंत पर कलमित लताओं में लक्षणों का अवलोकन नहीं हुआ। इस प्रकार 110 आर मूलवृंत खारे पानी के प्रति सहनशीलता दिखाता है।

जैवनियंत्रक / कृषि रसायन - साइकोसिल (सीसीसी), एन-2 (2-क्लोरो-4-पाइरीडिल)-एन-फिनाइल यूरिया (सीपीपीयू), शर्करा, प्रोपीकोनाजोल विभिन्न सांद्रताओं के साथ गुलाबी मणी बनने से रोकने के लिए प्रयोग किए गए लेकिन कोई भी प्रभावकारी नियंत्रक नहीं पाया गया। जब गुच्छों को विभिन्न प्रकार के कागजों से ढका गया तो गुलाबी मणी बनने में अंतर पाया गया। प्रयोग के तीन दिन बाद जीए-3 के अवशेषों में बडी तेजी से गिरावट शुरू हुई तथा प्रयोग के 10 दिन बाद सबसे कम अवशेष जो कि 18 मिग्रा प्रति ग्राम था देखा गया। थॉम्पसन सीडलैस, शरद सीडलैस तथा फ्लेम सीडलैस प्रजातियों में दूसरे वर्ष के अध्ययनों में यह पुन: पाया गया कि जैव उद्दीपक, मणी आकार बढ़ाने की क्षमता रखते हैं।

फसल संरक्षण

केन्द्र द्वारा विकसित मॉडल जो कि चूर्णिल आसिता के दैनिक जोखिम का आकलन करता है के लिए मौसम के आँकडों का प्रयोग किया गया। प्राप्त परिणामों के आधार पर चूर्णिल आसिता नियंत्रण के लिए छिड़काव अनुसूची तैयार

की गयी। परिगलित गुच्छों के खिलने के पूर्व से विरेजन तक ऊस्पोर की उपस्थिति के लिए जाँचा गया। परिणामत: गुच्छा परिगलन का कारण, मृदुल आसिता संक्रमण को पाया गया। अनुसूची में दो प्रणालीगत कवकनाशियों के छिडकाव को पोटेशियम कार्बोनेट 5 ग्राम प्रति लिटर की दर तथा मोनो पोटेशियम फास्फेट 3 ग्राम प्रति लीटर की दर के छिडकावों से प्रतिस्थापित किया जा सकता है। इन रसायनों का प्रयोग वैटेबल गंधक के साथ किया जा सकता है। इन उपचारों का प्रयोग जैविक अंगूर उत्पादन में किया जा सकता है। मेलबैक किस्म पत्ती रोल के विशिष्ट लक्षण दिखा रहा थी लेकिन यह सभी उपलब्ध एलीसा परिक्षणों के लिए नकारात्मक थी। वायरस से संक्रमित लताएँ ठंड के प्रति अधिक संवेदनशील पायी गयीं। पीले धब्बों के लक्षण दिखाने वाली सोविग्नॉन ब्लैंक जीवीएलआरएवी 1 + 3 के प्रति सकारात्मक थी। थ्रिप्स की आबादी का अत्यधिक महत्वपूर्ण नकारात्मक सहसंबंध न्यूनतम तापमान ($r = -0.75$) और वर्षा ($r = -0.47$) के हाथ दर्ज किया गया। छिटपुट मिलीबग की आबादी सभी अंगूर उत्पादक क्षत्रों में पायी गयी। तथापि तनाछेदक का अधिक प्रकोप महाराष्ट्र के सांगली क्षेत्र में देखा गया।

किशमिश वेली, 2 ए क्लोन, पूसा उर्वशी और सुपिरियर सीडलैस की तुलना मे तन्नत, खलीली, लेक अमरलड किस्मों में थ्रिप्स का आक्रमण कम पाया गया। केन्द्र द्वारा विकसित मिलीबग आईपीएम पैकेज में विभिन्न भौतिक विधियों, जैव कीटनाशकों, परजीवी और शिकारियों, नीम उत्पादों एवं तेल उत्पादों का मूल्यांकन किया गया। अंगूर के बाग से कीटनाशी अवशेष विश्लेषण के लिए नमूना लेने की एक प्रक्रिया का मानकीकरण किया गया। इस प्रक्रिया के अनुसार 5 किग्रा अंगूरों का एकत्रीकरण जिसमें छोटे गुच्छे शामिल हों, समान परिणाम के लिए एक हेक्टेअर के अवशेष विश्लेषण के लिए प्रयोगशाला नमूना होगा।

तुडाई उपरान्त प्रौद्योगिकी

तास-ए-गणेश में गाँठ के साथ गुच्छा में बिना गाँठ के गुच्छे की अपेक्षा न्यूनतम वजन में कमी हुई। स्वाद परीक्षण अध्ययन दर्शाता है कि सोडा पानी के द्वारा अंगूर रस को 14° ब्रिक्स टीएसएस तक तनु करने पर भी रंग, मिठास, खूशबू, अम्लता आदि ने स्वीकृती को प्रभावित नहीं किया।

कोडेक्स मानकों के लिए किशमिश नमूनों के विश्लेषण के बाद यह पाया गया कि 30 प्रति शत नमूने छोटे तिनकों की संख्या का मानक अनुपालन नहीं करते हैं।

अखिल भारतीय समन्वित अनुसंधान परियोजना (उष्ण कटिबंधीय फल - अंगूर)

केन्द्र भारतीय समन्वित अनुसंधान परियोजना (उष्ण कटिबंधीय फल) - अंगूर का तकनीकी समन्वयक है। चार प्रायोजित और तीन स्वैच्छिक केन्द्र इस कार्यक्रम में भाग ले रहे हैं। देश के विभिन्न क्षेत्रों में आनुवांशिक संसाधनों का प्रबंधन और किस्म सुधार, प्रवर्धन, मूलवृंत और कृषि तकनीक और कीट तथा रोग प्रबंधन इस कार्यक्रम की मुख्य गतिविधियाँ हैं।

प्रौद्योगिकी और सूचना स्थानांतरण

अंगूर की खेती के विभिन्न पहलुओं और अंगूर मदिरा प्रौद्योगिकी और सूचना का, अंगूर उद्योग के विभिन्न हितधारकों कि लिए प्रशिक्षण कार्यक्रमों के आयोजन, क्षेत्र दौरों, उत्पादक संघों में भागीदारी, सेमिनारों, केन्द्र पर संवाद, केन्द्र की वेबसाइट पर जानकारी डालकर तकनीकी का स्थानांतरण किया गया। वैज्ञानिकों ने अंगूर उत्पादकों,

उत्पादक संघों, राज्य सरकारों, आदि के द्वारा आयोजित सेमिनारों में 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 लाभान्वित हुए।

मानव संसाधन विकास

दो वैज्ञानिकों को एक वर्ष के लिए अपने संबंधित क्षेत्रों जैवप्रौद्योगिकी, कृषि मृदा विज्ञान और रसायनशास्त्र में अग्रिम ज्ञान प्राप्त करने के लिए ऑस्ट्रेलिया भेजा गया। हालांकि, अन्य चार वैज्ञानिकों ने संयुक्त राज्य अमेरिका और दक्षिण अफ्रीका का दौरा एओएसी बैठक और प्रशिक्षण कार्यक्रमों में भाग लेने के लिए किया। इसके अलावा, तीन वैज्ञानिकों और एक तकनीकी कर्मी ने देश के भीतर विभिन्न क्षेत्रों में प्रशिक्षण प्राप्त किया।

राजस्व आय

निर्धारित लक्ष्य 45 लाख रूपये के मुकाबले केन्द्र ने 45.3751 लाख रूपये की राजस्व आय अर्जित की। यह राजस्व आय प्रशिक्षण, सलाह, अनुबन्धित अनुसंधान और सेवाएँ, फार्म उत्पाद और पौधा सामग्री बेच कर हुई। इस राजस्व के अतिरिक्त रूपये 27.4265 लाख जमा राशि पर ब्याज के रूप में अर्जित किए गए।

भावी प्रतिबल क्षेत्र

ऊपज कायम रखना, उत्पाद की गुणवत्ता में सुधार, गुलाबी मणी में कमी, नए रसायनों के विश्लेषण की विधि, गुणवत्ता मदिरा उत्पादन के लिए फसल वजन अध्ययन आनेवाले वर्ष में शोध के क्षेत्र होंगे।

Executive Summary

National Research Centre for Grapes was established in 1997 with the mandate to undertake mission-oriented programme involving basic and strategic research for resolving the major biotic and abiotic constraints affecting the grapes production, productivity and utilization. To achieve this, research is carried out in the broad areas of crop improvement, crop production, crop protection and post harvest technology.

During last 11 years of its establishment, the Centre has progressed by leaps and bounds. Excellent infrastructure is developed during last six years and the laboratories are now equipped with modern and sophisticated equipments. Several agencies specially Agricultural and Processed Food Products Export Development Authority (APEDA), Department of Biotechnology (DBT) and Bhabha Atomic Research Centre (BARC) have funded research projects in their respective field of works. The Centre's contribution towards progress of grape industry in the country was recognized at different fora. Excellent efforts of this Centre as National Referral Laboratory resulted in considerable reduction in pesticide residues in export grapes during last five years as compared to 2003-04 as the first year of the programme. This is also helping in reduction of pesticide use in domestic production.

Besides 15 institute programmes, which were formulated after thorough understanding of the growers' need and refined time to time after recommendations of the Resarch Advisory Committee and Institute Research Committee, research was carried out under DBT, APEDA, BARC and Indian Council of Agricultural Research (ICAR) Network projects and also undertook several contract research and consultancy projects. The salient achievements of the Institute during 2007-08 are given below:

Crop Improvement

Twenty nine accessions were introduced and established taking the cumulative collection to 444 accessions at the National Active Germplasm Site. A mother block of quality planting material comprising 12 table / raisin varieties, 6 wine varieties and 9 rootstocks has been established. One hundred and fifteen varieties including 28 wine / juice and 25 crosses made at the Centre were evaluated for their various desirable attributes. The crosses made at Centre were also evaluated.

The F1 hybrids viz. Flame Seedless × Sevye Villard and Thompson Seedless × Sevye Villard were maintained in the green house and some progenies were transferred to field. *In vitro* screening of these available F1 hybrids was also done against *Plasmopara viticola*. The rating of this year's observations confirmed the previous rating. DNA from 41 hybrids was analysed with 32 microsatellite primers. So far, F1 hybrids were analysed with 36 primers. Based on the sequence data, three promising bands obtained with primers VVMD 21, VVI 52 and VVI B23.

Crop Production

Long term field experiments on performance of Thompson Seedless grafted on different rootstocks revealed that early and uniform sprouting recorded in 110 R 1103 P, 99 R and own rooted vines. Late and least sprouting was noted in Dogridge and SO4. More yield was recorded in 110 R, 99R and 1103 P rootstocks. Results of preliminary studies showed that the yield and quality parameters of Thompson Seedless grafted on rootstocks affected by various levels of salinity and moisture stress.

During the rooting process of rootstocks, it was found that polyphenol oxidase (PPO) activity plays an important role and relationship was established in root primordial and root length with PPO activity.

The physico-chemical changes were recorded at various stages in Thompson Seedless grafted on different rootstocks. Total phenolic compounds started declining from fruit set to harvest in all the rootstocks and significant differences were noted during all two stages of berry development. Among different rootstocks, highest raisin recovery was noted in Thompson Seedless grafted on 110 R and Dogridge. PPO activity was more in Thompson Seedless on Dogridge as compared to 110 R.

Study on Tas-A-Ganesh grafted on Dogridge and trained as flat roof gable system, revealed that more number of bunches per vine, bunch weight, 50 berry weight, berry diameter and yield per vine was recorded more in double cordon in comparison with single cordon. It was found that shoots positioned vertically to the cordon were more fruitful than the horizontal. The bunch weight was more in single cordon placed horizontally as compared to the double and four cordon system. Number of bunches per vine, bunch weight and yield per vine was recorded more in double stem as compared to single stem in Tas-A-Ganesh grafted on Dogridge under bower training system.

Cumulative total uptake of sodium in cane, lamina and petiole was significantly more in Tas-A-Ganesh grafted on Dogridge as compared to 110R. Leaves contained more sodium than canes in grafted or ungrafted vines. Dogridge rootstock couldn't exclude sodium under saline irrigation. The total accumulation of chloride among different tissues was found highest in lamina followed by cane and petiole both in grafted and ungrafted vines. However, potassium concentration was low in all three vine parts in case of own rooted vines as compared to grafted vines. The rootstocks differed significantly in leaf damage caused by leaf blackening. The symptoms were more severe in Salt Creek followed by Dogridge and own rooted vines. However, symptoms were not observed in vines grafted on 110R rootstock. Thus, 110R rootstock showed tolerance against saline water.

In field conditions, bioregulator / agrochemicals viz. Cycocel (CCC), N-(2-chloro-4-pyridyl)-N-phenyl urea (CPPU), Sucrose, Propiconazole with different concentration were applied to avoid pink berry formation but none was found effective in controlling the malady. Differences were recorded in pink berry formation when bunches were covered with different type of papers. The GA3 residues starts reducing drastically after 3 days of application and it showed least residues i.e. 18 g g-1 at 10th day after application. In second year studies, it was again found that biostimulant having potential to increase berry size in varieties viz. Thompson Seedless, Sharad Seedless and Flame Seedless.

Crop Protection

The weather data was used for estimating daily risk of powdery mildews using model developed by the Centre. On the basis of obtained results, spray schedule for the control of powdery mildew has been prepared. Necrotic bunches from pre bloom to veraison stage were tested for presence of oospore and as a result downy mildew infection was detected for the cause of bunch necrosis. In the schedule, two systemic fungicide sprays can be substituted with sprays of potassium carbonate @ 5 g L^{-1} and monopotassium phosphate @ 3.0 g L^{-1}. These chemicals can be used in combination with wettable sulfur. These treatments have potential to use in organic grape production. The variety

Melback was showing typical symptoms of leaf roll but it was negative to all available ELISA tests. It was recorded that virus infected vines were more sensitive to cold. Healthy looking vine of Sauvignon Blanc showing yellow mottle symptoms was found positive for GVLRaV 1+3.

Highly significant negative correlation was recorded among thrips population with minimum temperature (r= -0.75) and rainfall (r= -0.47). Mealybug population was sporadic in all grape growing areas however, heavy incidence of stem borer was noticed in Sangli region of Maharashtra. Thrips attack was noted low in Tannat, Khalili, Lake Emerald varieties as compared to Thompson Seedless, Kishmish Veli, 2A clone, Pusa Urvashi and Superior Seedless. Various physical, cultural methods, bio-pesticides, parasites and predators neem formulation and oil formulations were evaluated in IPM package developed by centre for mealy bug.

A procedure of sampling grapes from vineyards was standardized for pesticide residue analysis. As per this procedure sampling by collecting 5 kg grapes comprising of small bunchlets will be laboratory sample from 1 ha for residue analysis with homogenous results.

Post harvest Technology

Minimum loss of weight was recorded in bunches of Tas-A-Ganesh with knot as compared to bunches without knot. Organoleptic studies revealed that grape juices diluted with soda water up to TSS level of 14°B did not affect the acceptance in terms of colour, sweetness, flavour acidity etc. After the analysis of raisin samples for Codex standards, it was noted that 30% samples did not comply the standard in respect of number of cap stem.

AICRP on STF-Grapes

The Centre is the coordinator (Technical) for All India Coordinated Research Project on Sub-tropical Fruits in respect of Grapes. Four sponsored and three voluntary centers are participating in this programme. Management of genetic resources and varietal improvement, propagation, rootstocks and agro-techniques and pest and disease management are main activities of this programme under the different ecoregions of the country.

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 centre and placing information on the centre'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 Centre.

Human Resource Development

Two scientist were deputed Australia for one year to acquire advance knowledge in their respective areas viz. Biotechnology and Agricultural Soils Science and Chemistry. However, other four scientists visited USA and South Africa and participated in AOAC meeting and training programmes respectively. Further, three scientists and one technical personnel acquired training in various fields within the country.

Revenue Generation

Gross revenue of Rs. 45.3751 lakhs was generated against the target of 45 lakhs through training, consultancy, contract research, services and sale of farm produce. Interest on term deports receipts was earned of Rs. 27.42654 lakhs apart from revenue.

Future Thrusts

Sustaining of yield, improving the produce quality, minimization of pink berry, method of development analysis of new chemicals, crop load studies for production of quality wines will be focus of research in coming year.

Introduction

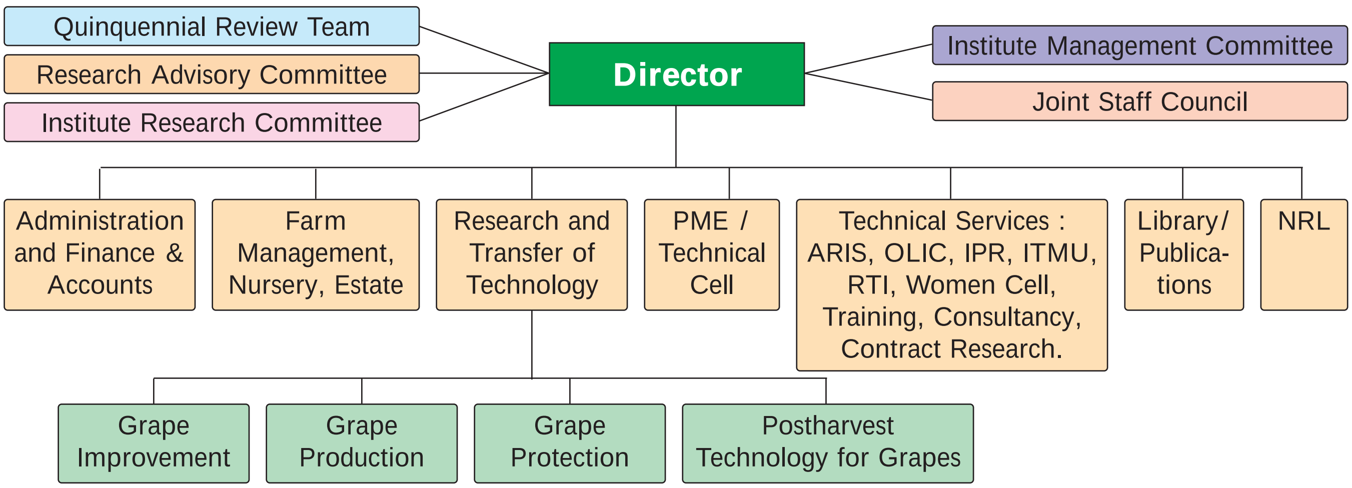
The National Research Centre for Grapes has completed 11 years of its establishment at Pune. The Centre is spread over an area of 46.78 ha and functions from its Laboratory-cum-Administrative building. A total area of about 14 ha has been planted with Dogridge rootstock, of which 2.4 ha has been covered with Thompson Seedless and Tas-A-Ganesh cultivars for various experimental trials. National Active Germplasm Site for grapes contained a number of 444 germplasms including indigenous and exotic spp./varieties/hybrids, rootstocks etc. Extended 'Y' trellises system i.e. flat roof gable equipped with drip irrigation/fertigation facilities have been established for training the vines. One ha of vineyard grafted with newly introduced commercially important table varieties has been established to develop mother block for supplying high quality planting material. Irrigation facilities are being augmented time to time to meet the water requirement for additional vineyards. A polyhouse, glasshouse and FRP houses have been constructed to maintain seedlings and conducting experiments under controlled conditions. The development of another 8 ha of vineyards mainly for wine grapes is under progress.

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.



Financial statement

(Rs. in Lakhs)

Sl. No.	Heads	R. E. 2007-08		Expenditure 2007-08		Final Grant		Revenue Generated
		Plan	Non-Plan	Plan	Non-Plan	Plan	Non-Plan	
1.	Estt. Charges	0.00	101.60	0.00	101.60	0.00	101.60	
2.	O.T.A.	0.00	0.10	0.00	0.06	0.00	0.10	
3.	T.A.	3.00	2.00	3.00	2.00	3.00	2.00	
4.	Other charges	101.00	65.15	101.00	65.15	101.00	65.15	
5.	Works	76.00	6.75	76.00	6.75	76.00	6.75	
	Total	**180.00**	**175.60**	**180.00**	**175.56**	**180.00**	**175.60**	**45.3751***

* Revenue of Rs. 45.3751 lakhs was generated against the target of Rs. 45.00 lakhs through training, consultancy, contract research and services, sale of planting material and farm produce. Interest on term deposit receipts was earned of Rs. 27.42654 lakhs apart from the revenue receipts during 2007-08.

