Annual Report
2008-09

Directorate of Onion and Garlic Research

Vision

To become number one in production, productivity, export and add on value to the excess production.

Mission

Harness the national resources to increase the production of onion and garlic and identify the strategies for sustainable and eco-friendly practices to enhance profitability and welfare of the farming community.

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2008-09

Directorate of Onion and Garlic Research
Indian Council of Agricultural Research
Rajgurunagar - 410 505, Dist. Pune, Maharashtra

Annual Report 2008-09

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कार्यकारी सारांश

इस वर्ष केन्द्र द्वारा प्याज की किस्म (भीमा रेड) एवं लहसुन की किस्म (भीमा ओंकार) राष्ट्रीय स्तर पर जारी की गई है। किसान मेला एवं राष्ट्रीय संगोष्ठी जनवरी माह मे आयोजित किया गया था, जिसमे किसानो का मुख्य आकर्षण प्याज एवं लहसुन की नवीनतम तकनीकी की जानकारी, विभीन्न किस्मों तथा उनके बीज की उपलब्धता के बारे मे था। केन्द्र की दस वर्षो की उपलब्धिया तथा फसल के महत्व के आधार पर एन.आर.सी. को प्याज एवं लहसुन अनुसंधान निदेशालय के रुप मे पदोन्नत किया गया है, जिसमे केन्द्र के अलावा देश के विभिन्न राज्य के कृषी विश्वविद्यालय/आय.सी.ए.आर. के संस्थानो मे 12 अतिरिक्त नेटवर्क केन्द्रो का समावेश किया गया है। यह अतिरिक्त केन्द्र, निदेशालय द्वारा विकसीत तकनीको का विभिन्न जलवायु मे मुल्यांकन करने तथा स्थानीय आवश्यकता के अनुसार उसमे बदलाव हेतु सुविधा प्रदान करेगा। इन सब व्यवस्था एवं सुविधाओ के बाद सही अर्थो में यह केन्द्र एक राष्ट्रीय स्तर का हो गया है। प्याज एवं लहसुन अखिल भारतीय नेटवर्क परियोजना का उद्घाटन XXVIII ए.आय.सी.आर.पी. (व्ही.सी.) की तमिलनाडू कृषी विश्वविद्यालय, कोइंबतुर मे आयोजित कार्यशाला में डॉ. एच.पी.सिंग, उपमहानिदेशक (बागवानी) के करकमलों द्वारा किया गया।

फसल सुधार परियोजना के अंतर्गत, लाल एवं सफेद रंग के प्याज के जनन द्रव्य का, अधिक उत्पादन देने वाली किस्मो के विकास हेतु मुल्यांकन किया गया। लाल रंग के प्याज मे कुछ जनन द्रव्य खरीफ मौसम (704,1093) तथा कुछ रबी मौसम मे (ई.वी.1043, 545) अधिक उत्पादन देने की दृष्टी से चुने गए। कुछ किस्मो की भंडारण क्षमता भी अच्छी पाई गई, जैसे सुखसागर, 733, 926, 711 तथा भीमा सुपर। प्रक्षेत्र प्रदर्शन प्रयोगों मे एन.आर.सि.ओ.जी. –1156 तथा एन.आर.सि.ओ.जी. –1168 अधिक उत्पादन देने वाली किस्मे पाई गई। इनमे विक्रियोग्य प्याज का अनुपात बढाने की गुंजाईश है। भंडारण प्रयोगों मे 4 किस्मो (इ.एल.–546, इ.एल –571, ई.एल –592, इ.एल –597) पछेती खरीफ के लिए, 2 इलाइट लाइन (एन.र.सि.ओ.जी.–1168 एवं एन.आर.सि.ओ.जी.–1156) पछेती खरीफ एवं 3 लाइन (एन.आर.सि.ओ.जी.–595, एन.आर.सि.ओ.जी.–597 तथा एन.आर.सि.ओ.जी.–1133) रबी मौसम मे अधिक भंडारण क्षमता युक्त पाई गई। संकर और प्रजनन प्रयोगों मे विदेशी संकर किस्मे भारतीय किस्मो की तुलना मे अच्छी नही पायी गयी, अपितु केन्द्र द्वारा विकसीत चार संकर किस्मे अच्छी पाई गई है।

सफेद प्याज के फसल सुधार प्रयोगों मे सात लाइन खरीफ मे, चार लाईन पछेती खरीफ तथा सतराह लाइन रबी मौसम मे अधिक उत्पादन देने वाली पाई गई। सफेद् प्याज मे अधिक संपुर्ण घुलनशील ठोस युक्त किस्मो का विकास प्राथमिकता है तथा इस दिशा मे 18^{0} ब्रिक्स संपुर्ण घुलनशील ठोस से अधिक कुछ लाइनों मे देखा गया है जो कि प्रसंस्करण उद्योग के लिए एक वरदान साबीत होगा। निर्यात की दृष्टी से पीले रंग की प्याज की किस्मो का विकास प्रगती पर है तथा इस दिशा मे कुछ उपयुक्त लाइनो को चुना गया है। ए.आय.सी.आर.पी. प्रयोगो मे एन.आर.सी.डब्ल्यु.ओ.–2 प्रारंभिक किस्म मुल्यांकन (आय. ई. टी.) प्रयोगो मे, लाइन 355 एडवांस किस्म मुल्यांकन प्रयोग (ए.व्ही.टी.–I) एवं आर.एच.आर–ओ.एस.–1 एडवांस किस्म मुल्यांकन प्रयोग (ए.व्ही.टी.–II) में प्रथम क्रमांक पर पाई गई।

लहसून के अंतर्गत, आठ लाइने ताइवान से, 40 लाइने जर्मनी से, 199 लाइने यु.एस.ए. से तथा 10 लाइने पश्चिम बंगाल से लाई गई। सुधारी हुई (इलाइट) लाइनो मे तेरह लाइन वर्तमान किस्मो की तुलना मे अच्छी पाई गई। प्रक्षेत्र मे 850 जननद्रव्य(लाइनों)का रख रखाव किया गया है। ए.आय.सी.आर.पी. प्रयोगों मे लाइन व्ही.जी.पी.–5 (आय.ई. टी.) तथा जी–189 (आय. ई. टी.) सर्वोत्तम पाई गई, उसके बाद एन.आर.सी.जी.–1 उपयुक्त पाई गई। इसी प्रकार ए.व्ही. टी. II– प्रयोगो मे जे.एन. डी. जी. 213 तथा ए. सी. 200 उपयुक्त पाई गई।

जैव प्रैद्योगिकी प्रयोगों मे लहसुन मे सोमाक्लोनल विविधता एवं विषाणु मुक्त लहसुन के विकास के लिए विभिन्न संयोग चुने गए। लहसुन मे अनुवंशिक विविधता जानने हेतु माईक्रो सेटेलाईट मार्कर के सहयोग से आण्विक स्तर पर विश्लेषन किया तथा कुछ मार्कर जिनमे पॉलीमार्फिजम (विविधता) पाई गई, चुना गया। प्याज मे, अधिक संपूर्ण घुलनशील ठोस तथा नर वंध्यत्व लाइनो मे हेप्लोइड (एक गुणता) निर्माण करने के लिए प्रयोग किए गए। द्विगुणन तकनीक का निर्धारन तथा पार्थेनोजेनेसिस द्वारा विकसित पौधों मे प्लाईडी स्तर निर्धारित करने के लिए अध्ययन जारी है। प्याज मे विभिन्न किस्मो मे सूक्ष्म प्रवर्धन तथा डि.एन.ए. प्रोफाइलिंग किया गया। स्थानिय जंगली प्रजातीयो की उत्पत्ती की जानकारी हासिल करने के लिए इन्टरनल ट्रान्सस्क्राइब स्पेसर्स (आय. टी. एस) तथा एक्सटरनल ट्रान्सस्क्राइब स्पेसर्स (ई. टी. एस.) की सहायता से प्रयोग आरंभ किए गए है।

फसल उत्पादन प्रयोगों मे प्याज मे एकिक्रत पोषण प्रबंधन तथा लहसुन मे पोषक तत्वो की आवश्यकता, कमी के लक्षण तथा पौधो द्वारा लिए जाने वाले तत्वो हेतु अध्ययन जारी है तथा अनुमान है कि अगले 2–3 वर्षों मे किसानो के लिए जारी की जाएगी। प्याज एवं लहसुन मे टपक सिंचाई प्रणाली पर कार्बनिक तथा अकार्बनिक (रासायनिक) पोषण तत्वो के संयुक्त प्रयोगों मे ऐसा पाया गया है की विभिन्न कार्बनिक खादोंका संयोग (गोबर की खाद 7 टन/हे., मुर्गी खाद 3.5 टन/हे. तथा वर्मिकम्पोस्ट 3.5 टन/हे.) एवं पानी मे घुलनशील रासायनिक उर्वरक जारी की गई मात्रा का 80% टपक सिंचाई प्रणाली द्वारा दिए जाने पर दोनो ही फसलो में बढवार उत्पादन एवं गुणवत्ता पर अच्छे प्रभाव देखे गए। कार्बनिक तथा अकार्बनिक पोषण प्रयोगों मे फसल के जैव रासायनिक घटको (संम्पुर्ण घुलनशील ठोस, पायरुविक अम्ल, संम्पुर्ण शर्करा तथा टाईट्रेबल अम्लता) मे कोई भी अंतर नही पाया गया। पछेती खरिफ एवं रबी मौसम के प्रयोगों मे प्याज एवं लहसुन की फसल मे विक्री योग्य कंद कार्बनिक संयोग की तुलना मे जारी किए हुए अकार्बनिक रसायनिक उर्वरको में अधिक पाए गए। भंडारण क्षमता एवं गुणवत्ता पैमानो पर भी इन दोनो फसलों में कोई अंतर नही पाया गया। खरपतवार प्रबंधन प्रयोगों में पाया गाया कि प्याज एवं लहसुन मे विभिन्न प्रकार के खरपतवार, उनकी सघनता तथा फसल एवं खरपतवार मे प्रतीस्पर्धा अवधी के अनुसार कंद उत्पादन मे 12 से 94.8 प्रतिशत तक नुकसान होता पाया गया। संपूर्ण अवधी मे प्याज मे खरपतवार से प्रतीस्पर्धा के कारण उत्पादन मे 71.2% जबकी लहसुन मे 94.8% कमी होती पाई गई और लहसुन फसल प्याज की तुलना मे खरपतवार के प्रती अधिक संवेदनशील है। एकदलीय एवं द्विदलीय खरपतवार नियंत्रण के लिए ऑक्सीफ्लोरोफेन 0.15 कि. ग्रा. सक्रीय तत्व जमीन मे रोपाई के तीन दिन बाद दिए जाने पर अधिक लाभदायक पाया गया। घुलनशील नत्र: स्फुरद: पालाश 19:09:19 के तीन छिडकाव किए जाने से प्याज मे विक्री योग्य उत्पादन अधिक प्राप्त हुआ। बीजोत्पाद प्रयोगों मे सामान्य सिंचाई विधि के तुलना मे टपक सिंचाई विधि मे 27 से 45% पानी की बचत हुई।

पौंध संस्करण प्रयोगोमें स्टेमफिलियम , अल्टरनेरिया और इमलेशिया को पृथक करने मे सफलता मिली। इनमे से 30 आयसोलेट एक बीजाणु मुक्त है। स्टेमफिलियम कवक के 210 आयसोलेटका आण्विक स्तर पर अध्ययन मे इन्हें दो समूहों मे पाया गया , जिसमें समूह –1 अधिक विविधता लिए हुए था तथा दक्षिणी अमेरिका संदर्भ के समान था जबकी समूह –2 अमेरिका संदर्भ आयसोलेटके समान था एवं महाराष्ट्र और गुजरात समूह अधिक विविधता लिए पाया गया। मृदा एवं वायु जनित रोगों के प्रती रोगरोधिता गुणों के लिए जंगली एवं खेती योग्य विभिन्न प्रजतियों के चयन हेतु अध्ययन में एलियम फिस्टुलोसम, ए. अलटाइकम, ए. एम्पिलोप्रासम , ए. ट्युबरोसम, ए. फिस्टुलोसम X ए.सेपा (एफ –1) प्रजातिया स्टेमफिलियम , अल्टरनेरिया , फ्युजेरियम और पाइरेनोकिटा रोगों के प्रति पूर्ण रुप से रोग मुक्त पाए गए। प्याज के विभिन्न लाइनोमे ए.एल.ए.ल. 1587 लाइन में स्टेमफिलियम तथा अल्टरनेरिया का बहुत कम प्रभाव देखा गया। फ्युजेरियम आधारीय सडन तथा गुलाबी जड रोग (पिंक रूट) के पृथक्करण, चयन एवं रख रखाव के लिए तकनिकी का मानकीकरण किया गया। आयरिश पीला धब्बा (आय.वाय.एस.) रोग मे थ्रिप्स की भूमिका का प्रारंभिक अध्ययन किया गया।