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	9	0
5.	Supportive	7	7	0
	Total	41	39	2

Programme 1. Management of genetic resources of grapes

1.1 Collection and augmentation

Seven exotic varieties were introduced by the Institute from the PGR Unit, Cornell University, Geneva, New York, USA. Private winery M/s. Sula Wine also deposited introduced 17 pregrafted composite accessions of wine varieties/rootstocks out of which six are from France and 11 from South Africa. All the collections are given in Table 1. In all, 11 scion varieties and 18 rootstock accessions were introduced during the year. Cumulative collection at the centre has reached 444 accessions in the germplasm.

Table 1. Accessions introduced during 2007-08.

Sl. No.	Variety / rootstock	Source	Quantity
1	Bertille Seyve 5563 (EC 612807)	PGR Unit Cornell University, Geneva, New York, USA	3
2	Chambourcin Joannes Seyve(EC 612808)	-do-	3
3	Harmony (EC612809)	-do-	6
4	Neagra Seedless (EC 612810)	-do-	3
5	SV-5276 (Seyval) (EC 612 811)	-do-	3
6	Freedom (EC612812).	-do-	6
7	Karmrajut (EC 612813)	-do-	3
8	Cabernet Sauvignon 337 /140RU265,	France	15
9	Sauvignon Bl 905 /1103P 767,	- do -	15
10	Sauvignon Bl 905 /1103P768,	- do -	15
11	Sauvignon Bl 905 /1103P113	- do -	15
12	COT 598/110R237	- do -	15
13	COT598/1103P768	- do -	15
14	Grenache Noir / 1103P-GN70	South Africa	12
15	Grenache Noir / 110R-GN70	- do -	15
16	Grenache Noir / 101-14Mgt- GN136	- do -	15
17	Grenache Noir/ 101-14Mgt-GN 70	- do -	15
18	Grenache Noir/ SO4-GN136	- do -	15
19	Viognier VR642 / 110 R-RQ4	- do -	15
20	Viognier VR1A / 110R-RQ28C	- do -	15
21	Malbec MC71B / 99R	- do -	15
22	Malbec MC71B / 110R	- do -	15
23	Malbec MC71B /US 8-7 UC274D	- do -	15
24	Sauvignon Bl SB317A / 110R-RQ28C	- do -	15

1.2 Establishment of nursery mother block

Healthy mother plants in the germplasm with constant good yield performance, vigour/growth and quality of fruits were identified for establishment of nursery mother block at the centre. Mother plants including 12 table and raisin varieties viz.; Thompson Seedless (France), Flame Seedless, Christmas Rose, Sharad Seedless, A 18-3, A17-3, Red Globe, 2A Clone of Thompson Seedless, Cardinal, Crimson Seedless, Fantasy Seedless, and Kishmish Rozavis White; six wine varieties (Cabernet Sauvignon, Merlot, Chenin Blanc, Shiraz, Sauvignon Blanc and Zinfandel) and also for nine rootstock varieties (B2-56, SO-4, 1103 P, Dogridge, 140 RU, Salt Creek, Freedom, 41B, 110R).

1.3. Evaluation for fruit yield and quality

115 varieties, including 28 wine/juice varieties and 25 crosses made at the centre were screened for fruit yield, bunch weight, berries/bunch, berry weight, berry size, juice percentage, seed content, TSS, acidity and pH of the juice. In general, the TSS build up was slow but gradual, whereas acidity levels were high in most of the varieties tested during this season.

Ten wine varieties were tested for must qualities. Among the five red wine varieties, Merlot recorded maximum TSS (21.8%) followed by Shiraz and Cabernet Sauvignon (21.0% each) and Zinfandel (20.4%), whereas lowest TSS (18.0%) was noted in Athens. Highest acidity was recorded in Cabernet Sauvignon (0.92%), followed by Zinfandel (0.82%), Shiraz (0.72%), Athens (0.71%) and Merlot (0.70%). The pH values of the must recorded between 3.2 (Shiraz) to 3.5 (Athens and Merlot). Anthocyanin pigments in the fresh juice were highest in Merlot (77.05 mg 100 g^{-1}), followed by Shiraz (74.21 mg 100 g^{-1}), Cabernet Sauvignon (58.63 mg 100 g^{-1}) whereas Zinfandel (52.08 mg 100 g^{-1}) and Athens (52.0 mg 100 g^{-1}) recorded low in anthocyanin pigments. Maximum total phenolics were recorded in Merlot (8940 mg 100 g^{-1}), followed by Shiraz (5806 mg 100 g^{-1}), Zinfandel (5046 mg 100 g^{-1}), Cabernet Sauvignon (4146 mg 100 g^{-1}) and Athens (3950 mg 100 g^{-1}). Among the five white wine varieties Sauvignon Blanc and Chardonnay recorded maximum TSS (22.0%) followed by Chenin Blanc and Char x Ark-2 (20.0% each), whereas lowest TSS i.e. 18% was recorded in Symphony. Titrable acidity was recorded maximum in Sauvignon Blanc (0.84%) followed by Symphony (0.81%), Chardonnay (0.76%), Char x Ark-2 (0.69%) and Chenin Blanc (0.66%). Sauvignon Blanc also recorded the lowest pH (3.10), followed by Chenin Blanc (3.20), Symphony, Char x Ark-2 (3.30) and Chardonnay (3.36). Total phenolics were maximum in Char x Ark-2 (2650 mg 100 g^{-1}), followed by Chardonnay (1950 mg 100g^{-1}), Sauvignon Blanc (1450 mg 100 g^{-1}), Chenin Blanc (1020 mg 100 g^{-1}) and Symphony (920 mg 100 g^{-1}).

1.4 Evaluation for fruitfulness, growth, yield and quality parameters in some table and wine grape varieties

Seven table grape varieties viz.; Thompson Seedless, Sharad Seedless, Flame Seedless, Fantasy Seedless, Crimson Seedless, A - 17/3 and 2 A clone and five wine grape varieties viz.; Cabernet Sauvignon, Shiraz, Merlot, Sauvignon Blanc and Chenin Blanc were selected for this study. Among table grapes (Table 2), maximum fruitful canes were recorded on Flame Seedless followed by Thompson Seedless, Sharad Seedless, A 17/3 and 2A Clone. Least was on Crimson Seedless and Fantasy Seedless. Significant difference in position of fruitful bud was recorded among varieties and basal bud fruitfulness (3-5th bud) was observed in Flame Seedless, Fantasy Seedless and 2 A clone.

In Sharad Seedless and A - 17/3 maximum fruitfulness was recorded on 6th bud position, while on Thompson Seedless bud fruitfulness was recorded at 7th and 8th bud. Weight of 50 berries was highest in Fantasy Seedless and A - 17/3 while least was in Flame Seedless and Thompson Seedless. Maximum berry length was noted in Crimson Seedless, Fantasy Seedless and A - 17/3 while least was in Flame Seedless and Thompson Seedless. In case of berry diameter, TSS and acidity no significant differences were observed.

Among wine grapes (Table 3), maximum fruitful canes were recorded in Shiraz followed by Chenin Blanc and Sauvignon Blanc. However, minimum fruitful canes were recorded in Merlot and Cabernet Sauvignon. Maximum number of bunches were recorded in Shiraz, Chenin Blanc and Sauvignon Blanc. Least bunches were recorded on Cabernet Sauvignon. Maximum fruitful buds were recorded at 3rd bud in Chenin Blanc, Sauvignon Blanc and Shiraz, while it was recorded at 4-5th bud in Merlot and Cabernet sauvignon. Bold berries in terms of 50 berry weight, berry length and berry diameter was recorded in Merlot, while it was least in Cabernet Sauvignon. Significant difference in juice acidity was recorded with highest in Chenin Blanc and least in Merlot. Biochemical constituents like total proteins, phenols, proline, osmotic potential, reducing sugars, amino acids etc were also analyzed at various stages of berry development from fruit set till harvesting.

Table 2. Vegetative, yield and quality parameters of some important table grape varieties.

Varieties	Shoots/ vine	Stock Scion ratio	Sprouts/ vine	Panicles/ vine	Fruiting bud position on cane	Bunches/ vine	50 berry weight (g)	TSS (°B)	Acidity (%)	Berry diameter (mm)	Berry length (mm)
Thompson Seedless	57.33	0.80	122.33	49.33	7.32	32.67	119.57	20.13	0.67	15.43	17.77
Sharad Seedless	49.67	0.87	119.00	32.00	6.16	36.00	139.34	19.07	0.65	15.50	18.63
Crimson Seedless	44.67	0.90	87.67	24.00	6.02	25.00	135.96	19.40	0.82	16.17	19.30
Flame Seedless	54.67	0.70	112.67	55.33	4.61	51.33	121.23	18.93	0.60	15.33	16.47
Fantasy Seedless	41.00	0.75	50.67	27.00	4.30	26.00	156.21	20.38	0.86	16.47	20.90
2A clone	55.33	0.76	120.67	34.00	5.13	36.33	129.67	19.43	1.01	15.83	17.87
A 17/3	43.00	0.86	56.00	25.33	6.46	30.33	187.43	19.57	0.70	16.30	22.31

Table 3. Vegetative, yield and quality parameters of some important wine grape varieties.

Varieties	Shoots/ vine	Stock Scion ratio	Sprouts/ vine	Panicles/ vine	Fruiting bud position on cane	50 berry weight (g)	TSS (°B)	Acidity (%)	Juice pH	Berry diameter (mm)
Merlot	54.75	0.86	126.00	78.75	5.68	124.29	21.13	0.92	3.58	17.14
Cabernet Sauvignon	48.25	0.79	133.75	42.75	4.13	50.59	21.45	1.04	3.56	11.72
Sauvignon Blanc	49.50	0.82	112.25	82.75	3.43	69.64	21.18	1.04	3.64	14.13
Shiraz	47.00	0.75	105.50	77.50	3.24	69.56	20.62	1.15	3.53	14.12
Chenin Blanc	49.00	0.75	116.25	68.00	2.91	59.32	19.82	1.23	3.60	14.53

Programme 2. Germplasm utilization and genetic enhancement

2.1 Genetic enhancement and crosses developed

- **AH4-1-5 (Chardonnay x Arkavati) :** A precocious bearer. Medium late in maturity, bunches and berries almost resemble to Chardonnay. The vines found suitable for high density planting. TSS-21°Brix, acidity -0.76%, pH-3.4.

- **A27-1-1 (Pusa Navrang x Flame Seedless) :** A heavy bearer with good bunch and berry size. Bunches long and slightly shouldered, the berries dark purple, crisp and tienturier and having muscat flavour. The berry attachment is very good. The variety is suitable for table and munakka. TSS-22°Brix, acidity-0.58%.

- **A27-5 (Pusa Navrang x Flame Seedless) :** An early ripening type. Medium sized, conical and shouldered bunches. Attractive berries, light pinkish red colour, non- teinturier, medium bold, soft seeded, crisp pulp with muscat flavour and uniform ripening. Berry attachment is firm and tolerant to berry splitting unlike in Flame Seedless. TSS-18°Brix, acidity-0.55%.

- **AH2-20 (Spin Sahebi x Kishmish Chernyi) :** Black seedless, conical and medium sized bunches. The berries medium bold, spherical with firm pulp. An early maturing type. TSS-19°Brix, acidity-0.80%, pH-3.4.

- **AH2-22 (Spin Sahebi x Thompson Seedless) :** Medium maturing, bunches cylindrical and size medium, White seedless berries, medium bold, uniformly ripening. TSS-18°Brix, acidity-0.85%.

- **AH2-4 (Spin Sahebi x Superior Seedless) :** Medium sized, loose, conical bunches. The berries bold, white seedless, spherical with thick skin. Berry attachment is very firm, TSS-18°Brix, acidity-0.65%.
- **AH2-8 (Spin Sahebi x A 18-3) :** Bunches medium, shouldered conical, berries dark purple, spherical, pulpy and seedless. TSS 18.8°Brix, acidity 0.72%.
- **AH4-12 (*Vitis parviflora* x Thompson Seedless) :** Loose bunches, berries white with rudimentary seeds (almost seedless), late maturing. Peculiar taste as that of female parent. TSS-24°Brix, acidity 0.70%.
- **AH 3-7 (Fruhroter Veltiliner x Black Champa) :** Small to medium bunches with dark bluish-black berries. The moderate bold berries and even ripening, juice TSS 22°Brix, acidity-0.85% with pleasant flavour and pigmentation. Suitable for juice making.
- **AH 3-27 (Chardonnay x Pusa Navrang) :** (Medium late maturity): Sweet fruity aromatic and acidic flavour, berries small, juicy almost similar to Chardonnay.

Programme 3. Application of biotechnological research in grapes

3.1 Development of molecular markers for downy mildew resistance in grape

3.1.1 Maintenance of segregating population

F1 hybrids obtained from crossing Thompson Seedless and Flame Seedless with Sevye Villard lines were maintained in the green house and some of the progenies were transferred to the field.

3.1.2. *In vitro* evaluation of F1 hybrids

The F1 hybrids (FS × SV and TS × SV) available from previous crossings were subjected to *in vitro* evaluation against *Plasmopara viticola* for second consecutive year. This year's rating confirmed the previous years' ratings. The rating of these hybrids is given in Table 4.

Table 4. Disease rating of F1 hybrids.

S. No.	Rating	Hybrids
1.	1	AGB5R4P5, B1R11P6, B1R12P4, B2R13P4, B2R23P5, B4R22P1, B5R1P4, B5R2P6, B5R5P3, B5R8P6
2.	3	B15R3P5, B2R21P1, B2R27P6, B4R10P3
3.	5	B111P2, B3R8P3, B4R2P5
4.	6	B1R11P5, B3R7P1
5.	8	B1R6P3
6.	9	B2R4P2, B5R5P4
7.	4	B4R4P5

3.1.3 Microsatellite analysis of F1 hybrids

DNA from 41 hybrids was analyzed with 32 micro satellite primers. So far F1 hybrids have been analysed with 36 primers. This data will be used for cosegregation analysis. The primers analysed were-VVIB23, VVII52, VRZAG62, VRZAG-79, VVS2, VVMD5, VVMD27, VVMD31, VVMD32, VVMD8, VVMD21, VVMD14, VVMD26, VMC7b1, VMC7c3, VMC7f2, VVMD25, VMC8a4, VMC7g3, VMC4f8, VVS16, VVIM01, VMC7g5, VMC8b5, VMC4d9.2, VVIN33, VVIB94, VVIP09, VVIQ57, VVIP77, VVIN61, VVIQ66, VVIT30, VVIV37, VVII52 and VVIB23.

The SSR profile of F1 hybrids with VVII52 and VVMD21 is given in Table 5. Alleles other than the parental alleles were observed in some of the hybrids.

Table 5. SSR profile of F1 hybrids with primers VVMD21 and VVII52

Hybrid	VVMD21		Hybrid	VVMD21		Hybrid	VVII52		Hybrid	VVII52	
AGB5R3P2	251		B2R4P2	257		AGB5R3P2	85	101	B2R4P2	85	101
AGB5R4P4	251		B3R7P1	251	257	AGB5R4P4	85	101	B3R7P1	101	
AGB5R6P2	257		B3R8P3	251	257	AGB5R6P2	85		B3R8P3	85	101
B15R3P5	251	257	B4R10P3	257		B15R3P5	101		B4R10P3	85	101
B1R10P2	251	257	B4R22P1	251		B1R10P2	85	101	B4R22P1	87	101
B1R11P1	251	257	B4R25P4	251	257	B1R11P1	85	101	B4R25P4	85	
B1R11P2	251	257	B4R2P5	251	257	B1R11P2	85	101	B4R2P5	101	
B1R11P5	251		B4R4P3	257		B1R11P5	85		B4R4P3	85	101
B1R11P6	251	257	B4R4P5	257		B1R11P6	85	101	B4R4P5	85	101
B1R12P4	251	257	B5R1P4	257		B1R12P4	101		B5R1P4	101	
B1R5P1	257		B5R1P5	257		B1R5P1	101		B5R1P5	85	
B1R6P3	251		B5R2P2	257		B1R6P3	101		B5R2P2	85	
B1R7P4	251	257	B5R2P6			B1R7P4	85	101	B5R2P6	85	
B1R7P5	257		B5R5P3	251	257	B1R7P5	85	101	B5R5P3	101	
B1R8P1	257		B5R5P4	251	257	B1R8P1	101		B5R5P4	85	
B1R9P5	257		B5R6P1	257	265	B1R9P5	85	101	B5R6P1	87	101
B1R9P6	251		B5R8P6	251	257	B1R9P6	98	101	B5R8P6	101	
B2R13P4	257		B7R10P2	251	257	B2R13P4	85	101	B7R10P2	101	
B2R20P5	251		B7R11P3	257		B2R20P5	85	101	B7R11P3	101	
B2R21P1	251		FS	251	257	B2R21P1	101		FS	85	101
B2R23P5	251	257	SV01	229	251	B2R23P5	85		SV01	87	94
B2R27P6	251		SV75	229	257	B2R27P6	101		SV75	87	98
			TS	251	257				TS	85	101

3.1.4 Primer design from promising bands and amplification

Based on the sequence data of three promising bands obtained with primers VVMD21, VVI52 and VVIB23, primers were synthesized in an attempt to develop SCAR markers.

The synthesized primers were used to analyze 44 accessions. However, all the primers resulted in single bands in all the accessions.

Programme 4. Development of propagation and nursery technology

4.1 Effect of different concentrations of IBA on rooting in bud stick of wine varieties

An experiment was conducted to study the effect of different IBA concentrations on rooting in wine grapes. Different concentrations of IBA viz.; 1000, 1500, 2000 ppm were included in the study with control. The study was conducted on four wine varieties viz.; Sauvignon Blanc, Cabernet Sauvignon, Chenin Blanc and Shiraz. Among the different concentrations, minimum days for bud sprouting was noted in 1000 ppm of IBA and with same concentration maximum rooting was also recorded. However, there was no variation among varieties.

4.2 Effect of different concentrations of IBA on rooting of bud sticks of rootstocks

Generally, grape rootstocks are propagated through bud stick cuttings. An experiment was executed to study the effect of different concentrations of IBA on rooting success. During the study, status of polyphenol oxidase (PPO) was also recorded. Different rootstocks responded differently for days taken for bud sprout and per cent rooting success. Minimum days taken for bud sprout were reported in Freedom and 1103 P rootstocks at 1000 ppm concentration as compared to other rootstocks. Significant differences were also recorded for PPO activity in the roots. Higher PPO was recorded in Freedom at 2000 ppm concentration and in 1103 P at 1500 concentration as compared to other treatments. Maximum rooting success and shoot length was recorded in the same treatments. However, the rootstock 110 R and B-2/56 sprouted early with the application at 1500 ppm IBA concentration. Higher PPO was recorded at the same concentration. Based on these observations it can be concluded that the higher rooting success was related to higher PPO activity in Freedom at 2000 ppm IBA concentrations.

Programme 5. Evaluation of rootstocks for grape cultivation

5.1 Evaluation of Thompson Seedless grafted on different rootstocks

Performance of Thompson Seedless grafted on five different rootstocks with own rooted vines was studied from 2001 onwards. Sixth year data revealed the significant differences in various parameters studied.

Among the morphological characters, early and uniform sprouting was recorded in Thompson Seedless grafted on rootstocks like 110 R, 1103 P, 99 R and own rooted vines. Late sprouting and least number of sprouts were recorded on Dogridge rootstock followed by SO-4. Pruning weight during both the prunings, was highest in Salt Creek followed by St. George, and Dogridge, while least pruning weight was recorded in own rooted vines.

More number of bunches were recorded in 110 R, 99 R and own rooted vines while less number of bunches were recorded in St. George and Dogridge. Yield per vine was differed significantly among rootstocks. More yield was recorded on 110 R, 99 R and 1103P rootstocks while it was less in St. George and Dogridge rootstocks. Bold berries in terms of their more diameter, length and weight were recorded. on 110 R, 1103 P and Dogridge, while small sized berries were recorded on St. George and own rooted vines. There was no signficant difference among 110 R, 1103 P and Dogridge

5.2 Field evaluation of grape rootstocks for salinity and drought tolerance

Thompson Seedless grafted on five different rootstocks viz.; Dogridge, 110 R, 1103 P, 99 R, St. George and own rooted vines were selected for this study. Six different treatments viz.; 100% irrigation, 75% irrigation, 100% irrigation with 2 Electrical Conductivity (EC) salinity, 75% irrigation with 2 EC salinity, 100% irrigation with 4 EC salinity and 75% irrigation with 4 EC salinity were imposed after flowering. The experiment was laid out in factorial randomised block design with rootstocks as one-factor and irrigation and salinity levels as second.

Data on yield and quality parameters and various elements at different stages of growth showed non-significant differences (Table 6). Parameters like number of bunches, yield per vine, berry size were differed significantly due to rootstock effect, while they did not differed significantly due to effect of irrigation and salt treatments. The parameters like juice pH, TSS, some elements like P and Na were influenced by salt and irrigation treatment, but there was no significant difference in most of the morphological and yield parameters due to interaction effect of rootstocks and salinity treatments. The experiment will be continued further to confirm the results.

Table 6. Effect of rootstocks, salt and moisture stress on yield, quality and nutrient content of Thompson Seedless grapes.

Parameter	Rootstock effect	Salinity and moisture stress effect	Interaction effect
April pruning biomass weight (kg)	NS	*	NS
October pruning weight (kg)	NS	**	NS
Number of bunches	**	**	NS
Berry diameter (mm)	**	**	NS
Berry length (mm)	**	**	NS
50 berry weight (g)	**	NS	NS
TSS (°B)	NS	**	NS
Acidity (%)	NS	**	NS
Juice pH	NS	**	NS
Sodium in juice (%)	**	**	NS
Calcium in juice (%)	NS	NS	NS
Phosphorus in juice (%)	**	NS	NS
Potassium in juice (%)	NS	NS	NS

NS : Non significant; *: Significant at $p < 0.05$; **: Significant at $p < 0.01$

5.3 Studies on PPO activity during rooting process in rootstocks of different *Vitis* species

Four rootstocks viz.; Dogridge (*Vitis champinii*), 110 R (*Vitis beralndierii* x *Vitis rupestris*), St. George (*Vitis rupestris*) and *Vitis longii* were selected for this study to observe the influence of PPO activity on rooting pattern (Fig. 1).

Maximum rooting success (%) was recorded in *Vitis longii* after 30 days of planting, where more number of roots primordial were also recorded in the same rootstock. But there was reduction in PPO activity from 30 days till 120 days after planting. Number of primordial after 30 days of planting was least in Dogridge but the more number of longer roots were recorded in the same rootstock. Even after 90 days of planting, there was formation of new primordial at the basal end indicating its ability to put forth new roots even after 90 days. Accordingly PPO activity was known to reduce till 90 days, but on 120th day after planting there was increase in PPO activity indicating that, PPO helps in cell division and cell elongation thus favouring formation of new root primordial even after 90 days of planting.

In 110 R rootstock on 60th day after planting, maximum number of root primordial were noted and after 60 days no new primordial initiation was noticed. Gradual reduction in PPO activity was recorded from 60 to 120 days after planting.

Cuttings of St. George, recorded highest number of primordial on 120th days after planting but only few roots were longer and others were very shallow roots. PPO activity was highest in this rootstock even 120 days after planting indicating its role in cell division and dedifferentiation to produce new root primordial even after 120 days of planting. The results will be verified in next season.

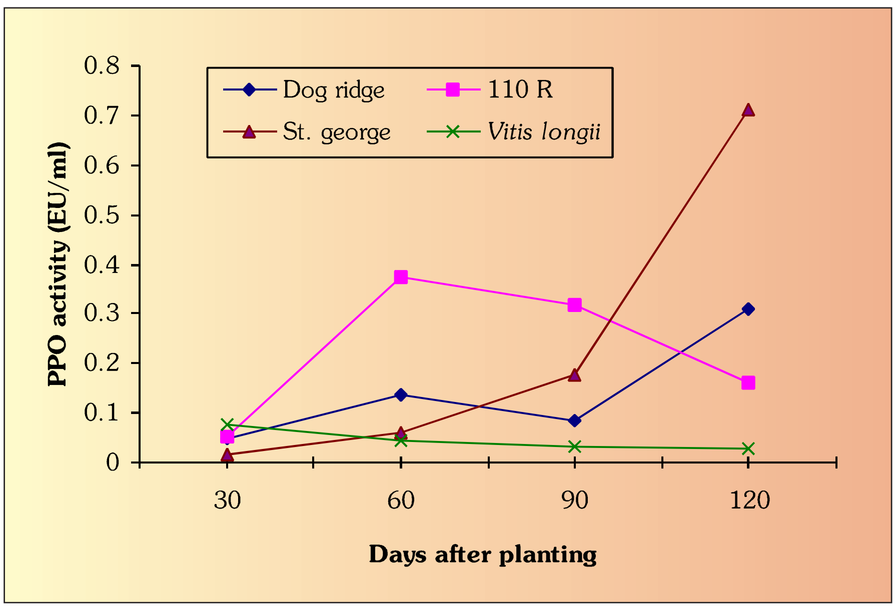


Fig. 1. PPO activity during rooting in bud stick cuttings of different rootstocks.

5.4 Physio-biochemical changes during berry development in Thompson Seedless grafted on different rootstocks

Berries of Thompson Seedless grafted on nine different rootstocks along with own rooted vines were sampled at seven different stages from fruit set to harvest to study the influence of rootstocks on changes in biochemical composition of Thompson Seedless grapes during the process of berry development.

Non-significant differences were observed in total protein content among different rootstocks at fruit set stage. But significant differences were observed during other stages of sampling. Gradual reduction in protein content was observed from fruit set to harvest with highest protein content in B2-56 rootstock and least on own rooted vines. Total phenolic compounds started declining from fruit set to harvest in all the rootstocks and significant differences were observed for total phenols during all the stages of berry development. Highest phenolic content at harvest was observed on SO-4.

Reducing sugar and proline content increased on all the rootstocks during all the stages of berry development, which is evident from the increased osmotic potential in the berries from fruit set to harvest. The increase in berry osmotic potential may be attributed to accumulation of important osmolytes like sugars, proline , potassium etc. During harvest stage, higher osmotic adjustment was recorded on 110 R, Salt creek, B2-56 and 1103 P rootstocks, while lower osmotic adjustment was recorded from 1613 C, St. George and SO-4 rootstocks.

5.5 Evaluation of rootstocks for raisin recovery

Rootstocks were evaluated for raisin recovery from Thompson Seedless grapes. Among different rootstocks, raisin recovery was highest in Thompson Seedless grapes grafted on 110 R rootstock followed by Dogridge, 1103 P and 99 R. Significant differences were observed in total proteins, reducing sugars, phenol contents and PPO activity in both fresh grapes and raisins. Increased content of proteins, reducing sugars and phenols were observed in raisins compared to fresh grapes. PPO activity was more in Thompson Seedless grapes grafted on Dogridge and low in 110 R. Activity of PPO (Fig. 2) was almost nil in raisin grapes which may be attributed to reduced moisture content in grapes leading to deactivation of enzymes.

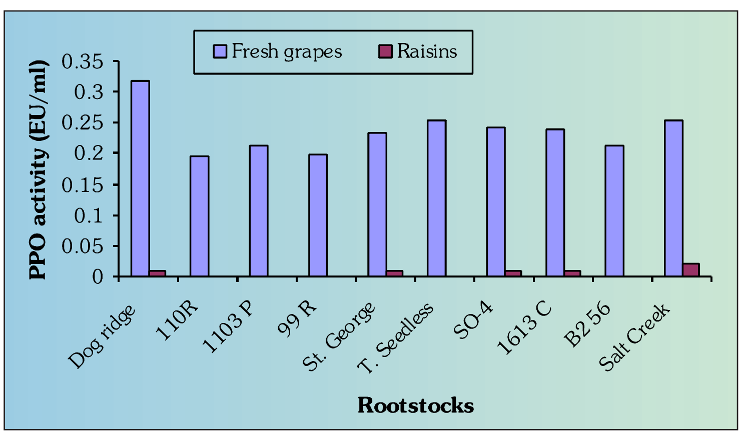


Fig. 2. PPO activity in Thompson Seedless fresh grapes and raisins on different rootstocks.

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

6.1 Flat roof gable training system

6.1.1 Effect of number of stems on yield and quality of Tas-A-Ganesh grapes grafted on Dogridge rootstock

To achieve higher yield per vine, preliminary results have shown the increased yield in Tas-A-Ganesh vines grafted on Dogridge rootstock having double stems as compared to the single stem. Observations were, therefore, recorded to study the long-term effect of number of stems on yield and quality. The growth performance in terms of shoot length and their number per vine, cane diameter, internodal length, etc. were studied in case of both the systems. Among the growth parameters, shoot length, number of shoots per vine and cane diameter was recorded more in Tas-A-Ganesh vines trained to double stem as compared to single stem.

Double stem with two cordons placed horizontally

Among the yield parameters, there was more number of bunches per vine, bunch weight, 50-berry weight, berry diameter and yield per vine in Tas-A-Ganesh vines grafted on Dogridge rootstock trained to double stem compared to the single stem. A yield of 15.898 kg was recorded in double stem as against 14.707 kg in single stem vines.

6.1.2 Effect of training modification on yield and quality of Tas-A-Ganesh vines grafted on Dogridge rootstock

To increase more canes per vine for higher yield, the vines were trained as single, double and four cordons placed either diagonally or horizontally to the primary arm. It was observed that the shoots positioned vertically to the cordon and cane were more fruitful than the horizontally placed shoots. With the increase in number of cordons, the number of shoots per vine also increased. More number of shoots were recorded in four cordon training followed by double and single cordons irrespective of their placement on cordon or cane. However, with the increase in number of canes, the cane diameter was reduced.

Four cordon diagonal training

More yield of 14.500 kg per vine was recorded in four cordons than the double and single cordon systems. The average bunch weight was more in single cordon placed horizontally as compared to the double and four cordons systems.

6.2 Bower training system

6.2.1 Effect of number of stems, plant type and training modification on yield and quality in bower trained Tas-A-Ganesh grapes grafted on Dogridge rootstock

The performance of vines trained to single stem and double stem was studied in seven year old Tas-A-Ganesh grapevines grafted on Dogridge rootstock. More number of bunches per vine, bunch weight (353.55 g) and yield per vine (15.35 kg) was recorded in double stem as compared to the single stem

The performance of vines grafted on Dogridge rootstock was better than the own rooted vines in the same training system. Shoot length, cane diameter, leaf area, number of shoots per vine and yield and yield attributing parameters i.e. number of bunches per vine, bunch weight, berry diameter, yield per vine was better on Dogridge than on own rooted vines. The vines grafted on Dogridge recorded more shoot length of 85.0 cm as compared to 72.0 cm in own rooted vines.

6.3 Yield and quality in Sharad Seedless grapes

6.3.1 Effect of bunch load on colour development in Sharad Seedless grafted on Dogridge rootstock

To fetch good price in the market, the harvested grapes should have uniform berry size and colour besides appropriate sweetness. Uniform colour is one of the important parameter considered by the consumers. The bunch load plays an important role in maintaining the colour of bunches. An experiment was, therefore, conducted to study the effect of bunch load in achieving the uniform bunch colour in Sharad Seedless grafted on Dogridge rootstock.

The bunch load per vine varied from 30, 40, 50, 60, 70, 80 and 90 bunches. The maximum bunch weight was 466.02 g in 30 bunches per vine. The reduction in bunch weight was recorded with the increase in number of bunches per vine. There bunch weight was reduced up to the extent of 299.64 g in case of 90 bunches per vine. With the increase in number of bunches per vine there was reduction in TSS of the berries to the extent of 16.15°B in 90 bunches per vine as compared to 18.5°B in 30 bunches per vine.

The increase in number of bunches per vine resulted into reduction in the berry size which resulted in poor quality. With the increase in more number of bunches per vine and yield, there was reduction in quality of grapes in terms of bunch weight, berry diameter and TSS.

6.3.2 Effect of girdling and ethrel dip on colour development and biochemical status of Sharad Seedless grapes

The quality of table grapes mainly depends on the berry size. In addition to the size, uniform colour in coloured varieties plays as important role. This can be achieved by manipulating cultural practices like use of growth regulators, girdling, bunch retention, etc. In quality grape production, girdling is considered as major important horticulture practice. An experiment was thus conducted to study the effect of girding and ethrel dip on colour development in Sharad Seedless grapes. Different treatments like trunk girdling, dipping the bunches in ethrel, trunk girdling + ethrel spray, cane girdling and in combination with ethrel were imposed and compared with control. The data was collected on bunch and berry characters. Significant differences were recorded for bunch characters (average bunch weight and 50-berry weight) and berry qualities (berry diameter, TSS, acidity, etc.).

Trunk girdling resulted into highest average bunch weight of 452.58 g as compared to 362.54 g in control. 50-berry weight was also higher in the same treatment (323.0 g) compared to 249.90 g in control. Highest berry diameter of 21.20 mm was recorded in trunk girdling followed by 19.70 mm in trunk girdling with ethrel treated vines. Higher TSS of 23.80°B was recorded in cane girdling and ethrel spray treatment. However, the higher rate of photosynthesis (53.70 μ mol $cm^{-2}s^{-1}$) was recorded in control.

Programme 7. Nutrient and soil management in grapes

7.1 Effect of graded doses of nitrogen (N), pruned biomass and green manuring on yield of Sharad Seedless vines

An experiment was conducted consecutively for the second year in Sharad Seedless vines to study the N substitution using pruned biomass, and green manuring. Treatment differences were not significant during the first year. The second year data on yield, bunch weight, bunch number, TSS and acidity have been recorded. Yield data did not differ among different treatment combinations. Thus the results of the second year also did not differ from the data collected in the first year.

7.2 Nutrient partitioning and uptake in fruit season growth in grafted and own rooted vines of Tas-A-Ganesh under saline irrigation

Nutrient content and uptake in the fruit pruning season, growth was determined in different tissues at harvest in grafted and own rooted vines of Tas-A-Ganesh under saline irrigation. The vines received saline irrigation during the fruiting season only and did not receive fertilizer. No significant differences were observed in sodium (Na) concentration between own rooted vines and vines grafted on Dogridge rootstock in petioles and lamina. Canes of own rooted vines contained significantly higher Na content. Total uptake (cane + lamina + petiole) of sodium was significantly higher in vines grafted on Dogridge rootstock. Vines grafted on 110R rootstock resulted in significantly lower Na uptake. More Na was accumulated in leaves compared to petioles and canes in both grafted and ungrafted vines. The results revealed that Dogridge rootstock couldn't exclude sodium under saline irrigation.

Own rooted vines resulted in significantly higher chloride uptake than vines grafted on 110R and Dogridge rootstocks. The rootstocks did not differ significantly with respect to chloride uptake. The total accumulation in different tissues was in the order of lamina > cane > petiole in both, grafted as well as ungrafted vines. Concentration of potassium was lowest in all the three vine parts (cane, petiole and lamina) of own rooted vines. Significantly lower potassium uptake was recorded in own rooted vines. Both the rootstocks resulted in significantly higher K uptake as well as K concentration in petioles and lamina. Similar to chloride, higher phosphorus content was accumulated in lamina followed by cane and petiole. Own rooted vines and vines grafted on 110R rootstock resulted in significantly higher uptake in petioles as well as lamina compared to vines grafted on Dogridge rootstock.

7.3 Effect of rootstock on nutrient content and yield parameters

All the rootstocks produced significantly higher yield than own rooted vines. Vines grafted on 110R rootstock had significantly higher bunch number/vine. Among the rootstocks, Dogridge produced lowest bunch number/vine but average bunch weight was significantly higher than 110R and Salt Creek. TSS content and pruned biomass was also significantly higher in case of grafted vines. Significantly lower P content was observed in case of vines grafted on Dogridge. The vines grafted on 110R rootstock and own rooted vines had significantly higher P content in petioles compared to vines grafted on Salt Creek and Dogridge. Own rooted vines also had significantly higher zinc content compared to grafted vines.

Table 7. Effect of rootstocks on yield, quality parameters and pruning weight of Thompson Seedless grapes.

Stocks	Yield / vine (kg)	Bunch weight (g)	Number of bunches/ vine	TSS (°Brix)	Acidity (%)	Pruning weight (fruit pruning) (kg)	Pruning weight (after harvest) (kg)
110R	12.03	291.7	41.20	21.6	0.53	2.93	4.05
Dogridge	10.25	327.0	31.40	21.6	0.52	3.62	4.71
Salt Creek	10.66	301.8	35.20	21.8	0.51	3.34	4.27
Own root	6.94	217.8	32.20	20.3	0.53	1.55	2.51
SEM	0.85	13.5	3.41	0.1	0.01	0.12	0.26
LSD (p=0.05)	1.85	29.5	7.44	1.1	0.03	0.26	0.58

Table 8. Petiole nutrient content at 90 days after fruit pruning in Thompson Seedless.

Stocks	K (%)	P (%)	Na (%)	Zn (ppm)
110R	3.16	0.276	0.447	50.0
Dogridge	2.96	0.18	0.62	49.0
Salt Creek	2.56	0.252	0.52	56.4
Own root	3.27	0.326	0.689	71.2
SEM±	0.16	0.019	0.04	3.12
C.D (p=0.05)	0.349	0.041	0.088	6.8

7.4 Leaf blackening, necrosis and berry composition in Thompson Seedless vines

The effect of rootstock in relation to leaf blackening and necrosis, these symptoms observed under saline irrigation, leading to reduced death of perennial vine parts were studied. The percent leaves on a vine exhibiting the symptoms were counted. The rootstocks differed significantly in leaf damage. The symptoms were more severe i.e. 62.75% (Fig. 3) in case of Salt Creek rootstock followed by Dogridge (45.50 %), own rooted vines (43.50%). Only one vine grafted on 1613C exhibited the symptoms. These symptoms were not observed in case of vines grafted on 110R rootstock, indicating more tolerance of 110R rootstock to saline irrigation. Further studies on nutrient composition on these stock/scion combinations are continued. The highest Na content was found in berries of Thompson Seedless vines grafted on Salt Creek followed by Dogridge and own rooted vines. Berries from vines grafted on 110 R and 1613C rootstocks contained significantly lower Na content than the above mentioned stock scion combinations. Least Na content was found in case of 1613 C rootstock.

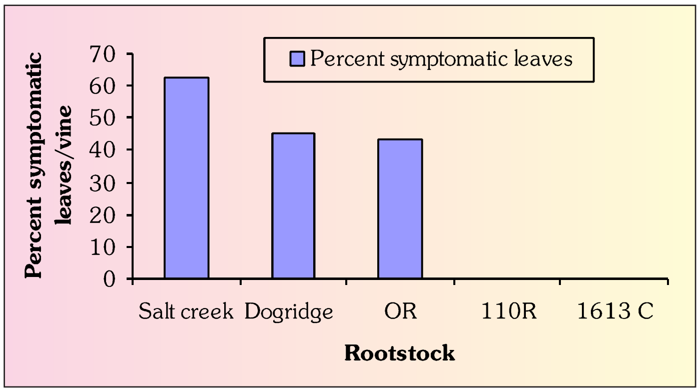


Fig. 3. Percent symptomatic leaves

7.5 Rootstock effect on yield and yield parameters in Cabernet Sauvignon

Significant differences were not recorded in yield and TSS content in grafted Cabernet Sauvignon vines and own rooted vines (Table 9). Own rooted vines had significantly higher bunch/vine and lower bunch weight. Cane, leaf and petiole samples have been collected at the harvest to study the nutritional status of the vines.

Table 9. Yield and yield parameters in Cabernet Sauvignon vines grafted on different rootstocks.

Stocks	Yield kg per vine	Bunch number	Bunch weight (g)	TSS (°B)	Acidity (%)
110R	4.40	63.00	69.70	21.54	0.58
Dogridge	4.72	59.57	76.76	21.80	0.54
Own root	4.68	70.71	66.63	22.11	0.47
SEM $\pm$	0.31	3.76	3.74	0.46	0.02
LSD (p=0.05)	0.67	8.19	8.16	0.99	0.05

Programme 9. Grape physiology including use of bioregulators

9.1 Studies on pink berry formation in white grapes and its management

9.1.1 Laboratory studies

Cell suspension culture

In plant tissue culture, callus may be induced from various parts of the plant grown on solid media with appropriate combinations of plant hormones supplements. Callus is particularly useful for the production of cells in suspension, which are a population of undifferentiated cells grown in liquid culture. Cell suspension cultures provides an unlimited supply of uniform cells, with a relatively shorter life cycle and remain undifferentiated. Cell suspension cultures will be therefore, utilized to find out the root cause of pink berry formation with a differential incorporation of hormones and nutritional supplement to the media. Callus formation is pre-requisite for cell suspension culture.The present experiment has been conducted to find out suitability of vine part for better callus formation.