प्याज पर थ्रिप्स का विभिन्न दिनांक के रोपाई में सार्थक प्रभाव देखा गया। पिछले वर्षो के तुलना मे इस वर्ष थ्रिप्स के प्रभाव मे बहुत अधिक विविधता पाई गई। थ्रिप्स कि संख्या (प्रभाव) के दो मुख्य शिखर पहला अगस्त माह में एवं दुसरा दिसंबर माह मे पाए गए। पिछलें नौ वर्षो मे एसा पहली बार हुआ है जब थ्रिप्स का प्रभत्व फरवरी के बजाय दिसंबर माह में अधिक हुआ है। लहसुन फसल मे भी थ्रिप्स की संख्या नवंबर और दिसंबर मे अधिक पाई गई। हालाकी उनकी संख्या अक्तूबर से मार्च के दौरान 30 प्रति पौंधोंसे अधिक नही बढी।

लहसुण फसल मे थ्रिप्स प्रबंधन हेतु बाढ.फसल के रूप में मक्का–गेंहू की बाढ, दो कतार वालें मक्के के बाढ के तुलना मे अधिक लाभदायक सिद्ध हुई। थ्रिप्स संख्या को नियंत्रण करने मे या कम करने मे 2% खनिजतेल का छिडकाव प्रभावी रहा। नए कीटनाशकों के प्रयोगे मे फिप्रोनिल का छिडकाव 10 दिन के अंतर पर अधिक प्रभावशाली रहा। लहसुन के विभिन्न जननद्रव्य के थ्रिप्स के लिए प्रतिरोधी लाइनो का चुनाव हेतु किए गए प्रयोगोंमे दो लाइनों (डब्ल्यु 119 तथा डब्ल्यु 97) मे सबसे कम थ्रिप्स पाए गए तथा मुल्यांकन मे उनका दर्जा क्रमश: 2 एवं 2.5 रहा। इसी प्रकार लहसुन की आठ उत्परिर्वतीत (म्युटेशन) लाइनोंमें थ्रिप्स के प्रति प्रतिरोधिता या मध्यम प्रतिरोधिता पाई गई जिसे अगले मौसम मे पुन: सुनिश्चित करना आवश्यक है। लहसुन कंदों के रंगों क थ्रिप्स के प्रतिरोधिता पर कोई सहसंबंध नही पाया गया।

अंत मे यह निष्कर्ष है कि प्याज एवं लहसुन में अधिक उत्पादन देने वाली एवं भंडारण मे अधिक टिकनेवाली आशाजनक लाइनों की पहचान की गई है। आण्विक स्तर पर चरित्रीकरण (केरेक्टराइझेशन) का कार्य प्रगती पर है। इसी प्रकार उत्पादन प्रयोंगो मे कुछ संयोग दोनो ही फसलों मे अधिक उत्पादन देते पाए गए। पर्ण रोग के लिए नए प्रतिरोधि स्तोत्र खोजे गए तथा स्टेमफिलियम कवक की विविधता जानने हेतु व्यापक विश्लेषण किया गया। थ्रिप्स के प्रंबधन मे खनिज तेल का उपयोग लाभदायक पाया गया जो कि जैविक कृषी उत्पदकों के लिए एक सुखद समचार है। साथ ही थ्रिप्स का उत्पात कम करने के लिए नए कीट नाशको की भी पहचान की गई।

Executive Summary

During the year under report, one variety of onion (Bhima Red) and one variety of garlic (Bhima Omkar) was released at the national level. *Kisan Mela* and National seminar was conducted in January and it was a major attraction to the farmers for learning about the latest techniques, varieties and seed availability in onion and garlic. Considering the achievements of NRC over the last 10 years and need for location specific research verification, the NRC has been upgraded as the Directorate of Onion and Garlic Research with 12 networking centres in 12 different states under SAUs/ICAR institutes. These centres will provide facilities for verification of technologies developed by the Directorate and also modification on local needs. With this arrangement, the centre has become truly national. The All India Network Project on Onion & Garlic Research was launched during XXVIII AICRP (VC) group meeting at TNAU, Coimbatore by Dr. H.P. Singh, DDG (H).

In crop improvement, evaluation of germplasm for identifying high yielding varieties were conducted in red and white onion. In red onion, some promising accessions in *kharif* (704, 1093) and *rabi* (EV 1043, 545) were identified for high yield. Some lines were found to be good storers viz., Sukhsagar, 733, 926, 711 and Bhima Super. In demonstration trials, NRCOG-1156 and NRCOG-1168 were high yielders and there is scope to improve share of marketable bulbs in red line. In storage trials, 4 lines (EL 546, EL-571, EL-592 and EL-597) of late *kharif*, 2 elite lines (NRCOG-1168 and NRCOG- 1156) in late *kharif* and 3 lines (NRCOG-595, NRCOG-597 and NRCOG-1133 OL) in *rabi* were found to be good storers. In heterosis breeding, none of the exotic hybrids were found to be superior than the open pollinated varieties whereas four hybrids, developed at our centre, were found superior than the checks.

In white onion, seven lines in *kharif*, four lines in late *kharif* and seventeen lines in *rabi* season proved to be high yielders. Development of high TSS lines in white onion is a priority and some lines having TSS higher than 18°B have been recorded which will prove to be a boon for the processing industry. Work on yellow onion for export is also underway and some of the promising lines have been identified. Under AICVIP trials, NRCWO-2 in initial evaluation trial (IET), line 355 in advance varietal trial (AVT-I) and line RHR-OS-1 in advanced varietal trial (AVT-II) were ranked first.

In garlic, eight lines from Taiwan, forty nine lines from Germany; 199 lines from USA and 10 lines from West Bengal were procured. In elite lines evaluation, thirteen accessions were found to be superior than the checks. A total of 850 accessions were maintained under field conditions. Under AICRP(VC) programme, line VGP-5 (IET), G-189 (IET) performed best followed by NRCRG-1 and line JNDG 213 performed superior closely followed by AC-200 in AVT-II trials.

In biotechnology, various combinations for inducing somaclonal variation in garlic and development of virus free garlic were identified. Molecular analysis of genetic diversity in garlic was tried using microsatellite markers and some

markers showing polymorphism were identified. In onion, work on induction of haploids in onion having high TSS and male sterile lines was carried out. Standardization of diploidisation protocol and ascertaining the ploidy level of plantlets obtained in the parthenogenesis studies is underway. Micropropagation and DNA profiling of the onion varieties was also achieved. Characterisation of wild species using internal transcribed spacers (ITS) and external transcribed spacer (ETS) was also initiated to study the phylogeny of our indigenous wild species.

In crop production, studies on integrated nutrient management for onion and nutrient requirement, deficiency symptoms and uptake study in garlic is going on and we expect results in next 2-3 years for recommendation to the farmers. Studies on combined effect of organic and inorganic nutrition in onion under drip irrigation system revealed that combined application of different organic manures (Farmyard manure - 7t/ha, poultry manure -3.5 t/ha and vermicompost - 3.5t/ha) along with 80 % recommended dose of water soluble fertilizers through drip fertigation improved the plant growth and yield characters in both the crops. No significant effect was observed on biochemical traits (TSS, Pyruvic acid, total sugar and titrable acidity) in organic versus inorganic application. Results from *late kharif* and *rabi* season revealed that higher marketable bulb yield of onion and garlic were noticed at recommended inorganic practices than organic package. With regards to storage life and quality parameters of onion and garlic, no significant difference were observed in total storage losses and quality of the bulbs in both the crops. Weed management trials revealed that yield losses in onion and garlic due to heavy weed competition were to the extent of 12 – 94.8 per cent depending upon types of weed flora, their intensity and duration of crop – weed competition. Weed competition during the whole crop cycle reduced bulb yield upto 71.2 % in onion and 94.8% in garlic and compared to onion, garlic is more sensitive to weed menace. Use of Oxyfluorfen @ 0.15kg a.i. at 3 days after planting as soil application was found most effective in reducing both dicot and monocot weeds. Application of water soluble NPK 19:09:19 at three sprays recorded higher marketable bulb yield in onion. In seed production, there was 27- 45% saving of water in drip irrigation over surface irrigation.

In crop protection trials, isolations of *Stemphylium*, *Alternaria* and *Emblesia* were obtained. Thirty isolates were single spored. Molecular characterization of 210 isolates of Stemphylium revealed two groups with Group I more diverse and similar to South American reference and Group II similar to American reference isolates and a diverse group from Maharashtra and Gujarat was found. In studies on screening of wild and cultivated genotypes against foliar and soil borne resistance, *Allium fistulosum*, *A.altaicum*, *A.ampeloprasum*, *A.tuberosum*, *A.fistulosum X A.cepa*(F1) were found to be completely free of either *Stemphylium*, *Alternaria*, *Fusarium* and *Pyraenochaeta* infection. Among onion lines, ALL 1587 recorded least incidence of both *Stemphylium* and *Alternaria*. Techniques for isolation, screening and maintenance of fusarium basal rot and pink root were also standardised. Preliminary studies on the role of thrips for spread of Iris Yellow Spot (IYS) in onion was also done.

Dates of planting had significant effect on thrips infestation in onion. Compared to previous years, thrips infestation was varied to large extent during present year. Two population peaks were observed in the months of August and December. In the last 9 years, this was the first time that thrips peak occurred in the month of December instead of February month. In case of garlic, thrips population reached to the peak in the month of November and December. However their number did not cross 30.0 /plant during any month from Oct- Mar. In barrier cropping for the thrips management in garlic, study suggested Maize Wheat barrier is more suitable as compared to 2M (2 Maize rows). Use of mineral oils along @2% at 10 days interval was effective in controlling thrips population. Among new insecticides studies, fipronil at 10 day interval was found significantly effective against thrips. Screening against thrips in garlic germplasm led to identification of two lines (WG 119; WG 97) with a lowest rating of 2.0 and 2.5 respectively. Eighteen mutant garlic lines were found resistant to moderately resistant but they need to be screened again for one more season to confirm the resistance. Bulb colour had no correlation to resistance to thrips in onion.

To conclude, a set of high yielding promising lines in onion and garlic with good storage potential have been identified. Work on molecular characterisation is underway and in production some of the combination giving good yield in both the crops has been observed. New sources for resistance to foliar diseases and comprehensive diversity analysis for *stemphylium* has been achieved. Mineral oils have been found to decrease the thrips infestation which is a welcome news for organic growers. Also some new insecticides have been identified for control of thrips menace.

Contents

INTRODUCTION

The Centre

The Indian Council of Agricultural Research (ICAR) established the National Research Centre for Onion and Garlic in the year 1994 and sanctioned the same during VIII plan with its headquarters at Nasik. Though the centre was initially located in Nasik, it was shifted to Rajgurunagar, 43 km away from Pune on Pune-Nasik highway and started functioning at the new location from June 1998. Till now 3 varieties of onion and one variety of garlic have been released by the Centre. Based upon the performance of the centre, ICAR has upgraded the centre from National Research Centre to the Directorate of Onion and Garlic Research in 2009. Now the centre has been officially renamed as Directorate of Onion & Garlic Research.

Location and Weather

The Centre is located at 18.32° N and 73.51° E at 553.8 m above m.s.l. with a temperature range of 5.5 °C - 42.0 °C having an annual average rainfall of 669 mm.

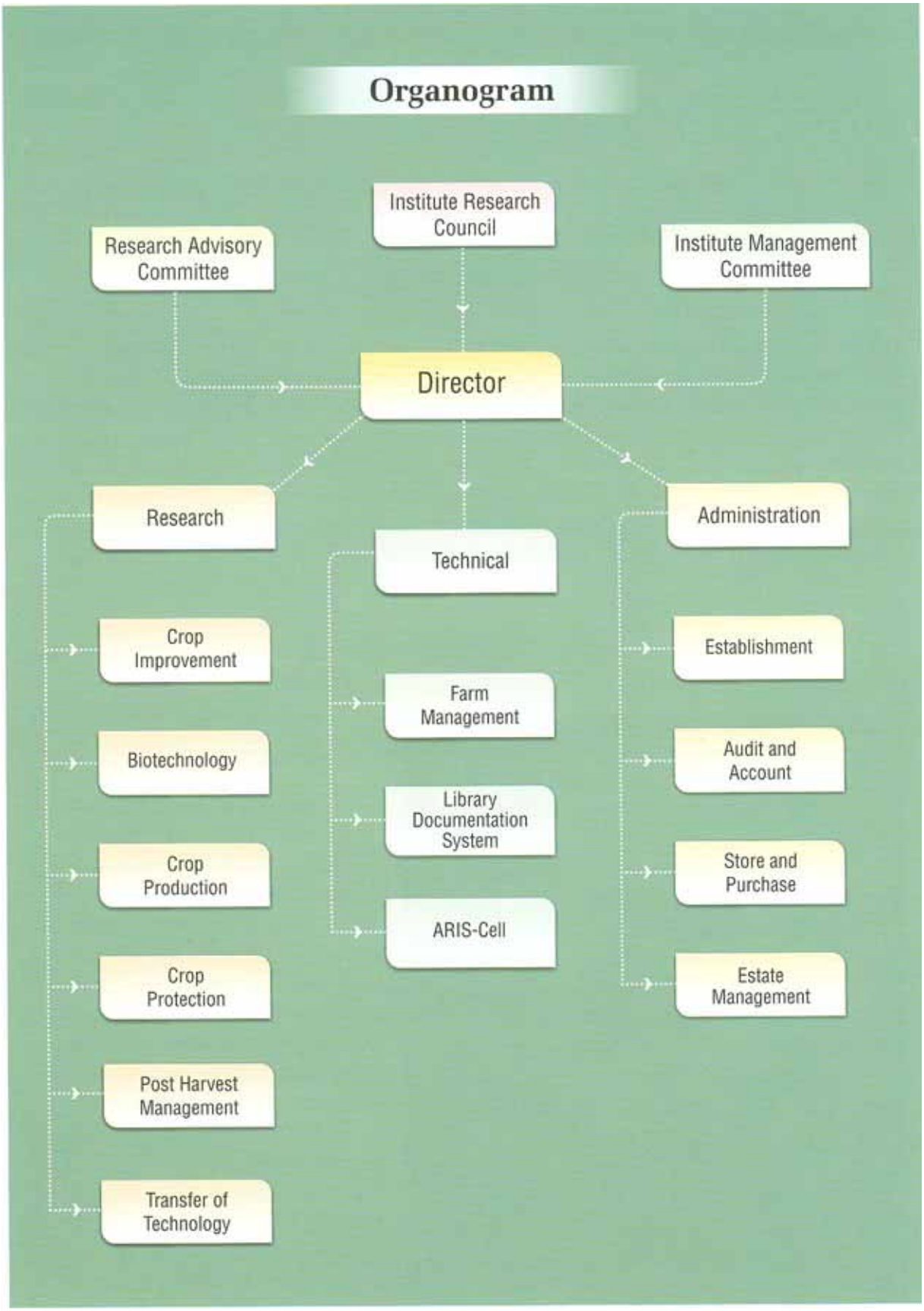
Mandate

- To collect, maintain and act as national repository for onion and garlic
- To develop varieties/hybrids suitable for domestic and export market coupled with resistance to biotic and abiotic stresses
- To enhance and sustain productivity and production of quality seed as well as bulb crop through agronomic innovations
- To develop integrated pest and disease management for high bulb and seed yield
- To develop technologies for post harvest handling of onion and garlic
- To act as a clearing-house for research and technical know-how related to onion and garlic
- To act as National Trainers Training Centre for technology dissemination of onion and garlic