Callus formation was tried from tender leaves, petioles, tendrils, berries and berry skin. Among the different explants petioles and tendrils were found effective for callus formation with respect to media, the combination of MS media + 1 mg BAP L^{-1} + 0.1 mg 2, 4-D L^{-1} + 0.2 mg ABA L^{-1} found to be effective for callus formation in Thompson Seedless grapes.

Table 10. Callus formation in grape varieties.

Varieties	Explant	Media composition	Success rate (%)
Thompson Seedless	Leaf	MS+BAP mg L^{-1} + 2,4D 0.1 mg L^{-1}	0%
	Petiole	MS+BAP mg L^{-1} + 2,4D 0.1 mg L^{-1}	50%
	Tendril	MS+BAP mg L^{-1} + 2,4D 0.1 mg L^{-1}	50%
	Leaf	MS+BAP mg L^{-1} + 2,4D 0.1 mg L^{-1} ABA 0.02 mg L^{-1}	0%
	Petiole	MS+BAP mg L^{-1} + 2,4D 0.1 mg L^{-1} ABA 0.02 mg L^{-1}	90%
	Tendril	MS+BAP mg L^{-1} + 2,4D 0.1 mg L^{-1} ABA 0.02 mg L^{-1}	70%
Flame Seedless	Leaf	MS+BAP mg L^{-1} + 2,4D 0.1 mg L^{-1}	0%
	Petiole	MS+BAP mg L^{-1} + 2,4D 0.1 mg L^{-1}	80%
	Tendril	MS+BAP mg L^{-1} + 2,4D 0.1 mg L^{-1}	60%
	Leaf	MS+BAP mg L^{-1} + 2,4D 0.1 mg L^{-1} ABA 0.02 mg L^{-1}	0%
	Petiole	MS+BAP mg L^{-1} + 2,4D 0.1 mg L^{-1} ABA 0.02 mg L^{-1}	90%
	Tendril	MS+BAP mg L^{-1} + 2,4D 0.1 mg L^{-1} ABA 0.02 mg L^{-1}	65%

9.1.2 Field studies

Effect of Bioregulators/Agrochemicals on incidence of pink berry formation

The bioregulators/agrochemicals like Propiconazole (100-800 ppm), CCC (500-4000 ppm), CPPU (1-8 ppm), Sucrose (1-8 ppm) were applied as dip in solution as a single or twice application after 75, 85 and 95 days of fruit pruning to avoid pink berry formation. However, none of the above agrochemicals were found effective to stop pink berry formation completely.

Effect of paper cover bags on incidence of pink berry formation in Thompson Seedless grapes

Preliminary studies undertaken during last year indicated that the bunches covered at 75 days after fruit pruning were effective. To confirm this, the present field trial was conducted in Thompson Seedless grapes by using different papers. Specially Tyvek make papers (reflecting 90% sunlight), newspapers and white papers were used and the bunches were fully and partially (bottom portion uncovered) covered with the above papers. The significant differences were recorded in number of pink berries with the paper covered and uncovered bunches.

The significantly less number of pink berries were recorded in Tyvek paper fully and partially covered bunches at 75 days after fruit pruning. The same trend was observed in anthocyanin content in berry skin of Thompson Seedless grapes.

Table 11. Effect of paper cover on pink berry disorder in Thompson Seedless grapes.

Treatment	Pink berry (%)	100 berry weight (g)	Berry crispness (g)	Anthocyanin content (ng g^{-1})
T1 : Bunches covered with Tyvek paper bags	4.68 ± 1.18	372.70 ± 70.80	203.00 ± 10.44	25.00 ± 1.88
T2 : Bunches covered with Tyvek paper bags	4.68 ± 2.66	334.63 ± 5.38	203.33 ± 13.86	17.00 ± 1.11
T3 : Bunches covered with Tyvek paper bags	5.34 ± 1.20	319.93 ± 43.16	209.00 ± 9.53	27.00 ± 1.49
T4 : Bunches covered with Tyvek paper bags	8.81 ± 3.85	308.30 ± 45.84	201.00 ± 7.00	28.00 ± 2.66
T5 : Bunches covered with Tyvek paper bags	5.52 ± 1.56	332.50 ± 32.94	214.33 ± 6.11	25.00 ± 2.50
T6 : Bunches covered with Tyvek paper bags	7.15 ± 1.24	393.60 ± 44.60	210.33 ± 10.06	23.00 ± 1.84
T7 : Bunches uncovered with any paper bags	8.63 ± 1.52	355.16 ± 36.30	213.00 ± 7.21	41.00 ± 2.67
LSD	3.56	–	–	0.213
Significance	**	NS	NS	**

9.2 Management of other physiological disorders

9.2.1 2, 4-D toxicity in grapes

This year many growers faced a problem of 2,4-D (2,4 dichlorophenoxy acetic acid) toxicity symptoms on grape rootstock seedlings. The doses of 2,4-D @ 10-10000 ppm and Glyphosate @ 8-16 ml L^{-1} were used. The preliminary observations showed the foliar applications at higher concentrations of 10 ppm onwards were toxic as compared to lower dose of drenching. Among the chemicals, 2,4-D was having more visible toxic symptoms than Glyphosate.

9.2.2 Berry scars in Sharad Seedless grapes

The excess doses of bioregulators like CPPU, GA, IAA, NAA etc. and pesticides (Systhane, Nuvan, Topas, sulphur, Mancozeb, Chloropyriphos and copper hydroxide) were used at veraison stage at the rate of double dose to get physiological disorder symptoms. However no visible abnormalities were observed. This experiment will be repeated for one more year for confirmation of the results.

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

9.3.2 Endogenous levels of bioregulators in grapes

i. Quantification of endogenous levels of bioregulators at different stages in grape varieties

For export of grapes, certain quality standards has to be followed, a minimum 18 mm berry diameter is one of the essential requirement in many markets. To achieve this, grape growers are using higher doses of GA_3 and CPPU bioregulators. The excess use of these bioregulators some time may lead to abnormalities in berries. To standardize the dose based on the actual requirements of bioregulators, the present experiment was planned.

Gibberellic acid (GA_3), Auxins (IAA) and Cytokinin (6BA) were analysed from the grape varieties viz.; Red Globe, Fantasy Seedless, Rizamat, Perelette, A-17/3 and Thompson Seedless at berry set, berry development and maturity stages. Using rapid method for determination of 67 Pesticides residues in foods by LC-TOF/MS Agilent technology (WP06113 - ASMS 2006). Samples were collected at pre-bloom stage, flowering, berry setting, 3-4 mm size, 6-7 mm size, veraison and harvesting. The results showed a variation in endogenous levels of hormones in different varieties. For confirmity, this trial will be repeated for one more year.

ii. GA_3 dissipation in Thompson Seedless grape

Field trial was conducted to study the dissipation pattern of the residues of Gibberellic acid in Thompson Seedless grapes to work out the second application time. GA_3 was applied at 3-4 mm berry size stage as a dipping of bunches. The samples were collected at regular interval of 10 days from day of application to 60 days after application. The residues of GA_3 were measured by rapid method for determination of 67 Pesticides residues in foods by LC-TOF/MS Agilent technology (WP06113 - ASMS 2006).

The results showed that the GA_3 residues starts reducing drastically after 3^{rd} day of application and at 10^{th} day after application it showed very less residues (18 ng g^{-1}) (Fig. 4). This shows that the 2^{nd}

application has to be followed before 10 days of 1st application. The half life of GA_3 solution applied for this purpose was 3.41.

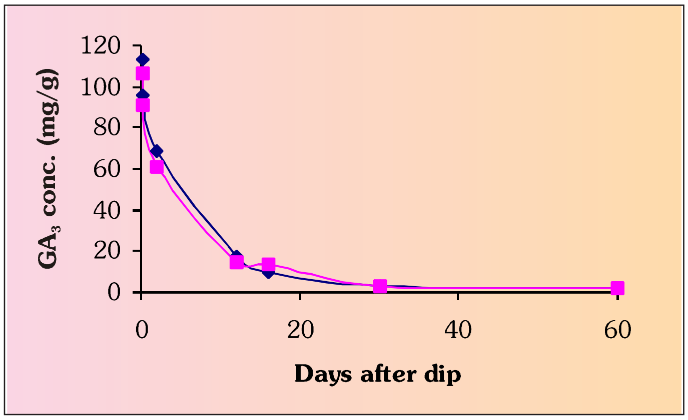


Fig. 4. GA_3 dissipation in Thompson Seedless

ii. Method development for multiresidue analysis of plant growth regulators

Modified AOAC International 2007 Method was used for analyzing bioregulators but it was not possible to analyse all the bioregulators by this method. Hence, the present study on method development was undertaken. In this method, sample preparation technique was standardised. For this purpose solvents like ACN and methanol were used along with formic acid (pH:3), Ammonium acetate (pH:5-6) and sodium acetate (pH:5-6) were tried as buffers. The new multi-residue method for bioregulators was evolved by standardizing 60% methanol/1% formic acid for maximum recovery of almost all the bioregulators.

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

9.5.1 Testing the bio-efficacy of bio-stimulants for increasing berry size of grapes

This study has been repeated consecutively for the second year and found that these bio-stimulants are having potential to increase the berry size in Thompson Seedless, Sharad Seedless and Flame Seedless grapes.

9.5.2 Bio-efficacy of Earth Care GA liquid in grapes

Earth care liquid GA is a liquid GA formation containing gibberellic acid 100 g L^{-1}. This was tested along with different adjuvants in comparison with the standard gibberellic formulation (Pro-Gibb) containing 99% of gibberellic acid alone for their bio-efficacy in terms of (i) reducing bunch compactness and (ii) increasing berry size.

Earth care liquid GA and pro-gibb were applied at pre-bloom (10 ppm), 40% capfall (20 ppm), 80% capfall (20 ppm) as a foliar spray and at 3 mm and 6mm berry size stage as a dip @ 60 ppm.

The significant differences were recorded with the application of Earth care GA Plus Seasol spray adjuvants with respect to berry weight, berry size and yield/vine. In general, Earth care liquid GA and

Progibb treatments along with adjuvant found superior over the control. Among the treatments seasol spray adjuvant 2 + Earth care liquid GA 100 (at 80% control rate) mixed on site and seasol spray adjuvant 4 + Earth care - GA (at 50% control rate) mixed on site.

The result on shelf life revealed that the significant differences were recorded up to 5th day in shelf life and the minimum physiological loss of weight was recorded in the application of Earth care liquid GA plus Seasol spray adjuvants.

By considering bioefficacy and shelf life study, the application of Earth care liquid GA plus Seasol spray adjuvants were found effective in increasing the berry size, yield and shelf life

9.5.3 Bio-efficacy of Ethrel (35% a.i.) for defoliation, berry characters and yield in Thompson Seedless grapes

Ethrel is a ripening hormone and used as a leaf defoliator in grape. The use of ethrel in grapes is limited because of apprehension in growers mind that it may lead to pink berry formation. Keeping this in view, the present study was initiated. The highest leaf fall was recorded in ethrel treatment as compared to control. Yield was also recorded more in ethrel treated vines as compared to without control.

Treatment details :

T1 - Control; T2 - Application of Ethephon 39% SL @ 1.5 ml L^{-1}; T3 - Application of Ethephon 39% SL @ 2.0 ml L^{-1}; T4 - Application of Ethephon 39% SL @ 2.5 ml L^{-1}; T5 - Application of Ethephon 39% SL @ 3.0 ml L^{-1}; T6 - Application of Ethephon 39% SL twice @ 4.0 ml L^{-1}

Table 11. Effect of ethephon on leaf fall and berry characters.

Treatment	Leaf fall (%)	Berry diameter (mm)	Berry length (mm)	100 berry weight (g)	Pedicel thickness (mm)	Yield t/ha	TSS (°B)	Acidity (%)
T1	37.23 ± 2.42	15.43 ± 0.12	20.93 ± 0.80	352.87 ± 34.26	1.60 ± 0.09	21.80 ± 1.64	21.0 ± 1.00	0.54 ± 0.02
T2	38.28 ± 2.11	14.37 ± 0.15	20.37 ± 0.15	285.60 ± 34.06	1.66 ± 0.04	18.97 ± 1.23	21.2 ± 1.00	0.51 ± 0.07
T3	43.95 ± 2.42	16.43 ± 1.63	21.23 ± 0.87	341.97 ± 61.58	1.84 ± 0.05	20.02 ± 1.10	21.33 ± 1.10	0.48 ± 0.01
T4	50.78 ± 4.57	15.63 ± 0.60	22.87 ± 0.32	376.13 ± 13.69	1.73 ± 0.23	24.72 ± 2.35	21.0 ± 0.60	0.53 ± 0.02
T5	55.62 ± 5.56	15.83 ± 0.40	19.00 ± 0.87	311.33 ± 9.59	1.60 ± 0.11	20.36 ± 2.04	22.13 ± 1.30	0.58 ± 0.02
T6	61.51 ± 4.00	15.73 ± 0.23	21.67 ± 0.58	326.83 ± 14.33	1.51 ± 0.20	18.96 ± 1.52	21.46 ± 0.64	0.52 ± 0.01
LSD	6.65	–	1.77	–	–	3.02	–	–
Significance	**	NS	**	NS	NS	*	NS	NS

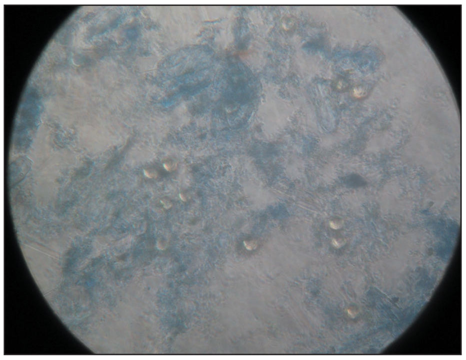
Programme 11. Integrated disease management in grapes

11.1 Disease Forecasting at five locations during fruiting season (2007-08)

Five weather stations were installed at five different locations. Two locations each in Nasik district (Khedgaon and Palkhed), in Sangli district (Palus and Malgaon), and one in Pandharpur (Kasegaon). The weather data on parameters like temperature, RH, dew point, precipitation, leaf wetness etc was recorded w.e.f. October 2007. One SRF was appointed at three locations viz.; Khedgaon, Palus and Malgaon, who collected the ground information on presence of disease in vineyards. In addition twenty vineyards in about one kilometer area were selected and roving survey in these vineyards was conducted to know the presence of diseases and insect pests. The data was used for estimating daily risk of powdery mildew using model developed at NRCG earlier.

11.2 Severe cluster necrosis due to restricted downy mildew infection

A number of Thompson Seedless or its mutants Tas-A-Ganesh and Sonaka vineyards with about 20-80% clusters with varying degrees of necrosis were observed in Maharashtra, including one of the vineyards of this Research Centre at Manjri, Pune. Visible diagnostic symptoms i.e. presence of white downy growth comprising of sporangiophores and sporangia of *P. viticola* were not apparent in the vineyards and there was no preceding rainy period. It was generally presumed that the necrosis was due to toxicity of externally applied plant bio-regulators.



Detection of oospores in necrotic tissues on grape bunches with the help of fluorescent dye.

The cluster symptoms varied from i) complete necrosis of the floral tissues in inflorescences at pre-bloom and flowering stages, which would drop off at slight shaking; ii) necrosis at the point of attachment of the laterals to the main rachis; iii) necrosis on the pedicle; iv) necrosis at the point of attachment of the berry with the pedicle; v) complete necrosis or brownish, reddish or pinkish discolouration of rachis of bunches at pre-bloom, flowering; 1-2mm, 3-5mm, 7-8mm, 10-11mm berry size; and vi) sunken brown spots on young (5-11mm) berries. Sporangiophores and sporangia of *Plasmopara viticola* were not observed in any of the samples. However, immature oospores could be detected in all the above samples, except more than 7 mm size berries with sunken brown spots through light and epifluorescence microscopy. The size of the oospores was approximately 25µ. After aniline blue staining the oospores fluorescened strongly in UV light. The number of oospores ranged from minimum 2 to maximum 131 within the tissues and the overall average number of oospores was 14.07 ± 8.67.

11.3 Studies on bio-efficacy of new fungicides in control of fungal diseases

11.3.1 Multilocational trials on control of downy mildew

Field trials were conducted on growers' vineyards at Khedgaon, Malgaon and Palus to study the bio-efficacy of new fungicides for the control of downy mildew. Out of total 27 treatments, the treatments effective for control of downy mildew are enlisted in Table 12 alongwith with effective doses. Terminal residue of the different fungicide treatments at effective doses were also estimated using standard multiresidue method used for grapes. None of the treatments showed residue above detection limit of the method (0.02 ppm). The marked (+) fungicides will be tested in multilocational trail for second consecutive year.

Table 12. Effective doses of fungicides against downy mildew.

Fungicide	Effective Dose g or ml L^{-1}
Verita 71 WDG	2.25
(fenamidone 10% + mancozeb 50%) 60WG^{+}	1.50
(iprovalicarb 5.5 % + propineb 61.25 %) 66.75 WP^{+}	3.00
(Fluopicolide 4.44% + Fosetyl Aluminium 66.7 %) 71.14 WG	2.25 - 2.50
Fluopicolide 40 SC	0.225
(Metiram 55% + Pyraclostrobin 5%) 60 WDG^{+}	1.5
Metiram 70%WG^{+}	2.00
Pyraclostrobin 20% WG^{+}	0.5
(Mandipropamid 5% + mancozeb 60%) 65WG^{+}	2.5
Azoxystrobin 25SC^{+}	1.0
Chlorothalonil	2.0
Mandipropamid 250 SC^{+}	0.8

11.3.2 Bio-efficacy of new fungicides for control of powdery mildew

Field experiment to study the bio-efficacy of new molecules was conducted at experimental vineyard of NRC grapes, Pune. Effective doses are listed in Table 13. Meptyldinocap was tested for second year.

Table 13. Bio-efficacy of new molecule.

Sl. No.	New molecule tested	Effective dose (ml L^{-1})
1	Folicur (Tebuconazole 25%) 250EC	0.5
2	Meptyldinocap 35 EC	0.309
3	Crystal 56 SL (Plant extracts)	5.0 to 6.0

11.3.3 Demonstration of spray schedules to manage powdery mildew

Based on our various bio-efficacy trials, spray schedules for the management of powdery mildew has been prepared. These schedules contain sprays of Flusilazole at early stages of 35 to 40 days after fruit pruning and azoxystrobin after 20 to 25 days before harvest, sulphur/chitosan/potassium bicarbonate/monopotassium phosphate (from 50 days of fruit pruning and onwards). The major findings of conducted experiment are mentioned below :

- As per the standard practice of the growers for the control of powdery mildew, five sprays of systemic fungicides are given. Out of these five sprays, one spray was given during flowering (35 to 40 days after pruning) and four sprays were given after fruit set till veraison (50 to 90 days after pruning). Our field demonstration of different schedules showed that out of last four sprays of systemic fungicides, two sprays can be substituted with sprays of potassium bicarbonate 5.0 g L^{-1}, or mono potassium phosphate (soluble grade fertilizer containing 0:52:34 NPK) 3.0 g L^{-1}. Both these chemicals have very safe environmental profile and safe for use as compared to fungicides.

- Potassium bicarbonate and mono potassium phosphate can be used in combination with wettable sulfur as tank mix for spray to manage powdery mildew.

- For the management of powdery mildew on rachis after veraison azoxystrobin 1.0 ml L^{-1} can be used as spray on bunches up to 15 days before harvest without any risk of residue. No detectable residues of azoxystrobin were found at harvest.

- Schedule containing 2 sprays of chitosan (1% solution) 20 ml L^{-1} and two sprays of wettable sulfur 2.0 g L^{-1} showed good control of powdery mildew. These treatments also have potential to be used in organic grape cultivation.

11.4 Survey of vineyards for presence of virus diseases

11.4.1. Survey for presence of virus diseases in newly imported plants of wine varieties, likely to be used for further multiplication.

Vineyards of wine varieties raised from imported plant material were visited and leaf samples were collected from plants which were showing viral symptoms. Attempts were made to detect virus in leaf samples using DAS-ELISA tests for Grape Vine Leaf Roll associated Virus, strains 1+3 (GVLRaV 1+3), 2 and 5, and Grapevine Fan Leaf Virus (GFLV). Most of the plants showed negative response to ELISA except one.

The wine variety Melback was showing typical symptoms of leaf roll, but it was negative to all available ELISA tests. It was suspected that it might have new or different strain of leaf roll which was not detected by available ELISA kits.

11.4.2 Presence of Grape Vine Leaf Roll associated Virus 1+3 (GVLRaV 1+3) in table grape varieties.

Samples collected from some table grape varieties and tested with above mentioned ELISA kits. Following observations were noted.

- Sharad Seedless vines showing reddening on leaves collected from Nasik (Khedgaon) showed positive to GVLRaV 1+3.

- Tas-A-Ganesh vines showing restricted growth, since last two years also showed positive to GVLRaV 1+3.

- Thompson Seedless vines (France collection), showed no visible symptoms, except the poor vigour. The vines found positive to GVLRaV 1+3.

All above samples showed very good titer of the virus.

11.4.3 Virus infected vines and cold sensitivity

During the survey visits in January - February 2008, it was observed that many vines of Cabernet Sauvignon and Shiraz varieties showed red pigmentation on leaves. Samples were collected from such symptomatic vines and as well as from adjacent vines with green leaves. All samples were tested with ELISA indicated above. Vines with red leaf symptom showed positive to GVLRaV 1+3, while vines with green leaves were found negative. The results indicated that plants infected with the virus are more sensitive to cold and therefore, showed red colour on leaves. These symptoms can be used for differentiating leaf roll virus infected vines in the vineyards. Quality parameters of the grapes from infected and healthy plants are being studied.

11.4.4 GVLRaV from infected plant is transmitted to immediately adjacent plant

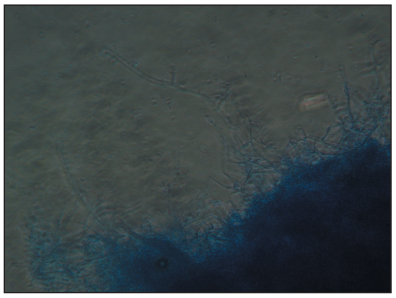
GVLRaV 1+3 infected vines in various vineyards were observed. Apparently healthy looking adjacent two vines to diseased vines were also sampled and tested by ELISA. Only one immediately adjacent vine was found positive but not the second adjacent vine.

11.4.5 Yellow mottle symptoms in Sauvignon Blanc associated with GVLRaV 1+3

One apparently healthy looking vineyard of Sauvignon Blanc in Nasik showed yellow mottle on new leaves developed on few canes during January 2008. All the affected leaf samples were found positive to GVLRaV 1+3. This symptom also can be used for detecting virus infected vines in vineyards.

11.5 Studies on pathogenicity of *Verticillium lecanii* on mealybugs.

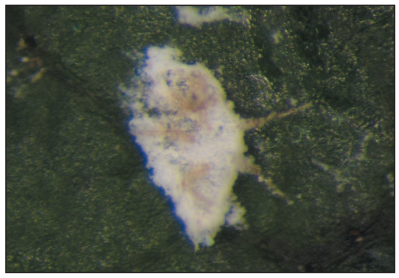
Laboratory studies to know the pathogenicity of five cultures of *Verticillium lecanii* supplied by Project Directorate of Biological Control, Bangalore, on grape mealybugs was conducted.



Growth of *Verticillium lecanii* on mealybug

- In a separate experiment, 25 young crawlers were collected from mealybug colony on pumpkin and delicately transferred with the help of small hairbrush on fresh detached leaves of grapes in humid petriplate. The crawlers were inoculated with drop of conidial suspension of *Verticillium lecanii*. Many crawlers showed infection of *Verticillium* which was confirmed microscopically and by re-isolation of the fungus from dead crawlers. Infection in different cultures varied from 1.67 % in VL1, to 23.34% in VL4. VL6 and VL7 showed 14.17 % infection, while VL8 showed 12.50 % infection. The infection was visible after 48 hrs. of inoculation.

- The conidial suspensions were sprayed on mealybugs grown on pumpkins and colonies were observed for *Verticillium* infection. No adult mealybug was found infected in case of any *Verticillium* culture. However, newly released crawlers were found running away from the pumpkins. Few also died away from pumpkin. Infection of *Verticillium* on dead crawlers was not detected. The development of mealybug colony on pumpkin did not show any adverse effect.



Mealybug infected with *Verticillium lecanii*

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

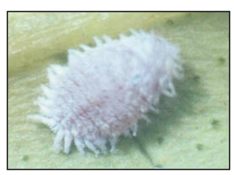
During 2007-08 there was a moderate incidence of mealybugs, thrips and mites was noticed in all the grape growing areas of Maharashtra. Total of five mealybug species, three thrips species and a species of mite was collected and identified. Total of eight ant species were found associated with mealybugs in vineyards of Maharashtra. Among natural enemies, two predators were identified.

Studies shown that the mealybug population build-up coincide with increased with the increase in temperature, decrease in the humidity and advancement in the berry development. Highly significant negative correlation among thrips population with minimum temperature ($r = -0.75$) and rain fall ($r = -0.47$) was recorded. Results indicated that the mite population was found to increase from 2.20/ leaf in December and the mite infestation reached peak to 10.0 mites/leaf in April at Pune. Analysis of data revealed the presence of highly significant negative correlation among mites population with minimum temperature ($r = -0.45$), and relative humidity ($r = -0.79$).

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

Moderate incidence of thrips was observed in 2007-08 in major grape growing areas of Maharashtra and around Hyderabad of Andhra Pradesh. However, mealybug population was found sporadic in all major growing areas of Maharashtra. Heavy incidence of stem borer noticed around Sangli region of Maharashtra. However, it has been observed that there was more mites incidence in months of January and February of 2008 especially around Nasik. The summary of collection of various species of mealybugs/thrips/mites is presented below :

- Four mealybug species viz.; *Maconellicoccus hirsutus*, *Planococcus citri*, *Nipaecoccus viridis* and *Pseudococcus longispinus* were collected. Among them, *M. hirsutus* and *P. citri* were found causing severe loss.



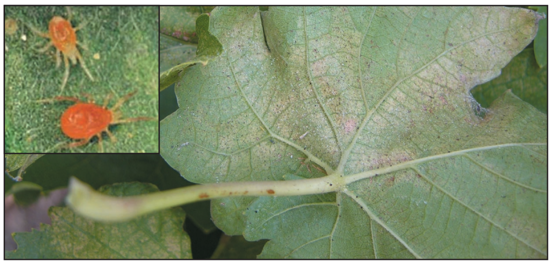
P. citri adult

- Eight species of ants viz.; *Componotus compressus*, *Componotus sericus*, *C. rufuglaucus*, *Tapinoma melanocephalum*, *Monomorium sp.*, *Techinomyrmix sp.*, *Solenopsis geminata* and *Dolichoderus affinis* were found associated with the mealybugs in the vineyards.

- The green lacewing *Chrysoperla carnea* was commonly found in many of the vineyards as a predator of the mealybugs.

Scirtothrips dorsalis

- Two species of thrips viz.; *Scirtothrips dorsalis* and *Haplothrips hawaiensis* were found attacking the grapes in Maharashtra



Mites on the lower surface of leaves

- 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 in Nasik region. The incidence of mite was also noticed in other parts of Maharashtra.

12.3 Different indigenous methods and insecticides used in grapes

Different cultural and mechanical methods for management of mealybugs and other insects were recorded (In progress). For the management of mealybugs, removal of loose bark, applying sticky bands by many grape growers and spraying green chilly and garlic extract (5:1ratio) by few growers was recorded. Several growers sprayed herbal preparation made out of tobacco, parthenium, *Vitex negundo*, *Lantana camara*, Dasha Parna (preparation made out of ten herbs). For the management of thrips, 10% Gomutra (cow's urine) is commonly being sprayed by few farmers.

12.4 Evaluation of germplasm for resistance to thrips

Different grape varieties and accessions were evaluated for their resistance to thrips. Five shoots per plant were observed for the incidence of thrips and each shoot was further divided into shoot tip, matured shoot and berries. Five plants were observed for each variety/accession. The varieties were rated on a scale of 1-10, with 1 being the most resistant and 10 being the most susceptible.

Thrips infected grape bunch

Varieties/accessions which showed least thrips attack were Tannat, Khalili, Lake Emerald, Malvasia Bianca de Vaporis and Pinot Noir. Varieties/accessions, which were found most susceptible to thrips damage, were Thompson Seedless, Kishmish Belyi, 2A clone (Thompson Seedless), Coarna Regia, EC 36506, Pusa Urvashi and Superior Seedless. It was found that most of the table grape varieties were more susceptible than wine varieties

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

Use of sticky traps for the management of thrips and use of sticky bands, removal of loose bark and dead woods, destruction of infected pruned material, removal weeds and alternated host plants for the management of mealybugs is under progress and later these components will be included in the IPM schedule (In Progress).

Use of yellow sticky trap for insect management

12.6 Evaluation and utilization of bio-pesticides

Microbial preparation of *Pseudomonas fumosoresus* was tested on mites under field conditions and found effective.

12.7 Evaluation and utilization of parasites and predators

In a grape vineyard at MRDBS farm Pune, larvae of *Cryptolaemus montrouzieri* were released @ 2000/ac in August-September 2007 and repeated in the last week of December. A mean of 0.75% bunch infestation was observed in the released plot as compared to 60.50% in the unreleased plot during February, 2008.

12.8 Evaluation and utilization of different neem formulations and other botanicals

During 2006-07 Nimbicidine 1% (Azadirachtin 10000 ppm) and another herbal preparation KK herbal - 74 GL were tried on thrips, mites and mealybugs for their bioefficacy and found effective.

12.9 Evaluation and utilization of different oil formulations

Bio-efficacy of Mineral oil (Agro spray Oil) on mealybugs and its phytotoxicity, effect on natural enemies was studied during 2007-08 in different locations and 0.5% was found to be effective in suppressing mealybug colonies.

12.10 Safety of new generation insecticides to Australian ladybird beetle *Cryptolaemus montrouzieri*

Several new generation insecticides like spinosad, buprofezin, methomyl, imidacloprid, ihiamethoxam, clothianidin, fipronil, chlorpyriphos and cichlorvos were tested for their toxicity to the ladybird beetle at laboratory. It was found that all the new generation insecticides were safe to beetle and hence they can be safely integrated in the IPM.

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

Several new generation insecticides like Cartap hydrochloride (Padan 50 SP), Admire 70 WG (Imidacloprid), Buprofezin 25 SC (applaud 25 SC) were tested for the management of mealybugs. Fipronil 80% WG (Regent 80% WG) was tested for thrips. New generation acaricides like Abamectin 1.9% EC (Vertimec 1.9% EC) and Fenpyroximate 5 SC were tested for their bio-efficacy on mites along with their phytotoxicity and effect on natural enemies. Samples were also drawn for studying the pesticide residues for calculating their PHI's (Pre Harvest interval) and MRL's (Maximum

Residual Limit). After completing all these experiments these chemicals were included in recommendation schedule of NRC for Grapes. New generation insecticides like Spirotetramate, CHA-5425 , Fipronil 80% WG (Regent 80% WG) are under trial on mealybugs, mites and thrips (Table 14).

Table 14. Details of insecticides, biopesticides, botanicals and safe chemicals tested for their bio-efficacy, phytotoxicity and effect on natural enemies during 2007-08.

Sl. No.	Insecticide / Biopesticide / Botanical / Safe chemical	Brand name	Strength	Dose / lit water	Target pest
I.	**Insecticide**				
1.	Spirotetramat	–	150 OD	0.5 ml L^{-1}	Mealybugs and mites
2.	CHA-5425	–	-	0.5 ml L^{-1}	Thrips
3.	Fipronil	Regent	80 WG	0.05 g L^{-1}	Thrips
4.	Abamectin	Vertimec	1.9% EC	0.25 ml L^{-1}	Mites
II.	**Biopesticide**				
1.	*Pseudomonas fumosoreus*	Priority	(2X 10^8 CFU ml^{-1})	500 ml	Mites
III.	**Botanical**				
1.	Azadirachtin	Nimbicidine	10000 ppm	300 ml	Flea beetle and Mealy bugs
IV.	**Safe chemical**				
1.	Botanical	KK herbal – 74 GL	-	500 ml	Thrips and Mealybugs
2.	Mineral Oil	Agro Spray Oil	-	500 ml	Thrips and Mealybugs

12.12 Testing of mealybug IPM

IPM module, farmers practice and check were evaluated for the management of mealybugs during 2007-08. Results indicated that a mean of 1.83%, 15.61% and 25.50% of bunch damage was recorded in the treatments IPM, farmers' practice and check, respectively. Components of IPM module includes debarking and pasting with chlropyriphos, soil drenching of imidachloprid 200 SL @ 1.5 ml/L/vine or imidachloprid 70WG @ 0.50 g/L/vine, foliar application of buprofezine 25 SC, release of ladybird beetles etc. In the farmers practice repeated spraying of methomyl, chlorpyriphos, dichlorovos was included.

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

13.1 Dissipation studies on trifloxystrobin and trifloxystrobin + tebuconazole

Pre-harvest interval (PHI) of both the fungicides was determined using non-linear kinetics. The residues of trifloxystrobin degraded to its acid metabolite within a week time and this metabolite further degraded or got assimilated as conjugates with natural cellular components. No residues of either of the fungicides could be identified after 30 days of foliar spray.

In soil also the acid metabolite was the only degradation product identified. The residues of this metabolite having toxicological significance was there up to 7 days and then started degrading and reached below 10 ppb level within 30 days. Tebuconazole residues could not be detected after 30 days of final spray.

13.2 Dissipation of Meptyl Dinocap in grapes in four different locations of India

HPLC-UV and LC-MS/MS based residue analysis method was validated for its analysis by considering the parent compound and its metabolite 2,4-Dinitro-octylphenol. Dissipation was studied at two doses with four levels of applications in four different grape growing regions of the country viz.; Pune, Bijapur, Hyderabad and Madurai.. PHI was found to be 7 days with reference to the EU MRL of 0.05 mg kg^{-1}.

13.3 Persistence and metabolic fate of the insecticide Abamectin in grape

The rate of degradation of abamectin reached below the limit of quantification (LOQ) of 0.01 mg kg^{-1} (ppb) within one day even when applied at the double dose (Abamectin 1.9 EC 1 ml L^{-1}, 1000 l water ha^{-1}).

13.4 Persistence and metabolic fate of the insecticide Fipronil in grapes and three different soils

Fipronil degraded to below the limit of detection of 0.01 mg kg^{-1} within 30 and 45 days in grapes and soils, respectively. Fipronil sulfone was the major detectable metabolite in grapes.

13.5 Standardization of sampling technique for residue analysis

A procedure of representative sampling for residue analysis was standardized. Buprofezin, used as a test pesticide was applied at 312.5 g a.i. ha^{-1} using a tractor driven sprayer over 1 ha area of grapevines with uniform canopy. The canopy architecture was 'Y' shaped having row-to-row spacing of 2.74 m and vine-to-vine spacing of 1.83 m. The vines having uniform height were selected for the study. Homogeneity of sampling was tested by comparing the residue status in the samples collected from 15 primary sampling locations (with similar vine characteristics) identified from 1 ha area. Different sampling strategies were followed to identify the following results:

- Bunch to bunch variation within single vine

- Bunch to bunch variation in different vines
- Vine to vine variation within 1 ha area
- Area-wise variations: The entire 1 ha area was divided into four equal locations (areas) of 0.25 ha and sampling (5 kg) was done separately in 15 replicates from each of the unit areas by randomly collecting bunchlets and not intact bunches.
- Representative random sampling: Fifteen random samples (5 kg each) were collected from the entire 1 ha area by randomly collecting bunchlets (8-10 berries) from different vines located in different primary sampling units.

Variations in the context of bunch-to-bunch, vine-to-vine and location-to-location were determined by estimating relative standard deviations (RSD) for each data set of 15 replicates.

Result

The sampling experiment yielded very interesting results with practical significance. When the variations in residues on bunch-to-bunch basis within single vine were considered, the RSD of residues was as high as 55%. This shows the extent of non-uniform distribution of a pesticide within a vine. Although spraying was done as uniformly as possible; with time the spray droplets might have fallen from upper canopy levels in favour of gravitational force and accumulated in relatively lower levels of the crop canopy. Thus, the samples collected after two hours of spraying from different heights within same vine had significantly different amounts of residues with relatively higher depositions at lower canopy levels. When residues in intact bunches from different vines were compared, such variation furthermore increased to 74% RSD. This reflects the limitation in considering intact bunches as component of laboratory sample. However, such sampling induced variations in residues reduced significantly when the samples comprising of small bunchlets overall drawn from all over single vines were compared (n = 15), when the RSD came down to around 20% indicating more representation of population. Furthermore, the variability was about 25%, when sampling was done by collecting small bunchlets randomly from different vines spread over each of the 0.25 ha area. But the representative sampling could best be achieved when 5 kg samples comprising of small bunchlets were drawn randomly from all over the 1 ha area. Such sampling in 15 replicates resulted in RSD of 14%, which was satisfactory considering natural variations. Therefore, it was decided to adopt the last method of sampling by randomly collecting 5 kg grapes comprising of small bunchlets from an area of 1 ha.

The above findings have high practical significance since around 15-20 ton of grapes are usually produced out of 1 ha vineyard and it is expected that around 5 kg laboratory sample will represent such a huge population of grape berries while conducting residue analysis. Thus, if sampling is not done perfectly, it introduces high level of uncertainty in analysis results, which in turn may affect the marketability of the produce in international market in terms of non-compliance to MRL and also consumer safety. Thus, it is essential that the sampling method be as much representative as possible to minimize error, which could be achieved through this experiment.

Programme 14. Development of post-harvest technologies

14.1 Effect of retention of knot of the bunch on the shelf life and changes in sugars, protein, phenols in Tas-A-Ganesh grapes

Considering the benefits of retention of knot, an experiment was conducted to study the relation of presence of knot with biochemical status in terms of sugars, phenols, proteins and also the shelf life in case of Tas-A-Ganesh grapes grafted on Dogridge rootstock. The bunches were harvested by following both the methods i.e. retaining the knot on peduncle and without knot. The harvested bunches were pre-cooled and then kept at cold storage at 0°C for 30 days. After removal of grapes from cold storage, the shelf life was studied for physiological loss in weight, fallen and rotten berries and biochemical status.

Significant differences were recorded for physiological loss in weight. Minimum loss of weight was recorded when the bunches were cut retaining the knot as compared to the bunches without the knot. On 5th day, minimum physiological loss in weight of 7.30% was recorded as compared to 7.78% without knot. Fallen berries were also minimum (4.5%) in bunch with knot as compared to without knot (5.7%). Higher berry rot was recorded in bunches without knot (2.2%) as compared to bunches with knot (1.4%).

The berries and rachis were analyzed for biochemical parameters. Significant differences were recorded for protein, phenols, sugars. In case of berries from bunches with knot, higher amount of protein i.e. (9.05 mg/g) was recorded as compared to bunches without knot. However, in rachis, this value was 200.25 mg/g in with knot as compared to 175.05 mg/g in without knot. Higher rate of phenol was recorded in berries (2.43 mg/g) of bunches with knot as compared to in without knot (2.27 mg/g). However, in rachis it was 18.28 mg/g compared to 14.32 mg/g in with knot and wihout knot, respectively. The amount of protein and phenol was higher in rachis as compared to berries.

Table 15. Biochemical parameter (mg g^{-1}) in berry and rachis.

Treatments	Berry			Rachis		
	Protein	Phenol	Sugar	Protein	Phenol	Sugar
Bunches with knot	9.05	2.59	281.27	200.25	18.28	140.15
Bunches without knot	7.30	2.28	261.11	175.05	14.32	103.41
t value	53.947	3.374	8.518	14.574	29.068	7.484
Significance	*	*	*	*	*	*

* Significant at 5%.

Higher amount of sugar was recorded in the rachis than the berries. The rachis and berries in bunches with knot recorded higher amount of sugar, as compared to bunches without the knot.

14.2 Studies on Juice

Grapes from nine varieties viz.; Concord, Gulabi, Bangalore Blue, Buckland Sweet Water, Muscat of Alexendria, etc. were collected from germplasm block to study TSS and pH in juices at maturity and data is presented in Table 16.

Table 16. TSS (°B) and pH values of juice of different varieties at maturity.

S. No.	Variety	TSS	pH
1	Concord	22.8	3.61
2	Muscat of Alexandria	18.2	4.25
3	Buckland Sweet Water	21.8	4.21
4	Gulabi	19.4	4.66
5	A-27-1	22.4	4.54
6	Ribier (Alphonse Lavallee)	23.6	4.54
7	Jaffayan	22.2	4.32
8	A-26-2	24.2	3.67
9	PS-III-11-I	23.6	4.60

In order to evaluate possibilities of dilution of grape juices with soda water the various combinations were made. For this purpose, following varieties were included in the study (Table 17). Organoleptic studies revealed, juices diluted with soda water up to TSS value of 14°B did not affect the acceptance in terms of colour, sweetness, flavour, acidity, etc.