Infrastructure

The Centre has 55 acres of research farm with perennial irrigation facilities at Rajgurunagar, 25 acres at Kalus and 10 acres at Manjri. The Centre has some major research laboratories for biotechnology, soil science, plant protection and post harvest technology with modern state of art equipments. The existing facilities for Internet and e-mail connectivity have been strengthened. The Institute library has 656 books, 12 national and 5 international journals, CD server, CD-ROMs of relevant literature on Alliums and other relevant facilities.

Organogram


Institute Research Council
Research Advisory Committee
Institute Management Committee
Director
Research
Technical
Administration
Crop Improvement
Biotechnology
Crop Production
Crop Protection
Post Harvest Management
Transfer of Technology
Farm Management
Library Documentation System
ARIS-Cell
Establishment
Audit and Account
Store and Purchase
Estate Management

RESEARCH ACHIEVEMENTS

Programme 1	Development of red and light red onion varieties/ hybrids suitable for different seasons having resistance to biotic and abiotic stresses
Project 1.1	Collection, evaluation and maintenance of red onion germplasm.

Evaluation of red onion germplasm during late *kharif* season 07-08

Twenty-five red onion germplasm lines were evaluated during late *kharif* in 1 sq. m area along with checks. Percentage A grade bulbs in the germplasm ranged from 0 to 51.4% with 0 to 53.0% double bulbs, 0 to 54.0% bolters and 20.2 to 100% marketable bulbs against the check variety Bhima Super which recorded 33.3% A grade bulbs, 0% double bulb and bolters and 92.1% marketable bulbs. Marketable yield and total yield varied from 1.0 to 25.0 t/ha and 3.1 to 27.5 t/ha, respectively in germplasm against check, which recorded 19.5 t/ha marketable yield and 21.2 t/ha total yield. Only two lines (704 and 1093) were found superior for marketable yield over check Bhima Super with 27.6% and 16.3% marketable yield superiority, respectively. Average bulb weight was maximum (up to 94.4 g) in R –Udaipur against check Bhima Super (41.9 g).

Evaluation of red onion germplasm during *rabi* season 07-08

Sixty-nine red onion germplasm were evaluated during *rabi* season in 1 sq. m plots with three replications along with three checks. Percentage A grade bulbs in the germplasm ranged from 6.5 to 56.0% with 0 to 38.2% double bulbs, 0 to 8.3% bolters and 54.2 to 100% marketable bulbs against the check N-2-4-1 which recorded 30.1% A grade bulbs, 7.8% double bulb, 0% bolters and 90.5% marketable bulbs. Marketable yield and total yield varied from 12.5 to 35.7 t/ha and 13.3 to 35.7 t/ha, respectively in germplasm against check N-2-4-1 which recorded 29.8 t/ha marketable yield and 32.8 t/ha total yield. Only one line (545) recorded significantly higher marketable yield (35.7 t/ha) than check N-2-4-1 (29.8 t/ha) with 19.6% marketable yield superiority. Average bulb weight was maximum up to 63.9 g (327) against check N-2-4-1 (56.0 g).

Evaluation of red onion germplasm during *kharif* season 08

Thirty-eight red onion germplasm were evaluated during *kharif* in 1 sq. m plot size along with check variety Bhima Super. Plant height ranged from 30.5 to 57.1 cm with 5.2 to 11.2 numbers of leaves and 5.5 to 13.2 mm

collar thickness in germplasm against check Bhima Super which recorded 54.8 cm plant height, 10.9 numbers of leaves and 13.2 mm collar thickness. Percentage marketable bulbs in the germplasm ranged from 30.9 to 92.8% against check Bhima Super which recorded 85.6% marketable bulbs. Marketable yield and total yield varied from 2.1 to 22.5 t/ha and 3.0 to 32.8 t/ha, respectively in germplasm against check which recorded 24.8 t/ha marketable yield and 29.0 t/ha total yield. None of the lines were found superior to check variety Bhima Super.

Performance of late *kharif* red germplasm under storage 07-08

Harvested bulbs of twenty two genotypes were kept in perforated crates and stored for 60 days in ventilated storage structure to study the post harvest performance of these genotypes. Perusal of results revealed that 5 genotypes viz. Sukhsagar, 733, 926, 711 and Bhima Super recorded less than 20% weight loss after 60 days of storage. However 5 genotypes viz. 970, 1095, R-437, R-172 and ADR recorded more than 50% weight loss after 60 days of storage.

Project 1.2 Development of onion varieties suitable for different seasons for year round availability

Evaluation of red onion elite lines during late *kharif* season 07-08

Thirteen red onion elite lines were evaluated in 1m x 4.5 m plot in two replications during late *kharif* season in flat beds along with check variety Bhima Super. Percent A grade bulbs, doubles, bolters and marketable bulbs were maximum up to 61.0%, 34.2%, 3.0% and 92.2%, respectively in these elite lines whereas it was 61.1%, 3.6%, 2.1%, and 91.7% in check variety Bhima Super. Marketable yield ranged from 8.7 to 26.0 t/ha and total yield from 15.1 to 29.6 t/ha in red elite lines against the check Bhima Super which recorded 27.0 and 29.4 t/ha, respectively. None of the lines were superior to check variety Bhima Super.

Evaluation of red varieties and advance lines in demonstration trial during late *kharif* 2007-08

Advance lines of red (11) onion along with five varieties were evaluated in demonstration block in 6 m^2 having three replications during late *kharif*. Percentage marketable yield in varieties ranged from 84.7 to 96.9 and in red onion lines 75.4 to 94.2%. Marketable yield in varieties and red lines varied from 22.3 to 41.2 t/ha and 30.5 to 40.2 t/ha, respectively. Percentage of bolters in varieties was 1.3 to 6.7 whereas it was 2.4 to 10.9% in red lines. Maximum double bulbs in varieties were up to 9.4% and in red lines up to 14.8. Red variety Bhima Super gave high marketable yield up to 41.2 t/ha and total yield 42.5 t/ha. Bolters and doubles in this variety were 2.4% and 0.07%, respectively with high percent of marketable bulbs (96.9%). In the demonstration, line NRCOG-1156 performed well for marketable yield. From total yield point of view, line NRCOG-1156 and NRCOG-1168 were high yielders. There is scope to improve share of marketable bulbs in red line.

Evaluation of red onion elite lines during *rabi* season 07-08

Sixteen red onion elite lines along with check N-2-4-1 were evaluated during *rabi* season in a

plot 3m x 2 m in three replications. Percentage A grade bulbs in elite lines ranged from 23.0 to 51.6, doubles from 0.3 to 2.8%, bolters from 0 to 2.3% and marketable bulbs from 81.3 to 97.1% as compared to the check N-2-4-1 where it was 48.5%, 0.9%, 0.1% and 95.2%, respectively. Marketable yield and total yield was higher in only one line (EL-571) with 40.0 t/ha and 41.8 t/ha than the check which recorded 36.8 and 38.7 t/ha, respectively.

Evaluation of varieties and advance lines in demonstration trial during *rabi* season 07-08

Overall,12 entries including four varieties were evaluated in bigger plot size of 2m x 6 m in two replications in demonstration trial during *rabi* season on drip irrigation. % A grade bulbs in red lines was maximum 50.4% and in red varieties 36.5%. Similarly % marketable bulbs were maximum up to 97.9% and 97.8%, respectively. Marketable yield and total yield ranged between 31.1 to 36.4 t/ha and 31.7 to 39.1 t/ha in red lines and 30.5 to 37.0 t/ha and 31.2 to 38.9 t/ha in red varieties, respectively. Only two lines (RGO-53 and Gene Pool) were found superior for total yield over N-2-4-1.

Evaluation of red onion elite lines during *kharif* season 08

Thirteen red onion elite lines were evaluated during late *kharif* in 2.1m x 1.0m plot size along with 5 checks. Plant height varied from 39.3 to 57.2 cm and 8.6 to 11.0 numbers of leaves in elite lines against check Bhima Super which recorded 54.8 cm plant height and 10.9 numbers of leaves. Collar thickness ranged from 9.7 to 13.2 mm and maximum was recorded by check. Per cent marketable bulbs in the elite lines ranged from 54.9 to 92.9% against check Bhima Super (85.6%). Range for marketable and total yield was 10.0 to 25.0 t/ha and 14.0 to 26.8 t/ha, respectively against check which recorded 24.8 t/ha marketable yield and 29.0 t/ha total yield. Only one line i e., EV-1043 gave higher marketable yield over check Bhima Super.

Evaluation of varieties and advance lines in demonstration trial during *kharif* 08

Eleven entries which included 6 red varieties and 5 red lines were evaluated in demonstration trial during *kharif* season in 1m x 6 m plot size with 3 replications. Percentage A grade bulbs in varieties were 4.5 to 37.9% and in red lines it was 21.9 to 37.2% against the check Bhima Super (36.4%). % double and % rot were maximum 13.0 and 36.0% in red varieties and 5.7 and 47.9% in red lines as compared to the check Bhima Super with 2.4 and 6.8%, respectively. Marketable yield was maximum 33.5 t/ha in variety Bhima Red with total yield of 35.6 t/ha. In red lines, maximum marketable yield was 26.3 t/ha and total yield 31.7 t/ha. None of the red lines were found superior to check variety Bhima Super.

Performance of late *kharif* red elite lines under storage 07-08

Harvested bulbs of twelve red elite lines were kept in perforated crates and stored for 135 days in ventilated storage structure to study the post harvest performance of elite lines. Results revealed that 4 lines viz. EL-546, EL-571, EL-592 and EL-597 showed less than 30% weight loss after 135 days of storage whereas 5 lines viz. EL-595, EL-651, EL-670, EL-Composite and N-2-4-1 recorded 30-40% weight loss after 135 days of storage. The variety Bhima Super along with EL-650 and EL-671 recorded 40-50% weight loss after 135 days of storage.

Performance of late *kharif* red varieties and advance lines under storage 07-08

Late *kharif* harvested bulbs of 16 red varieties

and advance lines were kept in perforated crates and stored for 135 days in ventilated storage structure to study the post harvest performance of advanced lines. Results revealed that 3 lines viz. N-2-4-1, NRCOG-1168 and NRCOG- 1156 showed 20 to 30% weight loss after 135 days of storage whereas 4 lines viz. NRCOG-595, NRCOG-597, B-780-5-3-1 LR and NRCOG-1133 OL recorded 30-40% weight loss after 135 days of storage. The massing lines (Red Massing-I, II and III) and hybrid Matahari recorded more than 70% weight loss after 135 days of storage.

Performance of *Rabi* red varieties and advance lines under storage 07-08

Rabi harvested bulbs of 11 red varieties and advance lines were kept in perforated crates and stored for 135 days in ventilated storage structure to study the post harvest performance of advanced lines. The perusal of results revealed that 4 lines viz. N-2-4-1, NRCOG-595, NRCOG-597 and NRCOG-1133 OL showed 20 to 30% weight loss after 135 days of storage whereas 3 lines viz. Bhima Super, Phule Samarth and RGO-53 recorded more than 70% weight loss after 135 days of storage.

Project 1.3 Heterosis breeding in red onion

Evaluation of red exotic onion hybrids during late *kharif* 07-08

Ten red onion exotic hybrids were evaluated during *late kharif* in 3 sq. m plot size with 2 replications along with 2 checks. Percentage A grade bulbs, doubles, bolters and marketable bulbs were maximum up to 31.4%, 52.6%, 23.5% and 68.2%, respectively in the hybrids whereas it was 31.4%, 22.3%, 13.9% and 59.4% in check variety (ALR). Marketable yield and total yield varied from 0 to 10.9 t/ha and 3.1 to 18.7 t/ha, respectively in exotic hybrids against check which recorded 12.3 t/ha marketable yield and 20.7 t/ha total yield. Average bulb weight was maximum in BSS-442 (65.8g) against check ALR (59.0g). Per cent plant establishment ranged from 22.5 to 70.0 against check (57.3%). None of the exotic hybrids were found superior to check ALR.

Evaluation of different F_1 hybrids of red onion during *rabi* season 07-08

Seventeen F_1 hybrids of red onion were evaluated during *rabi* season (2007-08) in 1 sq. m plot size along with 2 checks. Percentage A grade bulbs in the F_1 hybrids ranged from 0 to 48.3% with 0 to 29.4% double bulbs and 64.7 to 100% marketable bulbs against check N-2-4-1 which recorded 48.3% A grade bulbs, 0% doubles and 95.1% marketable bulbs. Range varied for marketable and total yield and was 10.4 to 35.5 t/ha and 14.2 to 35.5 t/ha, respectively against check N-2-4-1 which recorded 28.1 and 29.5 t/ha, respectively. Average bulb weight was maximum up to 60.6g (MS 48A x N-2-4-1) against check 60.20g. Four F_1 hybrids viz. MS 65A x B-780-5-3-1 LR, MS 48A x 179, MS 48A x B-780-5-2-1 and MS 48A x A. Pitamber gave higher marketable as well as total yield than check N-2-4-1.

Evaluation of red exotic onion hybrids during *rabi* season 07-08

Six red onion exotic hybrids were evaluated during *rabi* season in 6mx2m plot size with 2 replications along with check N-2-4-1. Percentage A grade bulbs, doubles, bolters and marketable bulbs were maximum up to 29.7%, 7.4%, 1.6% and 96.4% in the exotic hybrids, respectively, whereas it was 34.2%, 0%, 0.4% and 97.7% in check N-2-4-1.

Marketable yield and total yield varied from 7.1 to 27.4 t/ha and 14.4 to 30.8 t/ha, respectively in the exotic hybrids and it was 37.0 and 37.8 t/ha recorded by check N-2-4-1. Percentage T.S.S ranged from 9.6 to 10.5% and average bulb weight ranged from 41.2 to 54.6g against check N-2-4-1 which recorded 10.7% and 62.5g . None of the exotic hybrids were found superior to check.

Evaluation of red onion F_1 hybrids during *kharif* 08

Eleven F_1 hybrids of red onion were evaluated during *kharif* season 2008 in 2.1m x1.0 m plot size with 5 checks. Maximum percentage of marketable bulbs were recorded up to 92.3% in F_1 hybrid. However, maximum plant height (54.8 cm), numbers of leaves (10.9) and collar thickness (13.2 mm) was recorded in check Bhima Super. Range for marketable and total yield was 4.3 to 15.4 t/ha and 4.8 to 22.5 t/ha, respectively against check Bhima Super which recorded 24.8 t/ha marketable yield and 29.0 t/ha total yield. None of the F_1 hybrid were found superior to check.

Programme 2 — Development of onion (white and yellow) varieties for processing and export having resistance to biotic and abiotic stresses

Project 2.1 — Collection, evaluation and maintenance of white onion germplasm

Evaluation of white onion germplasm during late *kharif* 07-08

During late *kharif* season, eighteen germplasm along with four white checks were evaluated in row trial of 30 plants per row. Line w-185LK (33.3 t/ha) & w-009 LK (22.3 t/ha) performed well than the check for marketable yield. Line w-175-LK, w-185-LK, w-197-LK & w-225-LK gave higher total yield (27.6 to 33.3 t/ha). There is scope for selection and purification to increase marketable percentage. Check variety Phule Safed yielded 19.4 t/ha marketable yield whereas rest of the three white varieties had less marketable yield.

Evaluation of white onion germplasm lines during *rabi* season 07-08

Sixty seven white onion lines were evaluated during *rabi* season in 1 sq m plot size in a single replication along with check variety Phule Safed. Doubles, bolters, A grade bulbs and marketable bulbs in these lines ranged from 0 to 35.2%, 0 to 5.9%, 0 to 51.8% and 45.8 to 100%, respectively against the check variety where it was 0%, 6.3%, 37.9% and 88.6%, respectively. Days to harvest varied from 91 to 115 days after transplanting whereas, check variety took 109 days for harvesting. Marketable yield and total yield was 18.6 and 21.07 t/ha in check variety whereas it ranged from 6.77 to 39.3 and 14.3 to 40.5 t/ha, respectively. 17 lines yielded significantly higher marketable yield and 22 lines higher total yield than the check variety. Lines W-441, W-355, W-410, W-455, W-176, W-331, W-438, W-147, W-444, W-361, W-154, W-103, W-190, W-440, W-138, W-430, W-267 (25.2 – 39.2 t/ha) performed better for marketable yield. w-427 was earliest in maturity and it took 91 days to harvest with 16.6 t/ha marketable yield and 28.1 t/ha total yield. 11 lines matured in 106 days after transplanting.

Evaluation of white onion germplasm during *kharif* season 08

Thirty four lines were evaluated in an area of 1 sq. m along with 3 white check varieties. Maximum marketable yield and total yield in white varieties were 10.7 and 19.3 t/ha, respectively, whereas, it was 25.2 and 30.6 t/ha, respectively in check variety. A grade was maximum (28.5%) in the germplasm whereas it was 10.7% in the varieties. Doubles ranged from 0 to 32.6% in the germplasm while, it was 13.0 to 23.0% in varieties. High marketable yield of more than 33% over Phule Safed (more than 14 t/ha) was recorded in W-307 KH, W-161 KH, W-301 KH, W-442 KH, W-153 KH, W-064 KH, W-043 KH and ranged from 14.3 to 25.2 t/ha.

Project 2.2 Development of high TSS white onion varieties suitable for different seasons & processing

Evaluation of varieties and advance lines in demonstration trial during late *kharif* 07-08

Advance lines of white (4) onion along with varieties were evaluated in demonstration block in bigger plot size of 1m x 6 m and in 3 replications during late *kharif*. Marketable yield in Phule Safed was 72% whereas in white lines it was 73.91 to 89.2% and in red varieties, it ranged from 84.7 to 96.9%. Marketable yield in white lines varied from 23.1 to 34.5 t/ha against Phule Safed (19.8 t/ha) whereas in red varieties it was 31 to 41.2 t/ha. Bolters in white lines ranged from 7.29 to 13.2%, while in red varieties it was 1.38 to 5.3% and in Phule Safed 8.1%. Doubles were lowest in w-009 El-2 (1.46%) against Phule Safed (15.54%). In the demonstration among the white lines, w-009 EL-2 performed well for marketable yield with 34.5 t/ha and 89% marketable bulbs. The quality of this line was also good and bulbs were of round shape. TSS ranged from 11.09 to 12.14% in white lines whereas it was 10.8% in Phule Safed.

Evaluation of white onion elite lines during *rabi* 07-08

Ten elite lines including fifteen breeding lines along with four check varieties were evaluated during *rabi* season in 1m x 1.05 m plot size in 2 replications. A grade bulbs (57.9%) were maximum in elite lines and 42.7% in breeding lines, whereas in check variety Udaipur 102, it was 23.5%. Marketable yield ranged from 82.8 to 98.5% in elite line and 75.9 to 97.5% in breeding lines against varieties which recorded 71.19 to 94.5%. More than 90% marketable yield was recorded in 7 elite lines and 9 breeding lines. Six elite lines viz. W-

Promising rabi onion germplasum

418/EL-2RB, W-361/EL-2RB, W-417/EL-2RB, W-404/EL-2RB, W-444/EL-2RB, W-396/EL-2RB gave significantly higher marketable yield and varied from 28.1 to 37.4 t/ha. In case of breeding lines, 4 lines (W-236/M-2RB, W-132/M-1RB, W-469/M-2RB and W-197/M-1RB) gave significantly higher marketable yield (28.1 - 38.27 t/ha) as compared to the check Phule Safed (21.43 t/ha). TSS ranged between 10.3 to 11% and no doubles were recorded in 14 lines and over all bolters were almost zero except in one line w-132M1-Rb (1.3%).

Evaluation of white onion high TSS ratoon lines during *rabi* 07-08

Out of twenty ratoon lines, from the progenies of germplasm and mutated lines, evaluated for TSS along with 3 white checks, more than 15% bulbs recorded TSS above 18% in seven lines viz. W-227-21/HT-1+3+4-1-M-2RB-RT, W-HT>251/2M-2RB-RT, W-293-05/HT-1+2-2-M-2RB, W-227-21/HT-1+3+4-2-M-RB-RT, HT-SELF-20/SELF-2, HT-GR-1/M-2, AFW-GR-1/MUT-2, HT-MUT-GR-4/M-2 where average TSS ranged from 14.69 to 16.71 against the check varieties (10.36-11.64%). Marketable yield was 20.83 t/ha in W-227-21/HT-1+3+4-2-M-RB-RT and 20.67 t/ha in W-227-21/HT-1+3+4-1-M-2RB-RT with total yield of 25.20 & 22.0 t/ha, respectively, whereas in check varieties marketable yield ranged from 20.2 to 26.9 t/ha.

Evaluation of varieties and advance lines in demonstration trial during *rabi* season 07-08

Five varieties and three lines were evaluated in bigger plot size of 6m x 2 m in three replication in demonstration trial during *rabi* season. Maximum A grade bulbs in white lines was 37.5%, in red varieties 36.5% and white variety 29.12%. Similarly maximum marketable bulbs were 95.87%, 97.8% and 91.5%, respectively. Marketable yield and total yield ranged between 28.5 - 33.5 t/ha and 31.7 - 34.9 t/ha in white lines, 30.5 - 37 t/ha and 31.2 - 38.9 t/ha in red varieties and 20.05 and 21.8 t/ha in white variety (Phule Safed), respectively. All the three elite lines yielded significantly higher yield than the white check. White GP composite yielded maximum marketable yield of 33.5 t/ha and total yield (34.9 t/ha).

Evaluation of white onion elite /breeding lines during *kharif* season 2008

Six elite and eight breeding lines were evaluated during *kharif* season in 3 replication in a plot size of 1 sq. m along with two checks. Despite heavy rains, some lines performed well and yielded up to 30.89 t/ha of total and 22.78 t/ha of marketable yield in elite lines and 27.02 and 23.93 t/ha in breeding lines, respectively. Maximum marketable yield and total yield in white variety was 15.48 t/ha and 20.50 t/ha, respectively in Phule Safed. A grade were maximum (40.89%) in W-397/M-4-KH whereas it was 17.92% in check Phule Safed. Overall five lines viz. W-397/M-4-KH, W-453/M-3-KH, W-411/EL-5-KH, W-420/EL-1-KH, W-408/EL-5-KH gave significantly higher marketable yield (20.3 - 23.9 t/ha) out of 14 lines than the check Phule Safed (15.5 t/ha).

Evaluation of varieties and advance lines in demonstration trial during *kharif* 08

Ten entries including five germplasm, two checks and three *kharif* red checks were evaluated in demonstration trial during *kharif* in three replications in 6 m^2 area. A grade bulbs in white lines ranged from 19.12 to 35.48% against white varieties which had 3.5 to 7.8%. Percent doubles were maximum (4.67) in germplasm as compared to the check Phule Safed (11.9%) and PKV White (12.1). Marketable yield was maximum

(11.67 t/ha) in Phule Safed, 33.59 t/ha in variety Bhima Red, whereas it was 24.7 t/ha (marketable yield) with total yield of 28.67 t/ha in white line w-009EL-4KH. All the lines gave significantly higher marketable yield (16.7 - 24.7 t/ha) than the white check. Total yield in lines ranged from 22.53 to 28.67 t/ha against the check Phule Safed (21.2 t/ha).

Evaluation of late *kharif* demonstration varieties and advance lines in storage 08

Ten kg bulbs of each entry (10) were kept in storage in three replications during February 08. Final observations on total storage losses on weight basis were recorded after 4.5 months of storage. Losses in varieties ranged from 27.2% in N-2-4-1 to 73% in Phule Samarth. In germplasm, it ranged from 44.8 to 65.6% total loss. Losses in two exotic hybrids were very high (70.3%) in Mercedes and Collina (89.2%). Losses during first 3.5 months were also less in Bhima Red and Bhima Raj (up to 25%), whereas in white lines it was lowest in line w-009 El-2 (33.3%) followed by White Elite Composite (34%).

Evaluation of *rabi* demonstration varieties and advance lines in storage 08

Ten kg bulbs from seven entries were kept in storage during May 07 and observations were recorded at different intervals. Final observation was recorded after 4.5 months of storage. Total weight loss in N-2-4-1 was less (22.5%) among the varieties whereas it was maximum in Phule Samarth (87.2%). Total weight loss in lines ranged between 56% in White GP Composite to 65.3% in White Elite Composite. Losses in germplasm were less up to two months of storage and ranged from 22.8 to 31% total weight loss.