Table 17. pH and TSS (°B) values of juices after dilution with soda water.

S. No.	Variety	Juice percentage in blend									
		100		90		80		70		60	
		pH	TSS	pH	TSS	pH	TSS	pH	TSS	pH	TSS
1	Gulabi	4.66	19.4	4.64	17.6	4.62	15.8	4.58	13.8	4.55	12.0
2	A-27-1	4.54	22.4	4.52	20.4	4.48	18.2	4.46	15.8	4.44	13.6
3	Ribier (Alfonse Lavallee)	4.54	23.6	4.51	21.4	4.47	19.0	4.45	16.8	4.43	14.2
4	Jaffayan	4.32	22.2	4.27	20.2	4.23	18.0	4.21	15.8	4.20	13.6

14.3 Wines

To collect primary information on effect of variety on wine quality, following varieties (stored at 0 °C) were utilized for wine making. For fermentation purpose a commercial strain of yeast was inoculated in must. The pH and TSS values of musts are given in Table 18. The prepared wines were stored at 0 ºC for clarification and other further studies on wine quality.

Table 18. TSS and pH values of must used for wine making.

S. No.	Variety	TSS (°B)	pH
1	A 46-2	20.6	3.89
2	A 46-1	18.6	3.32
3	Cabernet Sauvignon	22.0	3.80
4	Pinot Noir	21.8	3.88

14.4 Raisins

About 30 raisins samples collected from different cold storages and vineyards in Sangli and Solapur region were analyzed as per the Codex standards and comparison was made with 2 US raisin samples viz.; Sun-Maid and Champion. The analysis results revealed that US samples (Sun-Maid and Champion) were found to be un-graded in respect of both colour and size. However, no pieces of cap stems were found in these samples. With regard to Indian raisin samples, there was about 30% samples did not comply with Codex standards in respect of number of cap stems i.e. 50 cap stems per 500 g.

Programme 15. Development of information and documentation systems

15.1 Development of databases for various applications

15.1.2 Information system on molecular data for grape germplasm in India

GUI and functional designs and coding have been conducted for the module that will generate a similarity or dissimilarity percentage of the selected accession with those in the database with respect to the specified primers. Designing and coding have also been performed for creation and maintenance of user login to ensure protected access to data entry and modification.

Unit testing, combine module testing, regression testing and rectification of identified errors have been carried out for all the modules and accordingly changes in the program logic, code and GUI design have been made. This process was carried out recursively.

An online help facility was created and integrated into the program for instant help on working of the program. The help files document the whole system and works as the user manual.

Allele data on 44 accessions with 33 primers was compiled and entered into the database using the program.

15.1.2 Development of grape data bank

Data have been collected from different sources on global area, production, utilization, trade and commerce, packing and storage, processing techniques, government policies and quality standards.

Collaborative, Externally Funded, Contract Research and Consultancy Projects

I. Collaborative and externally funded projects

i. National Referral Laboratory for monitoring pesticide residues for export of table grapes from India to EU countries

This was the fifth year of the Residue Monitoring Plan initiated by the APEDA in 2003-04 with National Research Centre for Grapes declared as the National Referral Laboratory. Presently, three state Governments viz.; Maharashtra, Andhra Pradesh and Karnataka are covered under this programme with a total 19723 farms registered with the total area of 13153.69 hectares as against the estimated acreage of 64,300 hectare under grape cultivation in the country.

Proficiency Testing (PT) was organized among the six nominated laboratories on 20th December 2007 and the results were evaluated through the 'Z'-scores. The performance of the laboratories in terms of the PT results improved against last year's results. A total of 8556 samples were analyzed in the nominated laboratories during 2008 season. Maharashtra accounted for the highest number of 1201 failed samples followed by Karnataka (20) and Andhra Pradesh (13). On re-sampling after the recommended pre-harvest intervals, 260 alerts were revoked on the basis of the MRL compliance in analyses reports. Within Maharashtra, Nasik district accounted for 713 alerts and out of these 152 alerts were revoked. In Sangli, a total 150 alerts were issued and 39 alerts were revoked. In Andhra Pradesh, the alerts were from Ranga Reddy (8) and Medak (5) districts. In Karnataka, alerts were pertaining to Bidar (7), Bijapur (6) and Bellary (3) districts.

In totality, there were 48 pesticides for which MRL exceedances were recorded in the 2008 season. A maximum of 407 alerts were issued for the insecticide Imidacloprid alone, which occurred primarily because of non-availability of MRL in the European Union countries other than the UK, Netherlands and Germany, and therefore the MRL for the EU was set at the limit of quantification (LOQ) of 0.01 mg kg^{-1}. On the contrary, the MRL of Imidacloprid applicable for the UK, Netherlands and Germany was as high as 1.0 mg kg^{-1}, which certainly allowed the export. The next most frequently detected insecticide was Thiamethoxam with 231 detections. But, for Thiamethoxam too, samples mostly passed for the UK and Germany on account of higher MRL of 0.5 mg kg^{-1} against 0.05 mg kg^{-1} in the Netherlands and the EU. The other major insecticides that detected in this season include Buprofezin (103) and Methomyl (99), which were used for mealybugs. The new-generation acaricide Abamectin, which was recommended in this season for the management of mites, was detected in 52 samples, although the residues were just above the LOQ level. These samples failed since there were no MRL recommendations available for this chemical in any EU country.

In case of the fungicides, highest detected chemical was Dimethomorph (106), followed by Flusilazole (56) Carbendazim (40), Thiophanate-methyl (40), Difenoconazole and Hexaconazole (21). For Dimethomorph, most of the alerts were however for the EU and the Netherlands because the MRL was 0.05 mg kg^{-1} against the MRL of 2 mg kg^{-1} applicable for Germany and UK. Majority of the alerts regarding fungicides were otherwise pertaining to those chemicals used to manage either powdery mildews or anthracnose.

On critical perusal of the results of the residue monitoring in 2007-08, it is evident that the percentage of the failed samples has reduced significantly in this season with only 261 failed samples for all European countries constituting 3.05% of the total number of samples analyzed. In previous four years, the alert statistics were 23.69% in 2003-04, 12.43% in 2004-05, 7.16% in 2005-06 and 6.76% in 2006-07. This trend clearly showed the improvement in the management of pesticide residues in grapes at the country level through the implementation of the Residue Monitoring Program.

Out of the 885 effective alerts, 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 2008-09. In this season, maximum number of alerts were pertaining to Imidacloprid, which might occur as a result of foliar as well as soil application of this chemical against mealybugs. This chemical was especially promoted in this season to manage ever-increasing mealybug infestations in vineyards and it could effectively minimize this pest. The frequent detection of this chemical could be because of indiscriminate or excessive use by the growers. But since in majority of cases of detections, the residues were below the MRL of UK, Netherlands and Germany, the products could be exported. Since, there were no MRL available for this chemical in case of the EU, the alerts were partially applicable. As a result, almost 36% of the alerts were pertaining to such cases, which could be exported to UK, Netherlands as well as Germany.

The proportion of detections of the residues of the non-recommended chemicals has reduced in most cases in this year compared to the earlier seasons, which indicates increasing awareness among the grape growers to use the recommended chemicals for pest management.

ii. Identification of drought and salt tolerant genes in grape rootstocks and their role in physio-biochemical process during abiotic stresses (BARC - BRNS funded)

Ten rootstocks viz.; Dogridge, 110 R, 1103 P, 99 R, St. George, Salt Creek, B2-56, 1613 C, Teleki 5A and *Vitis longii* were selected for this study. Two levels of irrigations, such as 100 % and 50%

based on the field capacity of the potting mixture was given for 21 days. Various physiological and biochemical observations like relative water content, specific leaf weight, gas exchange parameters (photosynthetic rate, transpiration rate, stomatal conductance), proline content, total phenols, proteins, reducing sugars, osmotic potential, glycine betaine, potassium etc were recorded at 4 days interval till termination of stress cycle.

Increased water use efficiency at single leaf level was recorded in 110 R, 1103 P, Salt Creek, B2 56 and Dogridge rootstock at 50 % stress on all the days of observation, while least was in 1613 C, *Vitis longii* and St. George (Table 19).

Table 19. WUE (µ mole (m mole)$^{-1}$) at single leaf level in different rootstocks at different levels of irrigation during stress cycle.

Rootstocks	0 day (100 % irrigation)	50 % Stress				
		4th day	7th day	14th day	18th day	21st day
99 R	23.74	15.92	55.97	24.86	18.48	8.86
1103 P	36.04	19.19	62.63	33.11	22.33	10.58
110 R	29.05	52.63	106.29	44.13	25.68	14.18
B2 56	41.27	24.30	50.30	36.03	20.53	10.61
Teleki 5A	31.83	20.00	11.53	21.16	17.08	4.52
Salt Creek	37.59	17.54	17.49	21.97	20.22	5.41
Dogridge	23.64	56.90	54.99	25.61	21.93	10.32
V. longii	31.89	17.57	12.95	11.44	13.02	3.94
1613 C	16.14	11.69	16.07	12.22	9.97	2.66
St. George	29.19	25.61	23.44	13.98	11.77	3.03
SEm ±	4.509	14.126	19.058	4.317	1.427	0.655
Sig. at 5%	*	NS	*	*	*	*

More osmotic adjustment in terms of accumulation of osmolytes like proline (Table 20), sugars, potassium and glycine betaine was recorded in rootstocks belonging to *berlandierii* and *rupestris* group (110 R, 99 R, 1103 P and B2 56) which was evident from increased osmotic potential in these rootstocks at 50 % stress on 21st day of the stress cycle.

Efforts were made to standardize protocol for RNA extraction from grape leaves using Quiagen RNA easy kits. But due to more phenolic compounds and other interfering substances in grape leaves, RNA could not be extracted using these kits. After exhaustive literature survey, it was found that Midi Total RNA extraction method would yield good quality RNA up to 40 - 60 µg from 1 g of grape tissue (leaf and berry). Hence, we are using this protocol to standardize RNA extraction and further construction of c DNA library to identify genes involved in drought and salt stress tolerance.

Table 20. Proline (mg g^{-1} fresh weight) content in leaves of rootstocks at different levels of irrigation during stress cycle.

Rootstocks	0 day (100 % irrigation)	50 % Stress		
		7^{th} day	14^{th} day	21^{st} day
99 R	0.08	1.22	13.61	11.17
1103 P	0.13	0.99	11.76	12.64
110 R	0.08	2.92	15.76	16.01
B2 56	0.16	1.53	14.81	11.46
Teleki 5A	0.09	0.69	9.87	9.23
Salt Creek	0.14	0.88	15.88	10.93
Dogridge	0.22	1.42	13.69	11.17
V. longii	0.18	1.29	9.08	6.50
1613 C	0.09	0.37	7.96	6.23
St. George	0.14	0.34	10.76	7.22
SEm ±	0.011	0.215	0.832	1.126
Sig. at 5%	*	*	*	*

iii. Introduction, evaluation and distribution of plant material of grapes varietis suitable for export and use of plastic structures for quality improvement

The progress made under this project was reviewed in a meeting held at APEDA office in New Delhi under the chairmanship of Dy. Director General (Hort.) Progress made so far is summerised below

Evaluation of export quality table grapes

Among the three table grape varieties introduced from USA, viz.; Red Globe, Crimson Seedless and Italia were evaluated during 2003-2007 at seven localities representing the states of Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu. The multi-locational trials indicated that Red Globe was found most promising among the three varieties, however, the other two varieties i.e. Crimson Seedless and Italia were average yielders and did not found favourable in the domestic markets. In contrast there is a good demand for increasing the acerage under Red Globe, due to its low cost of production and high price realizations. Many growers have already started exporting this variety to Middle-East countries and also to Indian metros (super bazaars).

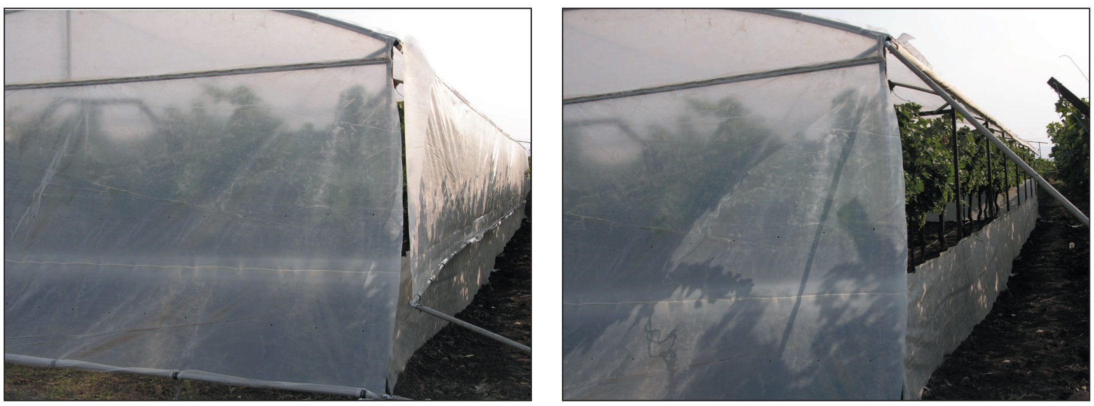
iv. Use of plastic cover in vineyards to improve the exportable percentage of crop

Support structure for covering plastic over vineyards

To support weight of 200 guage plastic polyhouse-like structures are needed to cover vineyards with plastic. With the help of such structures, life of the plastic will improve and plastic is not affected under heavy windy conditions. Such structures are more expensive and cost about Rs.350-400/- per square meter. Two such structures of 235 square meter size were constructed over existing vineyards of varieties Sharad Seedless and Thompson Seedless for research purpose during December 2007.

Modified plastic structure front view; front plastic sheet rolled up

Observations on weather parameters inside and outside of the plastic structures are being recorded using automatic weather data recorders. By opening and closing the side curtains of the structure, inside maximum temperature was maintained near 30°C during winter ensure good growth.



Side view of the plastic structure with side plastic sheet rolled down (a) and rolled up (b)

Use of shade nets for early sprouting in vineyards after backward pruning

Backward pruning in Maharashtra is done in the month of April and in most areas maximum temperature rises above 40°C and RH drops below 25%. Under such situation sprouting after pruning starts only after 20-25 days. In hotter areas like Solapur, Osmanabad districts, arms get damaged due to direct sunlight before sprouting, leading to woody appearance. The sprouting of the shoots will not be uniform and early sprouted canes grow thicker than late sprouted. Use of shade net (75% cut in light) over vineyards after forward pruning resulted in uniform sprouting within 12 days of pruning. The canes were vigourous and uniformely developed.

Side view of the plastic structure with side plastic sheet rolled down (a) and rolled up (b)

All India Coordinated Research Project on Sub-tropical Fruits - Grapes

Various varieties/crosses/hybrids were evaluated at AICRP centers. Maximum yield i.e. 5.43 kg/vine with 17.5°B was recorded in Red Globe at Grape Research Station, Hyderabad under the activity of varietal evaluation for export. The maximum berry diameter of 22.25 mm was recorded in Italia followed by Red Globe i.e. 19.5 mm. Hybrid H-516 (Punjab Purple) was found most suitable for processing at Punjab Agricultural University, Ludhiana. Flame Seedless has been recommended for cultivation in Punjab state.

At Grape Research Station, Hyderabad, Thompson Seedless was studied on four rootstocks viz.; Dogridge, Salt Creek, St. George and 1613C. Maximum stem girth was recorded on Dogridge followed by Salt Creek. The maximum yield was also recorded in Dogridge. At Punjab Agricultural University, Ludhiana, Perlette variety is grafted on St. George, 1613C and 1616C and own rooted for rootstock evaluation purpose.

Higher water use efficiency was recorded by drip irrigation method in comparison to flood irrigation at Punjab Agricultural University, Ludhiana. Yield and yield parameters revealed that use of two dippers were found equivalent to four dippers per vine.

Peak activity of flea beetal (*Scelodonta strigicollis*) was recorded during 36 to 43 standard weeks while chafer beetles (*Holotrichia* spp.) during 26-34 standard weeks, thrips (*Scrilothrips dorsalis*) during 44-52 standard weeks in grapes growing areas of Andhra Pradesh. Application of thiamethoxam 0.0075% recorded maximum thrips reduction at Mahatma Phule Krishi Vidyapeeth, Rahuri.

Technology Assessed and Transferred

Several technologies have been developed and assessed at the Institute during last eight years. The scientists disseminated these technologies to the grape growers through several field visits and participation in growers' seminar and also took their feedback. Some of the important technologies are given below:

1. Use of rootstocks for sustainable grape production under abiotic stress
2. Irrigation schedule
3. Rationalisation of fertilizer use
4. Use of mulch and subsurface irrigation under water deficit conditions
5. Use of bioregulators for improving grape quality
6. Strategies for insect pest and disease management during last 50 days before harvest.
7. Use of biocontrol agents
8. Disease forecasting based disease management

Farm Visits

- Dr. N. S. Kulkarni visited vineyards around Hyderabad and Nasik to guide the grape growers on 'IPM after April pruning' and IPM after October pruning on 2nd April and 30th September 2007, respectively.
- Dr. S. D. Ramteke participated in discussion on 23rd April 2007 at Solapur on 'Weight loss during ripening in grapes'.

- Dr. P. G. Adsule, Dr. G. S. Karibasappa, Dr. R. G. Somkuwar, Dr. A. K. Upadhyay and Dr. J. Satisha visited nursery of M/s Indage Wineries, Narayangaon on 10th August 2007 to see the planting material of grape wine varieties to be procured for experiment purpose and also to discuss about the import of rootstocks and the additional grape wine varieties required for experiments on wine varieties.

- Dr. P. G. Adsule, Director visited various vineyards in Pandharpur, raisin drying yards at Junoni and vineyards and wineries at Nimni and Borgaon along with the QRT Team on 5-6th October 2007.

- Dr. S. D. Ramteke visited nearby fields and delivered a lecture on 'Judicious use of bioregulators after October pruning in grapes' at Baramati and Bori on 18th October 2007.

- Dr. S. D. Ramteke visited the affected gardens with berry scars at Golegaon, Narayangaon on 17th November 2007.

- Dr. P. G. Adsule, Director visited few vineyards and had interaction meeting with the grape growers in Jaisinghpur area and made available the latest pesticide schedule for the export of table grapes. He participated in the 'Krishi Pragat 2007' programme organized by Farmers' Organization at Kolhapur and delivered presentation as requested, on Agro Processing Industries with reference to Grape Processing on 17-18th November 2007.

- Dr. P. G. Adsule, Director visited winery units and ICAR Research Complex at Goa to know the status of winery units in Goa. He participated in the Science Live Event organized by M/s Syngenta India Ltd. at Goa and assessed their pesticide lab facility. M/s. Geo-Chem Laboratory at Mumbai was visited to evaluate their ability to undertake the APEDA Pesticide Residue Monitoring programme during 26-29th November 2007.

- Dr. N. S. Kulkarni visited the grape vineyards at Palus on 5th December 2007, at Tasgaon on 6th December 2007, at Miraj on 7th December 2007and guided the grape growers on 'IPM of stem borer'.

- Dr. M. Mani and Dr. N.S. Kulkarni visited Satpur, Dindori, Pimplegaon, Nasik, Vani, Solapur, Tuljapur and Rahata during December 2007 to February 2008 to guide the grape growers on IPM of mealybugs and mite.

- Dr. J. Sharma and Dr. A. K. Sharma visited Kasegaon, Pandharpur, Umdi, and Mangalvedha areas on 24-25th January 2008 and identified incidence of bunch necrosis and mummification in raisin grapes.

- Dr. J. Sharma, Dr. A. K. Sharma and Dr. J. Satisha visited Miraj area of Sangli district on 28-29th January 2008 to study the performance of rootstocks and also to identify the vineyards growing wine grapes for future survey work. The effect of rootstocks on raisin quality can establish incidence of bunch necrosis and mummification. It was found that bunch necrosis and mummification was less in the vineyards with good management practices and open canopy.

- Dr. M. Mani and Dr. N.S. Kulkarni surveyed Sangli, Nasik and Solapur during 5-7th December 2007, 2nd - 3rd January 2008 and 8-9th January 2008, respectively for thrips, mealybugs and mites. Incidence of thrips was more in Solapur, however, more incidence was observed in and around Nasik. Recommendations were given on the spot for controlling thrips and mites as per Annexure - 7 of the pesticide residue monitoring plan of grapes for export.