Project 2.3 Collection, evaluation and maintenance of yellow onion germplasm

Evaluation of yellow onion germplasm lines during *rabi* season 07-08

Yellow onion germplasm were selected from red and white segregating population and were purified. Twenty accessions were evaluated during *rabi* along with check variety Phule Suwarna in 2 replication in 1 sq. m plot size. Percent marketable yield in the germplasm varied from 50.9 to 96.1% while it was 80.9% in the check. A grade bulbs, doubles and bolters ranged from 0 to 48.6%, 0 to 26.6% and 0 to 6.1%, respectively whereas it was 19.3%, 17.8% and 0.9% in the check variety. Six lines viz. Y-063, Y-078, Y-032, Y-075, Y-073 and Y-067 had high marketable yield (22.5 to 31.1 t/ha) than the check Phule Suwarna (14.5 t/ha).

Project 2.4 Development of yellow onion varieties suitable for export

Evaluation of yellow onion germplasm and breeding lines during *rabi* season 07-08

Five breeding lines were evaluated during *rabi* along with check variety Phule Suwarna in three replications in 1 sq. m plots. Percent marketable yield in the germplasm varied from 92.4 to 100 whereas it was 69.3% in the check. Average bulb weight, % A grade bulbs, % doubles and % bolters ranged from 61.8 to 74.7 g, 25.0 to 61.9, 0 to 6.3 and 0 to 1.4%, respectively in the breeding lines, whereas it

was 63.1 g, 18%, 5.8% and 17.7%, respectively in the check variety. 4 lines had high marketable yield (31.3 to 39.8 t/ha) than the check and 3 lines (Y-004/M-2-Rb, Y-003/M-2-Rb, Y-024/M-2-Rb) recorded more than 33 t/ha marketable yield.

Project 2.5 Heterosis breeding in white and yellow onion

Evaluation of exotic onion during late *kharif* season 07-08

Nine yellow exotic hybrids along with four white hybrids were evaluated in late *kharif*. Maximum marketable yield was 20.6 t/ha and total yield was 21.6 t/ha in Couger yellow onion whereas in white hybrid it was 17.4 & 20.9 t/ha, respectively. Phule Safed recorded 19.6 and Phule Suwarna recorded 13.7 t/ha marketable yield.

Evaluation of exotic onion hybrids during *rabi* season 07-08

Eight exotic hybrids including six yellow and two white were evaluated during *rabi* season along with yellow check Phule Suwarna in two replications in 2m x 6 m plots. All the hybrids were not uniform. Average bulb weight ranged from 50.45 to 92.65 g in yellow hybrids whereas it was maximum (46g) in white hybrid. Average bulb weight in Phule Suwarna was 44.29g, doubles and bolters were very less with maximum of 0.5% and 0.75% only in BSS-262-F-1 white hybrid. There was no bulb formation in hybrid Ampurdan whereas, hybrid Reforma yielded maximum marketable yield (52.5 t/ha) and total yield (61.4 t/ha) whereas Phule Suwarna recorded a marketable yield of 14.5 t/ha and total yield was 18 t/ha.

Crosses with exotic and indigenous varieties for creation of variability in yellow & white onion.

Sixty eight open cross combinations were evaluated during *rabi*. Crosses between white onion & red male sterile lines were made for further evaluation and transfer of male sterility in white onion background. GIZA-20 is being maintained through ratoons due to poor seed setting and the bulbs formed during *rabi* could not be stored due to less storage life. Seed were forced in V-12 but last year there was no seed setting hence ratoon of the same bulbs were planted for seed production. Back crosses with MS lines were done. Bulbs obtained from the back cross progenies were planted for second back cross to transfer male sterility in released onion varieties.

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In initial evaluation trial (IET), out of six varieties and four checks, NRCWO-2 ranked first at 5 centres viz. IIVR (22.78 t/ha), Parbhani (40.66 t/ha), Dharwad (32.42 t/ha), Kalyanpur (22.5 t/ha) and Akola (29.0 t/ha) over all the checks and at IARI (28.11 t/ha) over white check. It was second at Nashik (32.27 t/ha), Jabalpur (33.33 t/ha) over red check and at Rajgurunagar (36.97 t/ha) over white check. Variety Sel.-153 (31.77 t/ha) gave highest yield at IARI but had poor germination at most of the places. NRCRO-2 was superior at Rahuri (31.69 t/ha). None of the variety was superior over the checks at Solan, Srinagar, Ludhiana and IIHR. Overall TSS was highest at Junagadh (13.6%) centre whereas it was lowest at Solan (5.3%).

In advance varietal trial (AVT-I), out of five varieties and four checks, line-355 performed superior at Junagadh (36.9 t/ha), Akola (28.3 t/ha) and Nashik (36.6 t/ha) and was second at Rajgurunagar (40.5 t/ha) and Kalyanpur (18.3 t/ha). Variety RO-597 ranked first at Rahuri (32.5 t/ha), Kalyanpur (24.3 t/ha), Durgapura (24.3 t/ha), IARI (34.7 t/ha), Rajgurunagar (43.3 t/ha) and Solan (16.2 t/ha) and second at Junagadh (30.0 t/ha). White variety Agrifound White performed better at Parbhani (34.6 t/ha), Akola (21.5 t/ha) and Nashik (26.7 t/ha) as compared with white check. Overall TSS was high at Junagadh centre (13.5%) and was low at Solan (6.2%) among the varieties.

In advance varietal trial (AVT-II), nine varieties were evaluated along with four checks. RHR-OS-1 ranked first at IIVR (22.2 t/ha) and Rahuri (36.2 t/ha) and second at Dharwad (28.8 t/ha) and Jabalpur (28.5 t/ha). Variety PRO-6 performed well at Ludhiana (33.7 t/ha), Durgapura (23.2 t/ha) and Srinagar (22.0 t/ha). Sel.-283 gave highest yield at IARI (37.1 t/ha), Kalyanpur (28.4 t/ha), Junagadh (37.0 t/ha) and Solan (16.9 t/ha) and was second at Parbhani (40.6 t/ha). PKV White recorded maximum yield at Dharwad (31.1 t/ha), Akola (25.9 t/ha) and Nashik (36.6 t/ha) and was second at Kalyanpur (24.0 t/ha) and Rahuri (34.2 t/ha). There were 3 white varieties and as compared with white check, Punjab White performed well at Kalyani (25.2 t/ha) and Solan (13.3 t/ha). JNDWO-207 gave highest yield at Parbhani (36.2 t/ha) and was second at IIVR (18.8 t/ha) and Kalyanpur (20.2 t/ha) whereas, PKV White was at the top at Dharwad (31.1 t/ha), Akola (25.9 t/ha) and Nashik (36.6 t/ha) and was second at IARI (31.6 t/ha), Rahuri (34.2 t/ha) and Parbhani (34.6 t/ha). Overall TSS was highest at Junagadh centre (13.6%) whereas it was lowest at Solan (5.8%).

Programme 3 — Improvement of garlic through coventional and biotechnological approaches

Project 3.1 — Collection, Evaluation and maintenance of garlic germplasm.

In germplasm collection, a total of 266 lines of garlic germplasm were collected from India and abroad. Eight lines from AVRDC, Taiwan; forty nine lines from IPK, Germany; 199 lines from USDA, Pullman, USA and 10 lines from West Bengal were procured. The lines obtained from abroad were sent to NBPGR, Regional Station, Shimla for multiplication and evaluation because of their temperate nature for cultivation.

Germplasm evaluation

In white germplasm, a total of thirty lines were evaluated including the checks. Total yield ranged from 0.6 kg/m^2 to 0.2 kg/m^2. Acc. No. 74-7, 416, 471, 365, 321-4-1 and 74-5 performed best with a total yield of 0.6 kg/m^2 butwere at par with the best check variety G-41 (0.5 kg/m^2).

In coloured germplasm, forty one accessions were evaluated alongwith their local checks. The total yield of the best check variety (G-41) was 0.4 kg/m^2 and all the lines were at par with the check variety.

In germplasm maintenance, a total of 850 accessions of garlic germplasm were maintained *ex situ* by planting in the field.

Project 3.2 Development of high yielding garlic varieties suitable for different production areas

Variety G-41 was treated with different mutagens and some of the clones showing higher yield have continuously been selected for higher yield. Out of the high yielding lines (M3-M4 generation) some of the lines were evaluated along with other promising lines for yield and other horticultural traits. Out of 35 lines, including check varieties, thirteen accessions viz., acc. No. CBS-16/M4, SCS-6-4/M3, EL-CBS-6-7/M3, CES-11/M4, SAT-3/M-4, CDS-16-3/M-3, CCS-5/M-4, CAT-5/M4, EL-CDS-14/M4, CDS-7-2/M-3, SAT-12/M4, EFT-10/M-4, CDS-16-4/M-3 showed significantly higher yield than the check variety G-41 (4.6 t/ha) with a range of 8.3 to 6.3 t/ha. The plant stand and plant vigour of the lines was very good as compared to the germplasm and multiplication lines.

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In initial evaluation trial (IET), under long day conditions, line VGP-5 performed superior at Almora and Mukteshwar. In Srinagar and Solan, local check yielded more than all the other entries. In IET trial, under short day conditions, entry G-189 performed best in IIVR, Ludhiana, Jabalpur, Junagarh, Pantnagar, Akola and Jhalawar followed by NRCRG-1 which performed well at IARI, Ludhiana, Kalyanpur, Junagarh and NHRDF, Karnal. Local checks were superior than the entries at Coimbatore, Sabour, NRCOG and Jhalawar. In advamced varietal trial –II (AVT-II), JNDG 213 performed superior at IIVR, Kalyanpur, Pantnagar and Akola whereas RAUG-5 performed better at IARI, Rahuri, Sabour, Junagarh and NHRDF Karnal. This was closely followed by AC-200 which recorded good yield at Rahuri, Jabalpur and Dharwad.

Project 3.3 Studies on somaclonal variations in garlic

The main aim of this experiment is to generate the somaclonal variation and develop the variants for increased yield and other horticultural traits. In this experiment, use of *in vitro* callus culture and regeneration is the easy method for development of somaclones. Another method is to treat the explant with various mutagenic sources for increasing the variation and selecting the best performing one. Our first aim was to try for direct shoot regeneration using root tip of garlic. The main advantage of this method is that a single clove has more than 8-10 roots and if we are able to regenerate the shoots through roots then it is easy to treat the root tips with suitable mutagens and generate multiple shoots and evaluate them under the field conditions. The time required to initiate callus (1-1.5 months), callus proliferation (3-4 months) and callus regeneration (1-2 months) is saved by adopting this method of direct regeneration through root tip culture. In this direction, we tried various combinations as reported by various authors but were unable to get the required results. The root tips culture either gave rise to callus or they

elongated after which they either dried or were unsuitable for further culture.

Since we were not able to get direct shoots out of the root tips hence we went for callus culture in root tip which can be directly treated with mutagens and then callus regeneration for development of shoots. So far we have been able to get callus from root tips and callus proliferation and callus regeneration is underway. The callus so obtained has been transferred to the regeneration media to select the best media for regeneration.

Project 3.4 Production of virus free garlic through *in vitro* meristem tip culture

Garlic is affected by lots of viruses. Virus infection leads to degeneration in garlic and as a result the yield declines steadily over the years. In order to develop virus free garlic, it is important to go through meristem tip culture since this technique has proven to be reliable for virus free production of garlic plants. In this study, we used different accessions and different media to study about meristem tip isolation, growth and development into whole plants. The plants so developed have been transferred to the greenhouse for their establishment and propagation. The plants are to be tested about their virus susceptibility and also post meristem tip culture plants for their virus free nature.

The future course of action will be to go for ELISA technique first to determine whether a particular plant is virus infected or not. Alternatively we can go for RNA isolation and RT-PCR (Reverse transcriptase PCR) to detect virus presence/absence in the plants.

Project 3.6 Molecular analysis of genetic diversity in garlic

Even though, garlic is a asexually propagated crop it displays great amount of variation in bulb shape, size, diameter and colour also. The objective of this programme is to evaluate the diversity present in our Indian garlic germplasm and then compare it with the exotic germplasm and also to form a core collection for evaluation and maintenance at our centre. In this we used Simple sequence repeats (SSR) for identifying the diversity.

Microsatellites are simple sequence tandem repeats (SSTRs). The repeat units are generally di-, tri- tetra- or pentanucleotides. Microsatellites are useful markers at a wide range of scales of analysis. Until recently, they were the most important tool in mapping genomes - such as the widely publicized mapping of the human genome. The main advantages of microsatellites is that they are locus-specific (in contrast to multi-locus markers such as minisatellites or RAPDs), Codominant (heterozygotes can be distinguished from homozygotes, in contrast to RAPDs and AFLPs which are "binary, 0/1"), PCR-based (means we need only tiny amounts of tissue; works on highly degraded or "ancient" DNA) and highly polymorphic ("hypervariable") and are useful at a range of scales from individual ID to fine-scale phylogenies.

Till now no work on determination of genetic diversity based on SSRs in garlic has been attempted. In this, first the microsatellites, developed by Fischer and Bachmann (2000) in onion, were synthesized and then used to see whether we are able to see any amplicons in

garlic. In addition to this, eight microsatellite sequence published in NCBI database (2008) were used for detecting the amplicons. Overall eight microsatellites showed the amplicons and they will be tested on 91 accessions comprising of commercial varieties, elite lines, exotic accessions and the landraces.

Programme 4	Onion Improvement through Biotechnological Approaches
Project 4.1	Induction of haploids in onion

Induction of haploids in high TSS and MS (100%) lines using standardized protocol

During *rabi* 06-07 various hormonal combinations were identified for the induction of haploids in onion using unopened flower bud culture. Several haploids were induced in these experiments of which one spontaneous dihaploid, DHO71 is at present in the field. The seven most potent combinations consisting of MS media fortified with BA alone and in combination with 2,4-D and IAA (B1, B2, B3, H1, H2, H3 and H15) were used for induction of haploids in pure MS lines and high TSS lines. Four high TSS lines, WHT-1CRb/M, WHT-5bRb/M, WHT-14Rb/M and HT-GR-3/M-2RT and 2 pure MS lines, P_7MS65A and P_3MS65A were used for haploid induction using the above combinations. Due to the absence of a large number of explants, only few flower buds per experiment could be inoculated. Maximum induction of two plants was seen in flower buds of HT-GR-3/M-2RT in B3. B2, H3 and H15 all produced one plant each. WHT-14Rb/M was the most responsive genotype with direct plant induction in B2, H3 and H15. Total of 7 plants were formed initially from the high TSS lines of which, only 3 plants of two lines (WHT-14Rb/M and WHT-1CRb/M) could survive. None of the pure MS lines produced haploids. The haploids are maintained in basal MS media with higher concentration of sucrose (6%) for ploidy analysis.

Standardization of diploidisation protocol

Last year an experiment was initiated to standardize a protocol for diploidisation of haploids using an anti-mitotic agent, colchicine. However, due to less number of haploids, standardization at different concentrations and time period was not possible. Except for one or two survivors, we lost all the other treated plants, where treatment was given using varying concentrations of colchicine in liquid MS medium for different time periods. Hence, another experiment was initiated with seedlings of Bhima Super, which resembles the embryoids formed during the haploid induction. Week-old germinated seedlings of variety Bhima Super were used for this experiment. Five different concentrations of colchicine (1, 2, 2.5, 25 and 50μM) were tried at three different time intervals (24, 48 and 72 hrs) in solid MS medium instead of liquid MS to identify the best treatment for chromosome doubling. Preliminary results showed that colchicine @ 20μM after 24 (28.5%), 48 (57.1%) and 72 (71.4%) hrs showed varied percentages of leaf enlargement suggesting a possible doubling in chromosome number. The same will be confirmed after ploidy analysis using the Ploidy Analyser (PA II, Partec, Germany) at NRCMAP, Anand. Survival percentage of plants in these combinations is also quite high (100%) after 15 days of transfer to basal MS without colchicine and these

combinations could be further used for diploidisation of haploids in future experiments.

A similar experiment was repeated with basal plate explants split into three parts. However, due to contamination or death of the explants, the experiment could not progress further and will be repeated. With these two protocols standardized, haploids can be either diploidized at the early embryoid stage or after bulb maturation.

Study the effect of media along with additives on enhancing haploid induction in onion

Elite lines and advanced varieties of onion were planted during *rabi* 08-09 for flowering and unopened flower bud explants from these will be used for the experiment to study the effect of additives namely Adenine Sulphate (AdS) and Casein hydrolysate (CH) in enhancing haploid induction.

Ascertaining the ploidy level of plantlets obtained in the study on parthenogenesis

A preliminary field study was formulated during *rabi* 05-06 for the induction of haploids by dusting foreign pollen (maize and parthenium) on onion varieties N-53 and N-2-4-1, as well as using dead pollen of the same onion varieties. Few seeds were obtained, which were planted during *rabi* 06–07. Upon harvest, the bulbs were cured and stored till the next planting season. After isolation of root tips for cytological analysis, the bulbs were treated with 2-3 drops of 1mg/ml solution of colchicine and planted in the green house during *rabi* 07-08. The resulting plants exhibited phenotypic variation in a few. Ploidy of these was assessed using the Ploidy Analyser (PA II, Partec, Germany). It was observed that most of them were diploids. However, the bulbs were not able to survive in the green house due to diseases and probably the toxicity of colchicine. Similar crossing experiment was repeated in *rabi* 06-07 and the few seeds obtained were sown in *rabi* 07-08. Only a few seeds germinated and these were not able to survive for long.

Project 4.2 Micropropagation studies in onion

Micropropagation in onion variety Bhima Super *via* shoot multiplication

Twenty different combinations of cytokinins (viz., BA/2 iP 0.5 – 2 mg/l or TDZ 0.5 – 1 mg/l) alone and in combination with different auxins (NAA/IAA 0.5 mg/l) were tried for the induction of multiple shoots in onion variety Bhima Super. Amongst the different combinations, BA (2 mg/l) + NAA (0.5 mg/l) gave the best result of 5-6 shoots after 1 month of culture. Low concentrations of BA (0.5 mg/l) and 2iP alone or in combination with IAA was not able to induce any multiple shoots. Multiple shoots upon transfer to the establishment medium consisting of basal MS gave upto 15 healthy shoots.

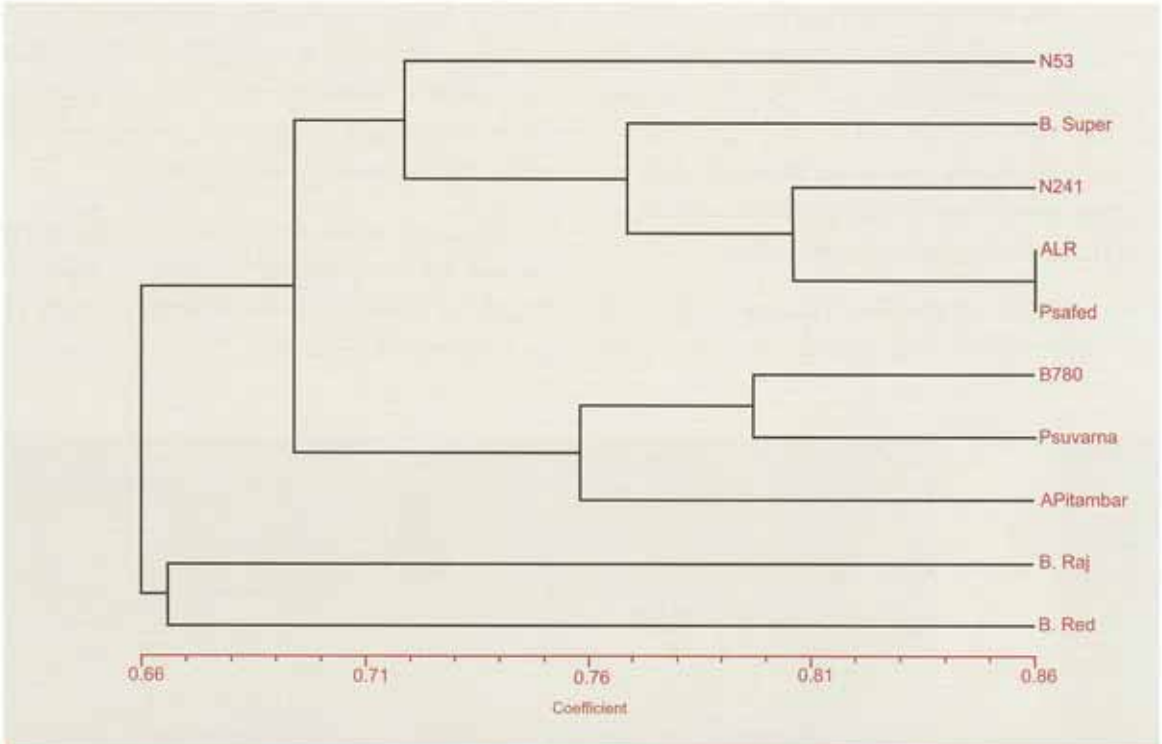
Somatic embryogenesis in onion

Twenty five different combinations consisting of various combinations of 2,4-D (0.5 – 2 mg/l) + BA/Kin (0.1 – 0.5 mg/l) / TDZ/2iP (0.25 – 0.5 mg/l) were tried for induction of somatic embryogenesis in onion variety Bhima Super from seed explants. The basal medium used was MS fortified with 3% sucrose and gelled with 0.8% agar agar. Callus was induced in all the combinations and many were friable. However, there has been no regeneration or embryogenesis as of yet. Further proliferation and prematuration media will be tried as the experiment progresses.

Preliminary DNA profiling of ten lines of DUS onion using RAPD

During preliminary screening of 18 onion varieties and four advanced lines along with two garlic varieties (as out groups) through RAPD, a total of 100 RAPD primers were screened initially of which 26 were short listed. However, it was observed that many of the primers tested were showing monomorphism among the onion lines and hence the number of polymorphic primers needs to be increased by screening more number of RAPD primers. Hence, further 60 were screened for polymorphism using selected lines of DUS onion. Of these 60 primers screened, only 8 showed polymorphism.

For this experiment, a total of 22 lines of DUS onion including *kharif, rangda* and *rabi* lines were subjected to fingerprinting. On a preliminary basis, dendrogram showed the presence of two major clusters. Cluster one has two sub clusters having five and three lines, respectively. Cluster two has the two onion lines Bhima Raj and Bhima Red. However, it was noted that the result shown by these 7 primers are not correct as B-780, Bhima Super, Bhima Raj and Bhima Red are not showing any association as should have been the case since B-780 is the parent material of the other three lines. This errant result is because of the less number of primers used for this experiment. For a heterozygous crop like onion more than hundred primers would give a better dependable result.



Dendrogram showing the UPGMA based clustering of ten DUS onion lines

Programme 5	Collection, characterisation and screening of wild species for *Allium* improvement
Project 5.1	Screening of wild species for biotic and abiotic stresses and introgression of desirable genes in *Allium cepa* L.

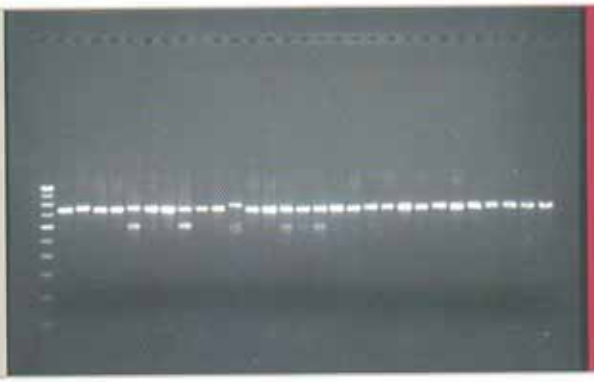
In this project, the leaves of the wild species were kindly provided by Dr. KS Negi, NBPGR, Bhowali and the DNA was isolated at our centre. In order to determine the diversity present in our Indian wild species, 30 genomic SSRs as published by Fischer and Bachmann (2000) were used. Some of the SSRs were able to amplify in some of the genotypes. But when the primers were tried in all the genotypes some genotypes failed to amplify. Hence work was started on diversity assessment using Internal Transcribed Spacers (ITS).

The internal transcribed spacer (ITS) region of 18S–26S nuclear rDNA has become widely used as a source of characters for phylogenetic studies of closely related plant species. Among the ca. 500 bp within ITS-1 and ITS-2 sufficient variation has been found in dozens of plant groups for robust resolution of some generic and subgeneric relationships.

The external transcribed spacer (ETS) of 18S–26S rDNA has shown potential for augmenting ITS data in phylogenetic studies of angiosperms. The ETS and ITSs may be evolving under similar functional constraints and at comparable rates, as parts of the same transcriptional unit and with evidence indicating similar, interdependent roles in the maturation of rRNAs .

In case of ITS, the primers were synthesized and DNA was amplified with those primers. A single amplicon was generated in all the species studied. The bands so obtained were eluted and DNA isolation was done. The sequencing was tried and some of the sequences were blasted. The sequences showed higher homology with the nrDNA sequences submitted in NCBI database. But the quality of the sequences was not good in all the genotypes. Hence the next step is to get the nested primers for sequencing.

In next experiment, work on ITS sequencing and also ETS sequencing will be tried again to prepare a comprehensive diversity chart of the Indian *Allium* species.



ITS Sequencing in Wild species of *Allium*

CROP PRODUCTION

Programme 6 Integrated nutrient management for onion and garlic

Project 6.4 Studies on nutrient deficiency symptoms of garlic

Garlic var. G-41 was planted in pots during first week of November 2008 with thirteen treatments including control with all the nutrients in three replications. Nutrients were supplied through Modified Hoagland's Nutrient solution. Nutrient symptoms were observed after 60 days after planting (DAP) for all the nutrients except sulphur. The treatment without sulphur did not produce any deficiency symptoms which might be due to the absorption of sulphur from atmosphere as sulphur dioxide. The deficiency symptoms were photographed and preserved. The plant samples at maturity were collected, processed and preserved for nutrient analysis. The experiment will be continued during 2009-2010 for confirmation.

Project 6.5 Assessment of Nutrient Requirement for Garlic

The present investigation was started with twelve treatments in three replications under a randomized block design. The objective of the study is to assess the requirement of nitrogen and potassium and effect of different levels of these nutrients on plant growth, yield and quality of garlic crop. Observations were recorded during 45, 60, 75, 90, 105 days after planting. Yield and yield parameters will be recorded after the harvest of the crop. The plant samples will also be collected after the harvest of the crop and analyzed for nutrient and quality parameter. Further, bulbs will be stored for storage quality study.