- Dr. P. G. Adsule, Director visited the APEDA-Variety Evaluation plots at Phaltan, vineyards in Vita/Borgaon, Sangli area, on 16th February 2008 particularly, with modern/precision modules for the management of plant protection and soil management, and discussed with the vineyard owners. He also visited to M/s. Fresh Express Logistics packhouse at Kupwad (Miraj) and discussed with packer for the impact of untimely rain in few pockets where from the grapes are being harvested for export and also visited to upcoming vineyards for export and other purpose in Kolhapur region.

Participation in Growers' Seminar

- Dr. S. D. Sawant and Dr. Jagdev Sharma interacted with growers and delivered lectures on disease and nutrient management in 'Charchasatra' organized by Gaonkari Newspaper at Mohadi, Nasik on 10th April 2007.

- Dr. N. S. Kulkarni delivered series of lectures on 'IPM after April Pruning' and participated in Charchasatra organized by Maharashtra Grape Growers' Association at Sangli on 18th April 2007 and at Solapur on 27th April 2007.

- Dr. S. D. Sawant, Dr. R. G. Somkuwar, Dr. J. Sharma and Dr. N. S. Kulkarni delivered lectures on their respective field in the seminar organized by Maharashtra State Grape Growers' Association at Nasik on 3rd May 2007.

- Dr. S. D. Sawant, Dr. R. G. Somkuwar, Dr. J. Sharma and Dr. N. S. Kulkarni delivered lectures in their respective fields in the seminar on 'Grapes and Pomegranate' organized by Maharashtra State Grape Growers' Association and State Department, Govt. of Maharashtra at Baramati from 11-12th May, 2007.

- Dr. P. G. Adsule, Director along with Dr. S. D Sawant, Dr. R. G. Somkuwar, Dr. J. Sharma and Dr. N. S. Kulkarni delivered lectures in their respective subjects in the seminar organized by Abhinav Grape Growers Association, Junnar on 22nd May 2007.

- Dr. N. S. Kulkarni delivered a lecture on 'IPM after April Pruning' at Sangamner on 12th June 2007.

- Dr. M. Mani, Dr. Indu S. Sawant, Dr. S. D. Sawant, Dr. R. G. Somkuwar, Dr. K. Banerjee, Dr. S. D. Ramteke, Dr. J. Sharma and Dr. N. S. Kulkarni participated and delivered lectures on their respective specialization in the Annual Seminar of Maharashtra State Grape Growers' Association held on 18-19th August 2007 at Pune. Dr. M. Mani chaired the session on Plant Protection in the Annual Seminar of Maharashtra State Grape Growers' Association held on 19th August 2007.

- Dr. S. D. Sawant and Dr. J. Sharma participated in 'Sharad 2007' organised by Golegaon Krishi Vikas Mandal, at Golegaon on 4th September 2007 and delivered lectures on disease and nutrient management.

- Dr. R. G. Somkuwar and Dr. A. K. Upadhyay delivered lectures on 'Canopy management after forward pruning in grapes' and 'Nutrient and water management in grapes' respectively to the grape growers at the seminar organized by M/s. Godawari Fertilizers at Palus on 14th September 2007.

- Dr. S. D. Sawant, Dr. R. G. Somkuwar, Dr. S. D. Ramteke, Dr. J. Sharma and Dr. N. S. Kulkarni participated and delivered lectures in their respective field in the seminar organized by Maharashtra State Grape Growers' Association at Nasik on 14th September, Sangli on 21st September, Solapur on 27th September and Babhaleshwar, Pune on 28th September 2007.

- Dr. R. G. Somkuwar and Dr. A. K. Upadhyay delivered a lecture on 'Cultural practices to be followed before and after fruit pruning in grapes' and 'Water management in grapes' respectively in the seminar organized by Bank of India for the grape growers of Niphad on 29th September 2007.

- Dr. S. D. Ramteke delivered lectures on growth regulators issues on 10th October and 17th November 2007 in seminars organized at Baramati and Narayangaon, respectively.

- Dr. G. S. Karibasappa delivered a lecture on 'Grape processing/raisin technology - backward and forward linkages' at Sangli, on the eve of Sri Vasantrao Memorial Annual function, on 14th January 2008.

- Dr. R. G. Somkuwar delivered lectures related with canopy management and production aspects on 10th, 17th, 20th, 22nd October 2007, 9th and 14th January 2008 in seminars at Osmanabad, Nasik, Yawat, Sangli, Tuljapur and Sangli, respectively. About 2400 participants benefited.

Participation in Kisan Mela / exhibition

- The institute participated in the Krishi Mela organized by Solapur District Central Co operative Bank, at Pandharpur from 11-15th April 2007. Dr. R. G. Somkuwar guided the grape growers at Kisan Mela.

- Dr. P. G. Adsule, Director Dr. Indu S. Sawant and Dr. J. Sharma and Mr. B. B. Khade participated in the 'Horticultural Summit 2007' organised by Confederation of Indian Horticulture at Lucknow on 16-17th June 2007 and interacted with the growers, govt officials, scientists during the Summit. A stall depicting the salient research activities of the Centre was also put up for the farmers benefit. The Director of the institute Dr. P. G. Adsule presented a paper on achievements of the institute on grapes in the seminar organized on the occasion.

- Dr. G. S. Karibasappa participated in Krishi Mela and delivered a lecture on 'Wine grape cultivation and production in Karnataka' on 7-8th December, 2007, organised by the Syndicate Bank Regional Office at Bijapur, Karnataka and delivered a lecture on prospects of wine grape cultivation in Karnataka.

- Dr. P. G. Adsule, Director, Dr. R. G. Somkuwar, Dr. J. Sharma and Dr. N. S. Kulkarni participated in the Krishi 2007 exhibition on 30th November 2007 at Nasik. Dr. P. G. Adsule, Director chaired the session on 'Techniques for production of quality grapes' during this exhibition. The technologies were displayed at Centre's stall from 28th November to 2nd December 2007.

- Dr. P. G. Adsule, Director and Dr. R. G. Somkuwar attended the Kisan Mela on 29-30th October 2007 at NRC for Citrus, Nagpur. Dr. P. G. Adsule delivered special address on this occasion. The technology of the centre was displayed in the form of charts and other published materials.

- The Centre participated in Horticulture Trade Fair 2008 organized by the Department of Horticulture Govt. of Andhra Pradesh at Hyderabad on 26-30th January 2008. A stall decorated with information charts/posters and live samples of table and wine grape varieties viz.; Sharad Seedless, A-17/3, Flame Seedless, Cabernet Sauvignon, Pusa Navrang, Beauty Seedless, Red Globe, etc. Horticulture Trade Fair was inaugurated by Dr. Y. S. Reddy, Hon'ble Chief Minister of Andhra Pradesh. About 1000 individuals including students, residents of Hyderabad and growers appreciated the stall especially wine grape varieties.

Sh. N. Raghuveera Reddy, Hon'ble Minister of Agriculture, Agriculture Technology Mission at NRC for Grapes stall

- The Centre's exhibits and grape varieties samples were presented in an exhibition organized by Tata Institute of Fundamental Research at Giant Meterwave Radio Telescope at Khodad, Narayangaon on the occasion of Science Day on 28-29th February 2008.

In house discussions

Approximately 600 farmers visited the Centre during this year to seek advise, consultancy for their problems being faced in the grape vineyard from the scientists of this Centre apart from collection of improved plant varieties/rootstocks.

Television programme/talk

1. Information on National Referral Laboratory of the Centre was made available by Dr. P. G. Adsule, Director and Dr. K. Banerjee to telecast on Doordarshan on 28th March 2008.

2. Dr. R. G. Somkuwar delivered a talk on 'Low temperature effect on berry development' broadcasted at 6.15 pm on Aakashwani, Nasik Kendra on 1st February 2008.

3. Television programme on 'Important practices after October pruning' was telecasted on Sahyadri Channel on 16-19th November 2007 where following scientists gave guidelines to grape growers:
   - Dr. S. D. Sawant : Management of diseases
   - Dr. R. G. Somkuwar : Canopy management
   - Dr. S. D. Ramteke : Use of bioregulators

Education and Training

Deputation Abroad

Dr. S. D. Ramteke and Dr. N. S. Kulkarni were deputed to attend Separation Science training programme at Council of Scientific and Industrial Research, Pretoria, Johannesburg, South Africa during 10-20th May 2007. During the visit, they interacted with the Plant Physiologist and Entomologist on the various researchable issues regarding the pink berry and mealybug management respectively. They also interacted with grape growers and visited various pack houses and leading wineries in and around Cape Town.

On special invitation, Dr. P. G. Adsule, Director and Dr. Kaushik Banerjee visited the Department of Viticulture and Enology, University of California, Davis, USA during 10-14th September 2007. Presentation was given on Indian viticulture and multi-residue analysis facilities of the Institute to the faculties of the UC, Davis. They participated in the 121st AOAC International Annual Meeting and Exhibition during 16-20th September 2007 at Anaheim, California. Dr. Banerjee presented a lead paper on 'Application of GC x GC-TOF mass spectrometry in multi-residue analysis' at AOAC symposium on contaminant analytical chemistry.

Dr. Anuradha Upadhyay was deputed to CSIRO Plant Industry, Adelaide, South Australia for undergoing 'Specialized training of young scientist in niche areas of Biotechnology' under Department of Biotechnology for a period of one year from 26th November 2007 to 25th November 2008.

Sabbatical leave for one year from 26th November 2007 has been sanctioned to Dr. A. K. Upadhyay to avail 'Visiting honorary post doctoral fellow at Adelaide, South Australia.

New Joining

Dr. A. K. Sharma, Sr. Scientist joined NRC for Grapes, Pune on 13th April 2007. He has been selected for this post by ASRB. Previously he was working as Assistant Professor (Sr. Scale) in the Division of Pomology, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar, Shrinagar.

Promotions

Name	Promoted to	Promoted to
Dr. G. S. Karibasappa	Pr. Scientist	29.08.2004
Dr. Indu S. Sawant	Pr. Scientist	27.07.2006
Dr. S. D. Sawant	Pr. Scientist	27.07.2006
Dr. J. Satisha	Sr. Scientist	07.01.2007
Dr. N. S. Kulkarni	Scientist SS	16.04.2007
Mr. P. B. Jadhav	T-3	29.06.2006
Mr. B. B. Khade	T-3	15.04.2007
Ms. Shailaja Satam	T-3	23.04.2007

Mr. N. K. Najan SSG-I (Beldar) has been granted first financial upgradation under assured career probation scheme in the pay scale of Rs. 2610-60-2910-65-3300-70-4000/-S-IIA on completion of 12 years of service.

Training Acquired

Sl. No.	Name	Training Title	Period	Organized by
I. Scientific staff				
1	Dr. N.S. Kulkarni	Computer based multimedia presentation	20th June - 11th July 2007	National Academy of Agricultural Research Management, Hyderabad
2	Dr. S. D. Ramteke and Dr. A. K. Sharma	ISO/IEC 17020	20 - 25th August 2007	APEDA, Navi Mumbai
II. Technical staff				
1	Ms. Shailaja V. Satam	Intelligent Reporting System (IRS) to Nodal Officers / Data Entry Operators of Research Institutes	30-31st August 2007	National Academy of Agricultural Research Management, Hyderabad

Training Programmes Organized

Workshop on 'Advances in Multiresidue Analysis of Pesticides Grapes'

The Centre organized a workshop on "Advances in Multiresidue Analysis of Pesticides Grapes" during 18th-19th July at NRCG, Pune. The workshop was specially meant for the scientist and chemists of the APEDA nominated laboratories involved in pesticide residue analysis as per the residue monitoring plan of the APEDA. Dr. Steven Lehotay, Lead Scientist, from the United States Department of Agriculture, participated in the workshop and enlightened the participants regarding the latest developments on the methodologies in pesticide residue analysis. In addition to the staffs of the NRL of the Institute, there were 23 participants from the APEDA nominated laboratories.

Use of GC-MS/LC-MS/MS for multiresidue analysis

The National Referral Laboratory of the Centre imparted training to the chemists of Insecticide Residue Testing Laboratory, Pune regarding use of GC-MS/LC-MS/MS for multiresidue analysis during 11-12th September 2007 at IRTL, Pune.

Recent advances in production of export quality grapes

A three days training programme was organized on 'Recent Advances in Production of Export Quality Grapes' from 8-10th October 2007 to 25 officers and Fresh Logistic Private Limited, Sangli. The training programme included all aspects of viticulture like global grape scenario, varieties suitable for export, use of rootstocks, water management, nutrient management, canopy management, use of growth regulators, disease management, insect pest management, pre and post harvest handling, monitoring pesticide residues etc. including field demonstration. Dr. J. Satisha coordinated the training programme.

GMP and GHP during post-harvest handling and maintenance of quality in grapes for export

Two days training programme on 'GMP and GHP during post-harvest handling and maintenance of quality in grapes for export' was organized on 5-6th December 2007 at the Centre to the staff of M/s. Field Fresh, Nasik. Dr. A. K. Sharma and Dr. K. Banerjee coordinated the programme.

Viticultural practices for export quality grapes

A special three days training programme on 'Viticultural practices for export quality grapes' was organized for M/s. Deepak Fertilizers on 10-12th December 2007. Dr. J. Sharma coordinated the training programme.

Summer training

Name of scientists	Title of the training	Duration	No. of students	Institution
Dr. Indu S. Sawant	'Isolation, identification and characterization of anthracnose pathogen of grape'	May - August 2007	1 B.Sc. (Biotechnology Applied)	New Arts, Commerce and Science College, Ahmednagar
Dr. Anuradha Upadhyay	'Basic molecular biology techniques'	May - August 2007	1 B.Sc. (Biotechnology Applied)	New Arts, Commerce and Science College, Ahmednagar
Dr. J. Satisha	'Physio biochemical characterization of grape rootstocks'	May - August 2007	1 PG Diploma in Applied Biotechnology	New Arts, Commerce and Science College, Ahmednagar

Resource persons for training programmes organized by Maharashtra State Grape Growers' Association

Assisted to the Maharashtra State Grape Growers' Association in organizing training programmes in 2 batches on 14-28th June and 9th - 23rd July 2007 at Pune. All the scientists of this Centre worked as resource persons and delivered talks in their respective areas of viticulture and enology.

Awards and Recognitions

- University of Pune has recognized National Research Centre for Grapes as a Ph.D. research centre in the subjects of i) Biotechnology, ii) Bioinformatics, iii) Botany, iv) Microbiology, v) Chemistry, vi) Environmental Science, vii) Zoology and viii) Biochemistry for the period of five years from 2007-08 to 2011-12 vide their letter No. CA/4933 dated 18th December 2007.

- Dr. N. S. Kulkarni has been awarded 'Abhinav Gaurav 2007' for the best guidance on insect pest management to the grape growers of Abhinav Grape Growers' Cooperative Society in annual function organized at Junnar on 22nd May 2007.

- Dr. Kaushik Banerjee was felicitated by the Maharashtra State Grape Growers' Association in their annual seminar on 18th August 2007 for his contributions in pesticide residue monitoring in grapes.

- The research paper Banerjee K, Oulkar D. P., Dasgupta S., Patil S. B., Patil S. H., Savant R. and Adsule P. G. 2007. Validation and uncertainty analysis of multi-residue method for pesticides in grapes using ethyl acetate extraction and liquid chromatography. Journal of Chromatography A. Vol. 1173 (1-2): 98-109, was ranked first among top 25 hottest articles during October - December 2007 by Science Direct in Journal of Chromatography A. This paper was also ranked 14th under top 25 hottest articles within chemistry group of Science Direct which covers more than 100 journals.

- Dr. R. G. Somkuwar received BHASKAR AWARD - 2007 by Journalist Foundation of Pune.

- Dr. N. S. Kulkarni has been awarded with best project preparation and presentation on "Strategies for the Management of Mealybugs" at CAS training on 'Computer based Multimedia Presentation' at National Academy of Agricultural Research Management, Hyderabad from 20th June to 11th July 2007.

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. Introduction, evaluation and distribution of plant material ofgrape varieties suitable for export (APEDA).

iii. Use of plastic covers in vineyards to improve export per cent of grapes (APEDA).

iv. Development of molecular markers linked to downy mildew resistance in grape (Sub-project of ICAR Network project on 'Molecular Breeding').

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

Publications

Research Publications

1. Adsule P. G., Karibasappa G. S., Banerjee K., Mundankar K. 2008. Status and Prospects of raisin industry in India. *Acta Horticulturae*. **785:** 507-514.

2. Banerjee Kaushik, Oulkar Dashrath P, Patil Sangram H, Dasgupta Soma and Adsule P. G. 2008. Degradation kinetics and safety evaluation of tetraconazole and difenoconazole residues in grape. *Pest Management Science*. **64:** 283-289.

3. Banerjee Kaushik, Oulkar Dashrath P. and Adsule P. G. 2008. Persistence and residue dynamics of mancozeb and its toxic metabolite ethylene thiourea (ETU) in table grapes. *Acta Horticulturae*. **785:** 409-412.

4. Banerjee Kaushik, Patil Sangram H, Dasgupta Soma, Oulkar Dashrath P and Adsule P. G. 2008. Sorption of thiamethoxam in three Indian soils. *Journal of Environmental Science and Health*. Part B **43:** 151-156.

5. Barreto M. S., Nookaraju A., Joglekar A. M., Karibasappa G. S., Agrawal D. C. 2008. Variability among *Vitis vinifera* cultivars to *in vitro* propagation. *Acta Horticulturae* **785:** 127-139.

6. Doshi P. J. and Adsule P. G. 2008. Effect of storage on physico-chemical parameters, phenolic compounds and anti-oxidant activity in grapes. *Acta Horticulturae*. **785:** 447-455.

7. Karibasappa G. S. and Adsule P. G. 2008. Evaluation of wine grape genotypes by National Research Centre for Grapes at their farm at Pune, Maharashtra, India. *Acta Horticulturae* **785:** 497-504.

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9. Kulkarni N.S., and Adsule P.G. 2007. Bio-efficacy of Proclaim 05 SG (emamectin benzoate) for the management of thrips in grapes. *Pestology* **31:** 33-39.

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11. Kulkarni N. S., Sawant S. D. and Adsule P. G. 2008. Seasonal incidence of insect pests in grape vineyard and its correlation with weather parameters. *Acta Horticulturae*. **785:** 313-320.

12. Kulkarni N. S., Sawant I. S., Sawant S. D. and Adsule P. G. 2008, Bio-Efficacy of Neem formulations (Azadirachtin 1% and 5%) on important insect pests of grapes and their effect on shelf life of grapes. *Acta Horticulturae*. **785:** 305-311.

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15. Mundankar K. Y., Sawant S. D., Sawant Indu S. and Sharma J. 2008. An expert system for the management of powdery mildew disease of grapes in India. *Acta Horticulturae*. **785:** 297-300.

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19. Ramteke S. D. and Somkuwar R. G. 2007. Effect of shade nets on berry growth and quality in Tas-A-Ganesh grapes. *The Asian J. Hort*. **2:** 224-226.

20. Ramteke S. D., Somkuwar R. G. and Adsule P. G. 2008. Effect of CPPU on bunch and berry development in Thompson Seedless grafted on Dogridge rootstock. *Acta Horticulturae*. **785:** 213-216.

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26. Satisha J., Ramteke S. D. and Karibasappa G. S. 2007. Physiological and biochemical characterization of grape rootstocks. *South African Journal of Enology and Viticulture*. **28:** 163-168.

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28. Sawant I. S., Sawant S. D. and Adsule P. G. 2008. Studies on fungi associated with post-harvest decay in table grapes from Maharashtra. *Acta Horticulturae*. **785:** 425-430.

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32. Sharma J. and Shikhamany S. D., Singh R. K. and Upadhyay A. K. 2008. Irrigation scheduling for improving water use efficiency in drip irrigated Thompson Seedless grape grown on Dogridge rootstock. *Acta Horticulturae*. **785:** 393-398.

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35. Shikhamany S. D. and Sharma J. 2008. Interaction of sodium and potassium use efficiency in Thompson Seedless grapes. *Acta Horticulturae*. **785:** 373-377.

36. Shikhamany S. D., Somkuwar R. G. and Venugopalan R. 2008. Evaluation of canopy efficiency using leaf area index in Thompson Seedless vines. *Acta Horticulturae*. **785:** 389-391.

37. Somkuwar R. G. and Ramteke S. D. 2007. Fruitfulness in relation to bud position in Tas-A-Ganesh grapes grafted on Dogridge rootstock. *The Asian J. Hort*. **2:** 87-88.

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39. Somkuwar R.G. and Ramteke S.D. 2007. Wedge grafting compatibility in different grape varieties raised on Dogridge rootstock. Ann. Plant Physiol. 20:22-25.