Project 6.6 Nutrient uptake study of Garlic

An experiment on nutrient uptake studies on garlic was initiated with eleven treatments and three replications in a randomized block design. The objective of the study is to assess the nutrient uptake by garlic at different growth stages with different levels of macronutrients. Garlic cv. G. 41 was planted during first week of November 2008 and the

plant samples were collected at 30, 45, 60, 75, 90 and 105 days after planting. Collected samples were air oven dried, ground and used for the laboratory analysis. Plant samples will also be collected after the harvest, processed and analyzed for nutrient. Yield and yield parameters will be recorded after the harvest of the crop. Subsequently, the nutrient uptake will be calculated by multiplying the nutrient content with yield of garlic.

Programme 7	Enhancement of production of onion and garlic through agronomic innovations
Project 7.3	Micro irrigation and fertigation studies in onion and garlic

Studies on combined effect of organic and inorganic nutrition in onion under drip irrigation system

In order to maximize the fertilizers use efficiency, drip fertigation experiment was started to find out optimum nutrient requirement of onion and garlic through drip fertigation combined with different organic and inorganic fertilizers. Results revealed that combined application of different organic manures (Farmyard manure - 7t/ha, poultry manure -3.5 t/ha and vermicompost - 3.5t/ha) along with 80 % recommended dose of water soluble fertilizers through drip fertigation improved the plant growth and yield characters in both the crops. However, no significant difference was noticed in main plot, subplot and their interactions. Higher marketable bulb yield (45.5t/ha) was noticed in M2S4 plot (combination of organic manures like farmyard manure, poultry manure and vermicompost + 80% recommended dose of water soluble fertilizers through drip system) followed by M2S2 (combination of poultry manure 10t/ha along with 80% recommended dose of water soluble fertilizers through drip irrigation) with marketable bulb yield of 44.3t/ha. There were no significant differences observed in organic manures and their interactions.

Same trend was observed in garlic also. Application of farmyard manure - 7t/ha + Poultry manure -3.5 t/ha and Vermicompost - 3.5t/ha along with 80 % recommended dose of water soluble fertilizers through drip fertigation improved the marketable bulb yield of garlic (4.48t/ha) . From the results, it was observed that there was no significant difference between organic manures and their interactions. Likewise, there were no significant effects on yield contributing characters like percent of A, B , C grade and diameter of bulbs in both the crops. Increased bulb yield in onion and garlic were mostly due to higher nutrient availability and uptake during entire growth period by combined application of organic manures along with 80% recommended dose of water soluble fertilizers through drip fertigation at right time in a required quantity.

Pooled results of last three years experiment revealed that combined application of organic manures (FYM@7t/ha, poultry manure@ 3.5 t/ha and vermicompost @ 3.5t/ha) along with 80 % recommended dose of water soluble fertilizers in onion and in case of garlic, application of poultry manure @10t/ha along with 80 % of recommended dose of water soluble fertilizers through drip irrigation recorded the higher marketable bulb.

With regards to storage life, significant effect was noticed in total storage losses of five months stored onion bulbs under well ventilated ambient storage conditions. Maximum storage losses (46.5 per cent) were noticed in M1S5 (NPK 50:50:80 kg /ha as basal +100 kg N in seven splits through drip irrigation +without organic manures) and minimum (33.3 per cent) were observed in M2S4 (80 % of recommended dose of fertilizers in the form of water soluble through drip irrigation + combined application of FYM + poultry manure + vermicompost). In case of garlic, minimum physiological loss of weight (19.2 %) was noticed in M2S2 (80 % of recommended dose of fertilizers in the form of water soluble through drip irrigation combined with Poultry manure @10t/ha).

Apart from growth, yield and storage life of onion and garlic, results from biochemical analysis revealed that there was no significant effect on TSS, Pyruvic acid, total sugar and titrable acidity content of onion and garlic bulbs. The highest B:C ratio was noticed in M1S6 (NPK 50:50:80 kg /ha as basal +100 kg N in seven splits through drip irrigation combined with foliar application of water soluble fertilizers without organic manures) in onion and garlic (NPK 50:50:80 kg /ha as basal +50 kg N in seven splits through drip irrigation combined with foliar application of water soluble fertilizers without organic manures)

Project 7.4 Studies on organic production of onion and garlic

Experiment was conducted in onion and garlic under four preceding crops of mung bean, french bean, bajra and soybean. Results from *late kharif* and *rabi* season experiments of onion and *rabi* season of garlic revealed that higher marketable bulb yield of onion and garlic were noticed at recommended inorganic practices than organic package. Almost 20-30% lesser yield was recorded in organic farming treatments in both the crops. In organic package, among the preceding crops and various organic manures evaluated, soybean in *kharif* season followed by onion or garlic in *rabi* season with application of poultry manure 10 t/ha noticed higher bulb yield than other combinations in both crops. From the experiment, it was observed that available nutrient content was on higher side in recommended practices than organic farming treatments.

With regards to storage life and quality parameters of onion and garlic, there were no significant difference observed in total storage losses and quality of the bulbs in both the crops.

Project 7.5 Weed management studies in onion and garlic

Crop weed competition studies in onion and garlic

Results revealed that yield losses in onion and garlic due to heavy weed competition were to the extent of 12 – 94.8 per cent depending upon the types of weed flora, their intensity and duration of crop – weed competition. Delayed weeding operations results in lanky growth, yellowing of leaves, poor development of bulb and impairs the keeping quality of bulbs. Weed competition during

Crop weed competition in onion & garlic

the whole crop cycle reduced bulb yield upto 71.2 % in onion and 94.8% in garlic and compared to onion, garlic is more sensitive to weed menace. Based on the first year results, it was observed that the critical period of crop-weed competition in both crops occurred from 30 to 60 days after planting.

Chemical weed management methods in *rabi* onion (AICRP)

Results revealed that there was difference in the marketable bulb yield of onion in different treatments. However, no significant difference was observed in between treatments. The highest marketable bulb yield was recorded at Oxyfluorfen @ 0.15kg a.i. at 3 days after planting as soil application (34.4 t/ha) . Moreover, the percent A grade bulbs were higher in Oxyfluorfen applied plots, while C grade bulbs were more in control. Among the various weedicides and the method of application, application of Oxyfluorfen @ 0.15kg a.i. at 3 days after planting was found most effective in reducing both dicot and monocot weeds in *rabi* season grown onion.

Project 7.6 Studies on foliar feeding of nutrients and growth regulators in onion and garlic

Effect of foliar application of water soluble fertilizers on *rabi* onion (AICRP)

Among the various grades of water soluble fertilizers evaluated during *rabi* season in onion var. N-2-4-1, none of them differed significantly among themselves. However, application of water soluble NPK 19:09:19 at three sprays (30, 45 & 60 days after planting) recorded higher marketable bulb yield (38.6t/ha) of onion among the treatments.

Effect of lihocin on growth and yield of garlic

The growth retardant, lihocin (Chlormequat Chloride) @6ml/L was applied as foliar spray at different intervals (60, 75, 90, 105 days after planting) either alone or in combinations. Based on the results, it was observed that there was no significant difference on marketable bulb yield and storage life of garlic by foliar application of lihocin.

Among the drip irrigation treatments, higher seed yield was recorded at drip irrigation of 100 PE daily (443.7kg/ha) followed by drip irrigation at 75% PE daily (426.6kg/ha) and in case of control (surface irrigation), seed yield was 375.8 kg/ha only. However, these treatments were at par with each other and no significant difference were observed in between levels and intervals of drip irrigation. As far as water saving is concerned, there was 27- 45% saving of water in drip irrigation over surface irrigation.

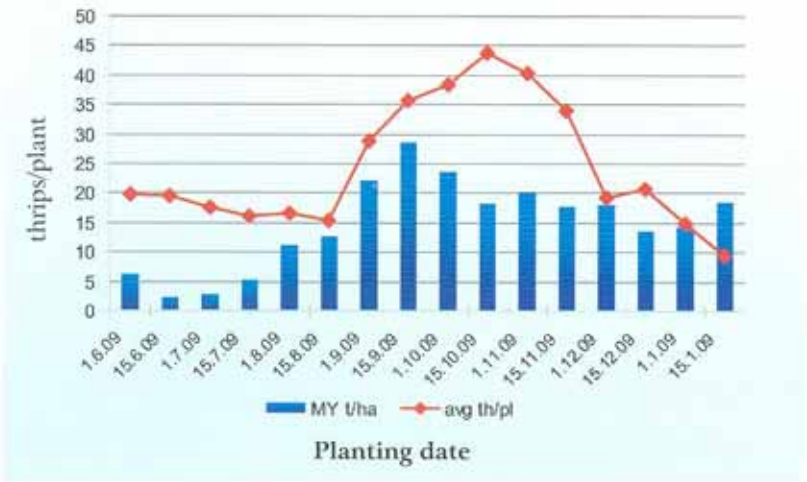
CROP PROTECTION

Programme 9	Integrated pest management in onion and garlic
Project 9.1	Population dynamics of thrips in onion and garlic

Impact of date of planting on thrips infestation and yield on onion

Dates of planting had significant effect on thrips infestation in onion. Compared to previous years, thrips infestation was varied to large extent during present year. This year (2007-08) late *kharif* plantings harboured more thrips than *rabi* plantings. Highest thrips infestation was noticed in the crop planted on 15 Oct (43.64/plant) followed by 1 Nov (40.14/plant) and 1 Oct (38.11/plant). *Rabi* plantings recorded thrips populations from 9.41 to 40.14/plant.

In *kharif* season, highest thrips were noticed in 1 and 15 June plantings. Unusually the lowest thrips were recorded in 15 Jan (9.41/plant) followed by 1 Jan plantings. Marketable yield was very low in *kharif* season plantings. Relatively yields were less in the present year. Highest yield was recorded in 15 September planting (28.45 t/ha). Yields were significantly higher in sprayed plots that recorded up to 33.79 t/ha. Yield losses were more in *kharif* season to the tune of 74.21% mainly because of poor plant stand, rotting and diseases.



Effect of date of planting on thrips infestation during 2007-08

Seasonal incidence of thrips: Two population peaks were observed in the months of August and December. During the infestation, thrips population was 51.51/plant. In the last 9 years this was the first time that thrips peak occurred in the month of December instead of February month.

Impact of planting dates on thrips infestation yield of garlic during 2007

In case of garlic, planting was done on 8 dates (D1-D8) starting from 1 Sep to 15 Dec. Thrips infestation was low during the period of study. Thrips infestation was varied across different planting dates. During the period of study, late plantings after October recorded significantly less population of thrips. Lowest thrips population was recorded on D8 and D7 followed by D6 and D5. Early and regular planting dates of October had significantly higher infestation of thrips, the highest being in 15 Oct and followed by 1 Sep plantings. Adult population did not change with the nymph population. At different dates, the thrip adults/plant ranged between 3.62-6.06/plant.

Dry bulb weight was recorded 15 days after harvesting. No particular planting i.e., early regular/recommended or late, recorded higher yield. Marketable yield ranged between 2.0-3.6 t/ha. In control plots, significantly higher yield was recorded in D8 and D2. In sprayed plots, the highest yield was 3.6 in D3 followed by 15 nov (3.5t/ha). Yield losses from 18.6- 83.9% were recorded across different planting dates with the lowest being in D8 and highest in D4. However the yield losses were not contributed by thrips infestation alone but also by the poor crop stand and growth as well.

Seasonal incidence: In case of garlic, thrips population reached to the peak in the month of November and December. However their number did not cross 30.0 /plant during any month from Oct- Mar. In the present year, thrips incidence was found unusually different compared to previous years. Adult thrips were found more in the month of January. The number of adults did not indicate the increase or decrease of nymphal population in the subsequent period. This shows that adult population may not give thrips load on plant.

Project 9.2 Development and evaluation of cultural methods for the control of thrips in onion and garlic

Barrier cropping for the management of thrips in garlic

Barrier crops were planted along with garlic crop. So initially the desired height of the barrier crop was not achieved to block the thrips. During the first one month, thrips population was same in all the treatments. At 2nd spray, thrips population in 2M & MW was 40% less than the control plots. After 3rd spray, thrips population increased to 48.83 in check plots on 16.01.2008 against 16.9 and 17.05/ pl. in MW & 2M, respectively. After each spray, thrips population increased in check plots faster than plots with barrier. On an average thrips were 11.22 and 11.91 /pl. in MW and 2M compared to control (55.21/ plant) check plots recorded 15.52 /M. Similarly number of adults were 5.02 and 5.40 /pl. in MW and 2M compared to 8.12 and 8.35 /pl. in check and control plots. The later 2 did no differ significantly. During the period of study 3 sprays were given in both check plots and barrier plots.