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43. Somkuwar R. G., Satisha J. and Ramteke S. D. 2007. Standardization of stock scion age for propagation through grafting in Thompson Seedless grapes. *J. Maharashtra Agril. Univ.*, **32(3):** 349-351.

44. Somkuwar R. G., Satisha J., Ramteke S. D. and Sharma J. 2008. Effect of rootstocks and preharvest treatments on storage life of Thompson Seedless grapes. *Acta Horticulturae*. **785:** 411-445.

45. Somkuwar R. G., Satisha J., Sharma J. and Ramteke S. D. Partitioning of dry matter and nutrient uptake in Thompson Seedless grafted on different rootstocks. *Acta Horticulturae*. **785:** 117-120.

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47. Srivastava K. K., Sharma A. K. and Das B. 2007. Genetic variability, heritability and genetic advance relating to physico-chemical properties of apricot. *Haryana Journal of Horticultural Sciences*. **35:** 41-42.

48. Tamhankar S. A., Argade N. C., More M. N., Dhanorkar V. M., Patil S. G., Rao V. S., Karibasappa G. S., Agrawal D. C. 2008. DNA Profiling of the grape varieties grown in India using ISSR markers. *Acta Horticulturae*. **785:** 147-152.

49. Upadhyay Anuradha, Deokar, K. P., Reddy Suvarna, Sawant Indu S., Kshirsagar M. D., Saboji M. D., G. S. Karibasappa. 2008. Identification of microsatellite markers associated with downy mildew resistance in grape- An example of association mapping in perennial crops. *Acta Horticulturae*. **785:**153-158.

Papers Presented at Symposia / Workshops / Meetings

1. Dr. R. G. Somkuwar presented a paper entitled 'Growth and yield performance of Thompson Seedless grapes grafted on different rootstocks in relation to root behaviour' at National Seminar on 'Livelihood Security through Rainwater Harvesting' jointly organized by Vasantrao Naik Krishi Pratishthan, Pusad and Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola at College of Agriculture, Nagpur on 22nd - 23rd October 2008..

2. Dr. N. S. Kulkarni presented a paper on "Management of two spotted spider mite *Tetranychus urticae* by Abamectin 1.9% EC in exportable grapes from Maharashtra" in 'National Symposium on Acarology' at UAS, GKVK, Bangalore on 23rd to 25th November 2007.

3. Paper accepted for oral presentation on 'Soil drenching of two formulations of imidacloprid (confidor 200 SL and admire 70 WG) for the management of mealybugs in exportable grapes in Maharashtra' at International Symposium on Agrochemicals Protecting Plant Health and Environment at IARI from 8-11th January, 2008.

4. Dr. S. D. Ramteke presented a paper at National Seminar on 'In the role of care-takers of Biosphere' and participated in discussion on 'photosynthesis and biochemical analysis' organized at Vidya Pratishthan, Baramati during 14-16th February 2008.

5. Dr. Indu S. Sawant presented a paper on 'Tools and machinery available for grapes and the current needs of the grape industry' in an interactive meeting on "Tools and machinery for development of horticulture" convened by ICAR at Central Institute of Subtropical Horticulture, Lucknow on 18th January 2008.

Technical Bulletins

1. Somkuwar R. G. 2008. Training and pruning in grapes. Technical Bulletin No.9.

Extension Bulletin

1. Package of practices for the management of major diseases and insect pests on grape in double pruning single cropping system. 2007. Dr. S. D. Sawant, Dr. Indu S. Sawant, Dr. N.S . Kulkarni, and Dr. M. Mani. Extension Bulletin No. 1.

Technical / Extension Folders

2. Somkuwar R. G. and Satisha J. 2007. Angur ki Baagh Ki Sthapana - Ek Margadharshika (In Hindi). Technical Folder No.10. NRC Grapes, Pune

3. Mani M., Kulkarni N. S. and Banerjee K. 2007. Management of mealybugs on grapes. Extension Folder No. 11.

4. Mani M., Kulkarni N. S. and Banerjee K. 2007. Management of mealybugs on grapes (In Marathi). Extension Folder No. 12.

5. Kulkarni N. S., Mani M, Banerjee K. 2008. Management of thrips on grapes. Extension Folder No.13.

6. Mani M, Kulkarni N. S, Banerjee K. and Adsule P. G. 2008. द्राक्षावरील फुलकिड्यांचे (थ्रीप्स) एकात्मिक नियंत्रण, Extension Folder No.14.

7. Kulkarni N. S., Mani M, Banerjee K. 2008. Management of mites on grapes. Extension Folder No.15.

8. Mani M, Kulkarni N. S., Banerjee K and Adsule P. G. 2008. द्राक्षबागेतील लाल कोळीचे (माइटस्) नियंत्रण, Extension Folder No.16.

Other Publications

1. Adsule P. G., Upadhyay Anuradha, Sawant Indu S. and Satisha J. Vision 2025. National Research Centre for Grapes, Pune.

2. Adsule P. G., Satisha J., Upadhyay Anuradha and Sawant Indu S., XI Plan EFC Document. NRC for Grapes, Pune.

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

Quinquennial Review Team Meeting

Following are the members of QRT (2002-2007) :

Dr. S. S. Kadam, VC, MAU, Parbhani	Chairman
Dr. Y. R. Chanana, Scientists Emeritus, PAU, Ludhiana	Member
Dr. K. R. Koundal, Jt. Director (Research), IARI, New Delhi	Member
Dr. S. J. Singh, Ex-Head, IARI Regional Station, Pune	Member
Dr. N. P. Agnihotri, Ex-Head, Div. of Agril. Chemicals, IARI, New Delhi	Member
Mr. S. G. Chougule, Chairman, Champagne Indage Ltd., Mumbai	Member
Dr. G. S. Karibasappa, Pr. Scientist, NRC for Grapes, Pune	Secretary

QRT discussion with scientists

QRT visit to winery

The first meeting of the QRT (2002-2007) of the Institute was held at ICAR headquarters on 25th May 2007. Second meeting was held at NRC for Grapes Pune during 6-8th July 2007 under the Chairmanship of Dr. S. S. Kadam, Vice-Chancellor, Marathwada Agricultural University, Parbhani, Maharashtra. The final meeting of the QRT was convened on 3rd - 4th December 2007 under the Chairmanship of Dr. S. S. Kadam for finalization of report. The QRT interacted with the IMC, IJSC and all the staff of the Centre and finalized the report for submission to the Director General, ICAR, New Delhi.

Research Advisory Committee (RAC) Meeting

Following are the members of RAC :

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

The 10th meeting of the Research Advisory Committee was held on 29-30th March 2008 under the Chairmanship of Dr. K. L. Chadha, Ex Dy. Director General (Hort.), ICAR, New Delhi. The Chairman and members reviewed the action taken report on 9th RAC and progress report of ongoing projects and suggestions were offered for further improvement.


RAC discussion with packhouse officials

Institute Research Committee (IRC) Meeting

Institute Research Committee meeting was held on 2nd - 3rd July 2007 under the chairmanship of Dr. P. G. Adsule, Director to review the progress made during the year 2006-07 and to discuss the technical programme for the year 2007-08.

A 12th mid-term IRC meeting was held during 22nd - 24th January 2008 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 QRT, IRC and RAC was presented by the project leaders and deliberated by the members. New project proposals were also presented and deliberated in the meeting.

Institute Management Committee (IMC) Meeting

Following are the members of IMC :

Director, NRC for Grapes, Pune	Chairman
The Director , Horticulture Commissionerate of Agriculture, Pune	Member
The Commissioner of Horticulture, Andhra Pradesh, Hyderabad	Member
The Associate Director of Research, NARP Plain Zone, RFRS, Pune	Member
Mr. Mahendra Shahir, Bhawani Peth, Solapur	Member
Mr. Ashok Vishnu Gaikwad, N.D. Wines Private Limited, Distt. Nasik	Member
Dr. V.S.R.K. Prasad, Pr. Scientist, NRC for Onion & Garlic, Pune	Member
Dr. Pious Thomas, Sr. Scientist, IIHR, Bangalore	Member
Dr. M. Mani, Pr. Scientist, NRC for Grapes, Pune	Member
Dr. Indu S. Sawant, Pr. Scientist, NRC for Grapes, Pune	Member
Finance & Accounts Officer, CIRCOT, Mumbai	Member
Mr. O. Babu, Assistant Admin. Officer, NRC for Grapes, Pune	Member Secretary

The Institute Management Committee meetings were held on 4th October 2007 and 27th February 2008 under the Chairmanship of Dr. P. G. Adsule, Director.

All the agenda items were discussed and recommendations of the Committee were submitted to the Council for approval.

IMC meeting going on

Meeting of wine grape growers and wine makers of India

A meeting was convened at NRC for Grapes on 14th June 2007 by inviting all the wine grape growers and wine makers of the country. Production of high quality wines and standardization of wine grape growing and wine making and quality standards of wine grape growing and wine making were some of the issues discussed. Apart from NRC Grapes staff, 33 grape growers and wine makers attended the meeting.

Meeting of grape growers and raisin makers of India

A meeting was convened at NRC for Grapes on 30th June 2007 by inviting all the raisin grape growers and raisin makers of the country. The issues discussed in the meeting were: the existing technologies followed by grape growers for growing raisin grapes and subsequent drying, packing and storage and the new protocols to be developed for washing of raisins after drying, technology for best storage and packaging of raisins, effect of various factors particularly ripping, use of various rootstocks, new varieties, distance between plant to plant and row to row etc. Apart from NRC Grapes scientists, 112 grape growers and raisin manufacturers attended the meeting.

Discussion with grape growers and raisin makers

Distribution of planting material under MTA

During the year, planting material of different table, wine, juice, raisin and rootstock varieties from the germplasm block was given to the farmers representing Maharashtra, Karnataka, Gujarat and Rajasthan as well as State Department of Horticulture, Maharashtra, PAU (Ludhiana), MPUAT (Udaipur), ARI, Pune, IARI, New Delhi and IIHR, Bangalore. Fourteen rootstock varieties, 21 table/raisin varieties, 15 wine varieties and 2 juice varieties were distributed.

During the year foundation planting material was distributed to 28 progressive farmers involving 22 table and wine and 6 rootstock varieties under material transfer agreement.

Approved On-going Institute Projects

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 scientist	Seminars / Symposia / Conferences	Duration	Organized by and place
Dr. P. G Adsule, Dr. Indu S. Sawant and Dr. J. Sharma	Horticulture Summit 2007	16-19th June 2007	Confederation of Indian Horticulture, Lucknow
Dr. P. G. Adsule	ICAR Directors' Conference	16-18th July 2007	ICAR at Krishi Bhavan, New Delhi
Dr. J. Satisha	National Seminar on Horticultural Biotechnology	8th December 2007	IIHR, Bangalore and IISR, Calicut at Bangalore
Dr. S. D. Ramteke	National Seminar on Plant Physiology	29th November - 1st December 2007	Konkan Krishi Vidyapeeth, Dapoli
Dr. R. G. Somkuwar	Symposia on MAHAWINES	11-13th January 2008	Wine Confederation, Nasik
Dr. P. G. Adsule, Dr. K. Banerjee, Dr. A. K. Sharma and Dr. J. Satisha	Seminar on Wine	23rd October 2007	ADEPTA, Pune
Dr. N. S. Kulkarni	National Symposium Acarology	23rd - 25th November, 2007	University of Agricultural Sciences, Bangalore

Workshops / Meetings

Name of the scientists	Workshops / Meetings	Duration	Organized by and place
Dr. R.G. Somkuwar	A meeting of Review Committee under the 'Mega seed project of planting material'	29-30th June 2007	Central Institute of Subtropical Horticulture, Lucknow
Dr. Anuradha Upadhyay	Second review meeting of 'Network project on molecular breeding'	20th July 2007	National Bureau of Plant Genetic Resources, New Delhi
Dr. J. Satisha	Workshop on 'Rejuvenation of horticulture and planting material'	21st September 2007	Lalbagh, Bangalore
Dr. P. G. Adsule and Dr. R. G. Somkuwar	Meeting on 'Preparation of handbook on seed and planting material for horticultural crops and labels to be prepared'	11-12th March 2008	Central Institute of Subtropical Horticulture, Lucknow
Dr. Indu S. Sawant	Interactive meeting on 'Tools and machinery for development of horticulture'	18th January 2008	Central Institute of Subtropical Horticulture, Lucknow

Distinguished Visitors

- Dr. V. M. Mayande, Vice-Chancellor, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola visited the Centre on 22nd October 2007 to appraise himself about the activities of the Centre and expressed his happiness at the direction and progress of research.
- Dr. R. C. Maheswari, Vice-Chancellor, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujrat visited the Centre on 12th September 2007.
- Mr. Davor Pisk, Asia Pacific Head; Mr. Prakash Apte, India Managing Director and Mrs. Aruna Bhinge, Business Head of M/s. Syngenta India Ltd. visited NRC Grapes on 18th October 2007 at 2.00 p.m. to discuss and seek the views on the future of India's grape industry and to share Syngenta's initiatives in this area.
- Mr. Dominique from Bayer CropScience Ltd. visited NRC Grapes on 17th January 2008 and held discussions with the Director and Scientists of the Centre regarding pesticide use in grapes.
- A delegation of Italian Government Officers visited NRC Grapes on 24th January 2008 in view of seeking possibility of executing joint venture with the Government Institutions related with wine industry.
- A French delegation under ADEPTA led by Mr. Rohit Pandhare visited the Centre on 22nd October 2007.
- Dr. Bala Deshmukh, Research Leader, The Dow Chemical Company, Midland, MI 48669 visited the Centre on 11th December 2007.
- Mr. Pradeep Lodha, Tanzania Plantations Ltd., Tanzania visited the Centre on 26th February 2008.

Research and Management Personnel

DIRECTOR
Dr. P. G. Adsule

CROP IMPROVEMENT
Dr. G. S. Karibasappa, Principal Scientist (Horticulture)
Dr. Anuradha Upadhyay, Sr. Scientist (Biotechnology)

CROP PRODUCTION
Dr. R. G. Somkuwar, Senior Scientist (Horticulture)
Dr. A. K. Upadhyay, Senior Scientist (Soil Science)
Dr. S. D. Ramteke, Senior Scientist (Plant Physiology)
Dr. J. Sharma, Senior Scientist (Soil Science)
Dr. J. Satisha, Senior Scientist (Horticulture)

CROP PROTECTION

Dr. M. Mani, Principal Scientist (Entomology)
Dr. Indu. S. Sawant, Principal Scientist (Plant Pathology)
Dr. S. D. Sawant, Principal Scientist (Plant Pathology)
Dr. K. Banerjee, Senior Scientist (Agricultural Chemistry)
Dr. N. S. Kulkarni, Scientist Senior Scale (Entomology)

POST-HARVEST TECHNOLOGY

Dr. A. K. Sharma, Senior Scientist (Horticulture)

ARIS

Mrs. Kavita Y. Mundankar, Scientist Senior Scale (Computer Applications)

ADMINISTRATION & FINANCE

Mr. O. Babu, Assistant Administrative Officer
Mr. A. Srinivasamurthy, Assistant Finance and Accounts Officer

Infrastructure Development

Laboratory

During the period, equipments viz.; PSYPRO 8 channel water system, C-52 Sf sample chambers with surefast connectors, PST 55-30-SP soil hygrometer / psychorometer, grafting machine, laboratory oven (Hot air oven), incubators, deep freezer, pH meter, electronic balance were procured and commissioned in various laboratories of the Institute.

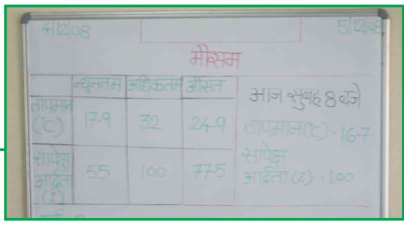
Library

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

Sl. No.	Item	Gift	Purchased	Total
1.	Books	16	5	21
2.	Scientific journals	–	58	58

New Structures

1. Raisin shed
2. Polyhouse/net house for the nursery
3. Initiation of water lifting system from nearby canal for the experimental vineyard
4. Training systems for the wine grape plantation



हिन्दी पखवाड़ा और हिन्दी कार्यशाला

केन्द्र में 14 से 29 सितम्बर तक हिन्दी पखवाड़ा मनाया गया। कार्यक्रम का शुभारम्भ दि. 14 सितम्बर को हिन्दी में अधिकाधिक काम करने की शपथ ले के हुआ। इस दौरान हिन्दी निबंध, कविता पाठ, कंप्युटर पर हिन्दी टंकण, वाद विवाद, प्रश्नोत्तरी, सुलेख व पत्र लेखन आदि प्रतियोगिताओं का आयोजन किया गया जिनमें सभी अधिकारियों और कर्मचारियों ने उत्साह पूर्वक भाग लिया। कार्यक्रम के समापन दिवस 29 सितंबर पर श्री. आर. पी. वर्मा, सहायक निदेशक, हिन्दी शिक्षण योजना, पुणे मुख्य अतिथी थे। उसी दिन हिन्दी कार्यशाला का भी आयोजन किया गया। जिसमें श्री. आर. पी. वर्मा ने हिन्दी में कार्य के लिए विकसित हुए नये सोफ्टवेयर की जानकारी दी।

पत्रव्यवहार

केन्द्र में प्राप्त हिन्दी पत्रों का उत्तर केवल हिन्दी में ही दिया जाता है। साथ ही कुछ पत्रों के उत्तर द्विभाषी भी होते हैं। इस वर्ष केन्द्र से 941 पत्र हिन्दी में प्रेषित किए गए।

हिन्दी पट्टिका

केन्द्र के प्रवेश कक्ष में एक पट्टिका 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 लिखी जाती है।

तिमाही प्रतिवेदन तथा बैठक

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

प्रकाशन

केन्द्र के निदेशक डॉ. पी. जी. अडसुले ने हिन्दी में 'अंगूर की खेती' पुस्तक लिखी जिसका प्रकाशन विस्तार निदेशालय, कृषि एवं सहकारिता विभाग, कृषि मंत्रालय, भारत सरकार द्वारा किया गया।

Implementation of NABL Accreditation for the Institute

Quality system as per the guidelines of the ISO/IEC 17025 is being implemented to streamline all the activities of the laboratories of this institute to the international regulations. A one-day awareness program was organised on 26th June for all the staff followed by a 3-day workshop during 2nd - 4th July where all the clauses of the ISO guidelines were deliberated in details

Celebrations

Institute Day

The Centre celebrated its 11th Institute Day on 18th January 2008.

Independence Day

Dr. P. G. Adsule, Director hoisted the national flag on the occasion of Independence Day on 15th August 2007. In his address, he urged all the staff to work hard for upliftment of the farmers. The children of the staff members who obtained first class or distinction in SSC or HSC examination were felicitated by offering cash prizes.

Vigilance Week

Vigilance Week was observed from 12-16th November 2007 with the address by the Director to the staff on the first day.

Republic Day

The Centre celebrated Republic Day on 26th January 2008 with joy and splendour. Dr. P. G. Adsule, Director, hoisted the flag. In his address, he called upon the staff to work towards betterment of the society in general and farming community in particular.

Institute Committees

Various units and committees were formed to look after Research Management & Coordination, Technical Cell, Publication, Sotre Purchase, Farm Management, Library, Works, Photography, Sports activities, ARIS Cell, IRGS 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 2007	18.90	39.27	17.67	83.27	6.85	11.68	2.60	3	0
May 2007	22.91	36.85	32.48	88.52	7.19	12.34	11.20	6	1
Jun 2007	22.43	33.21	64.50	99.63	2.29	11.30	184.00	23	10
Jul 2007	22.02	30.03	76.06	99.87	2.32	11.55	107.60	19	5
Aug 2007	21.29	29.59	79.03	99.97	1.46	11.21	78.40	28	5
Sep 2007	20.89	30.98	70.17	100.00	2.16	10.88	90.60	16	4
Oct 2007	17.13	32.39	35.74	97.29	3.93	10.90	1.60	4	0
Nov 2007	13.36	30.38	38.37	99.83	3.14	10.46	13.40	11	1
Dec 2007	11.63	29.78	44.16	99.58	2.90	9.57	2.20	9	0
Jan 2008	8.49	29.71	34.45	99.61	2.85	9.91	1.80	4	0
Feb 2008	9.71	31.59	31.10	95.52	3.84	10.46	1.20	3	0
Mar 2008	15.05	35.89	26.29	89.61	4.47	10.85	17.40	8	2
Total	–	–	–	–	–	131.11	512.00	134	28

Source : Weather station, NRC for Grapes, Pune

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NRCG

राष्ट्रीय अंगूर अनुसंधान केंद्र

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