Barrier Crops	MY t/ha	Increase over control	Sprays	Spray cost	Gross income	Net income	B:C ratio
Pooled (2006 &2007)							
2M	3.3	0.8	2.5	2000	14625	12625	6.3
MW	4.2	1.7	2.5	2000	30465	28465	14.2
CHK	3.6	1.1	3.0	2400	20138	17738	7.4
NB	2.5						

2W - Two rows of maize MW - Maize and Wheat barrier CHK-Check NB-No Barrier

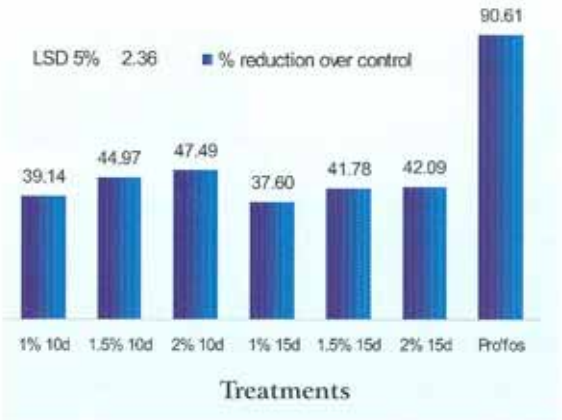
Marketable bulbs yield was recorded after one month. Plots with MW barrier recorded the highest yield of 5.5 t/ha followed by 4.1 t/ha in 2M. Check plot recorded 3.9 t/ha compared to the lowest yield of 2.4 t/ha in control. Net income was highest in MW (Rs. 53,400 /ha). Similarly, B:C ratio was the highest (22.3:1) in MW followed by 24 and check plots with 11.8 and 10.3 respectively.

When the two years data was pooled, the trend remained the same with lowest thrips of 11.4 in 2M and MW compared to 67.93/ pl in control, whereas check plot recorded 15.74/ pl. Based on two years data, the B:C ratio was highest in MW (14.2:1) against 2M (6.3:1) and check (7.4:1). The study suggested that for thrips management in garlic MW is more suitable as compared to 2M.

Project 9.4 Management of thrips through chemical control methods

Evaluation of mineral oil against onion thrips

Field trial was conducted during *rabi* season to evaluate the mineral oil (Servo Agro Spray) against thrips. Three doses viz., 1.0%, 1.5% and 2.0% were sprayed at 10 and 15 days interval. During the period of study thrips infestation was very low compared to regular years. Highest infestation of 36.9/pl was observed on 70 days old crop in control plots. Up to 30 days age there was no difference between mineral oils irrespective of doses. However, from 40 days onwards treatments, all the mineral oil treatments were found non-significant. The check treatment *i.e.* profenofos was found significantly superior over others in bringing down thrips. However, when thrips population averaged



over all sprays, mineral oil at 2.0% at 10 days interval was found significantly superior over other treatments. Efficacy of mineral oil ranged between 37.6 – 47.49%, the highest being with 2.0% mineral oil at 10 days interval. Profenofos brought down thrips by

90.62% as compared to control. Highest marketable yield of 39.36 t/ha was recorded in profenofos sprayed plots. However, there was no significant difference among the treatments including control. This may be due to very low infestation of thrips. The study suggested that mineral oil 2.0% sprays at 10 days interval were effective.

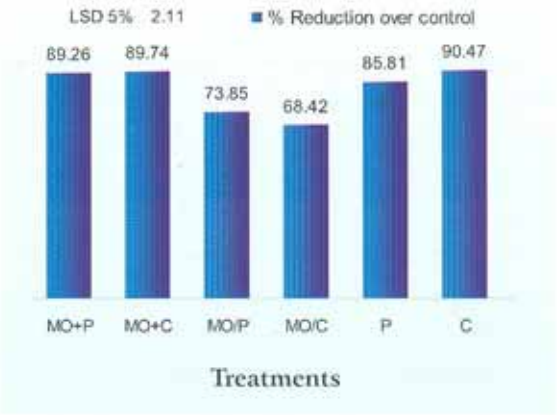
Effect of mineral oil on egg hatching and oviposition of thrips in onion

Mineral oils are known to form thin layer over the eggs laid down. As a result eggs do not hatch due to suffocation. To check this property and oviposition deterrence of mineral oil to thrips, a trial was conducted under poly house. The study clearly indicated that mineral oil had affected the emergence of thrips from eggs. T- Test (n= 15) suggested that mineral oil recorded 1.03 th/pl. compared to control which recorded 3.3 th/ plant.

In case of oviposition deterrence, 1.06 thrips / plant emerged from mineral oil sprayed plants compared to 6.23 /plant in case of control. The study suggested that mineral oil was effecting in both oviposition and egg hatching of thrips in onion.

Combined effect of mineral oil with insecticides on onion thrips infestation

To know the combined effect of insecticides with mineral oil, a field trial was conducted during rabi season. Mineral oil (1%) was combined with insecticides profenofos and carbosulfan. Treatments included combination of mineral oil with profenofos/ carbosulfan and alternate sprays of mineral oil with insecticides. Treatments were initiated as soon as infestation occurred. During the period of study thrips infestation was low. Except on 40 and 50 days, the



combination of mineral oil + profenofos and mineral oil + carbosulfan were found as good as simple sprays of carbosulfan and profenofos. Looking at the overall performance of all the treatments, all the treatments were significantly superior over control. The combination of mineral oil + carbosulfan (2.24 th/pl) and mineral oil + profenofos (2.36 th/pl) were as good as individual treatment of carbosulfan (2.09 th/pl) followed by profenofos (3.09 th/pl). Efficacy of these treatments was at par with around 90% control of thrips. In alternate sprays of mineral oil with these insecticides, efficacy was 73.85% and 68.42% as T3 and T4 respectively. Wherever mineral oil was sprayed, thrips population increased. Individual spray of carbosulfan recorded the highest marketable yield of 38.9 t/ha and was at par with profenofos (35.76 t/ha) and combined treatment of mineral oil + Profenofos (35.86 t/ha). Alternate sprays recorded the lower yields. Control plots recorded 26.0- 34.3 t/ha marketable yield.

Effect of some insecticides on onion thrips infestation

Insecticides viz., fipronil, methomyl, proclaim were evaluated at two doses with 10 and 15 days interval against onion thrips during rabi season. Observations were

recorded on 30-90 day aged plants at 10 day interval. In all the days of observation fipronil at both doses at 10 day interval was found significantly effective against thrips and were at par with check profenofos. When the thrips infestation averaged over the period from 30- 90 days, fipronil @ 60 g ai/ ha at 10 day interval recorded significantly lowest number of thrips @ 1.9/ plant followed by fipronil @ 50 g ai/ ha at 10 day interval (2.51 /pl.), profenofos (2.73/ pl.) and fipronil @ 60 g ai/ ha at 15 days interval (2.79/ pl.) which did not differ significantly among themselves. Proclaim was least effective but was found significantly superior over control. Fipronil @60 g ai/ ha when applied at 10 days interval has shown the highest efficacy of 91.61% in controlling thrips. Methomyl at both doses could bring thrips by 50 –60% only. Proclaim showed the least efficacy of 42.65 – 44.64%.

Efficacy of insecticides

Higher marketable yield was recorded in fipronil sprayed plots compared to all other insecticides. Highest marketable yield of 39.5 t/ha was recorded in fipronil @ 50 g ai/ha at 15 day interval, fipronil @ 60 g ai/ha at 10 days interval (39.4 t/ha), fipronil @ 60 g ai/ha (38.9 t/ha) at 15 days interval. Proclaim sprayed plots recorded the lowest yield of 25.06 – 25.50 t/ha. The study suggested that fipronil @ 60 g ai/ha at 15 days interval offered good protection against thrips and also gave the higher bulb yield in onion.

Reinfestation of thrips in insecticide sprayed plots

It was commonly noticed that reinfestation of thrips is very fast even in insecticides sprayed plots. To know the source for this re-infestation field trial was conducted. The thrips emergence was recorded on 7, 10 and 15 days later after each spray.

It was clear that re-infestation of thrips occurred in all the plants. The source of re-infestation was eggs laid down in the leaves and the external migration. 2.46 thrips/ plant were recorded in enclosed leaves and their number was 2.61 in plants where whole plant + soil was covered suggesting major contribution is from eggs laid inside the foliage. In case of open plants 6.4 th/ plant were recorded. Therefore even after good kill of thrips with insecticide sprays re-infestation occurred mainly from the inserted eggs that are not accessible to commonly sprayed insecticides.

When different insecticides were evaluated it was found that re-infestation was very less in fipronil (0.31/ plant) followed by profenofos with 2.14 thrips/ pl. Same trend was observed in plants where plant and soil were covered. Methomyl treated plants recorded 4.94 and 5.75 thrips/ plant when leaves, plant and soil were covered, respectively.

Fipronil was found effective in killing the emerged nymphs and made the plants free from thrips whereas in profenofos sprayed plants thrips number increased 10 day after spray from 1.67 – 4.83 /plant. In methomyl sprayed plants re-infestation was faster and thrips increased from 5.17 – 12.67 thrips at 7 – 10 days after spray. Control recorded highest re-infestation of 32.00 th/ pl. on 7 days after water spray. Studies suggested

that fipronil and profenofos might have either good ovicidal action or high persistence compared to other insecticides.

Reaction of garlic germplasm to thrips during *rabi* 2007

130 lines of garlic germplasm and 180 mutation lines of garlic were screened for thrips resistance during *rabi* 2007. In case of germplasm, 2 lines namely, WG 119 and WG 97 recorded the lowest rating of 2.0 and 2.5 respectively. All others had fallen in susceptible to highly susceptible category.

In case of mutation lines, 18 lines were found resistant to moderately resistant-CCS 16-2 M3, CDS 16-5 M3, CDT 14- M4, SAT 11-6 M3, CFS 4-1 M3, CBS 17-6 M3, CDS 8-M4, CDS 16-4 M3,CDS 12- M4, SAS 11- M4, CDS3-M4, CBS-16-M4, CDS16-M3, EL CBS 6-7-M3, SAT 10-4 M3, CDS 16-1 M3, CES 17-8 M3, EL CBS6-7 M3. They need to be screened for one more season to confirm the resistance.

Reaction of onion varieties to thrips during rabi 2007

Onion is available in different colours. However their relative reaction to thrips was not studied so far. Therefore, in *rabi* 2007, a total of 15 varieties (4 light red, 4 dark red, 5 white and 2 yellow) were screened for their reaction to thrips. However thrips population during the period of study was low ranging from 18.5 to 24.3 thrips/plant among different varieties. The curling was more in Y-74 and L-28 and was least in A. Niketan and N-2-4-1. Leaf injury ranged between 1.8 in Y-74 to 2.5 in NRCOG 650. Plant stand was good in all the varieties except in Phule suvarna. Highest marketable yield was recorded in N-2-4-1, PKV white, RGO-53, Phule safed, Pusa madhavi, ALR and NRCOG-650. Lowest yield was recorded in Phule suvarna and L-28. As thrips population was low, it was not clear to conclude which colour group was resistant to thrips.

Programme 10 Integrated disease management in onion and garlic

Project 10.1 Geospatial pathogenic and molecular characterisation of fungal diseases in onion and garlic-detection, management and risk analysis

Out of 86 GPS samples of major foliar diseases of onion and garlic collected from Gujarat, 1018 isolations were made, and 868 *Stemphylium*, 143 *Alternaria* and 7 *Emblesia* isolates were obtained. For the first time *Emblesia* isolates have been collected from Garlic growing areas. One *A.fistulosum* plant sample with purple blotch symptoms from China yielded 10 isolates .Thirty isolates were single spored. Molecular characterization of 210 isolates of Stemphylium following standard RAPD protocol using eight arbitrary 10-base oligonucleotide primers (Pacific Oligos), giving simple clear polymorphic banding patterns, was carried out. A cluster analysis was conducted to ascertain the number of natural groupings among these 210 isolates. Two groups were identified where in Group I is more diverse and similar to S.American reference and Group II is similar to American reference isolates A diverse group with 15 isolates from Maharastra and Gujarat was found which did not resemble any of the reference isolates.

GPS collection and characterization of isolates 2008-09

Region	Pathogen and number of isolates					
	Alternaria porri	*Stemphylium*	*Colletotrichum*	*Fusarium oxysporum f sp cepae*	*Pyrenochaeta terrestris*	*Emblesia*
Rajgurunagar	120	80	23	32	35	
Genotypes	143	868	-	-	-	7

Race typing for identification of differentials

Five genotypes, W-448BR-3, B-780, Pune-Phursungi, N-2-4-1, Colina, and two botanical varieties multiplier onion and Rose Onion were used as differentials for race typing against ten isolates of *A.porri* from garlic and onion. Race typing was done on tray grown seedlings at the age of 60 days using an atomizer @ 4000 spores /ml and kept for incubation covered in a Plexiglas chamber for 24 hrs and observations were recorded based on grading for every 15 days The data was analyzed and the mean of disease severity was calculated. The white genotype W-448BR-3, showed lowest mean disease incidence compared to other genotypes. Pune phursungi was least affected. No single genotype with high disease mean was found. The Chinese isolates were virulent on all genotypes

Mean and standard error (in parenthesis) of severity of 10 isolates of *Alternaria porri* on eight genotypes

Sl No	Isolate	W-448, BR-3	B-780	Pune-Fursungi	N-2-4-1	Colina	Multiplier onion	Rose Onion
1	3343-3 (Onion)	0.06 (0.01)	0.59 (0.05)	0.48 (0.06)	0.69 (0.05)	0.23 (0.03)	0.20 (0.03)	0.28 (0.05)
2	2146-4 (Onion)	0.03 (0.03)	0.46 (0.10)	0.12 (0.05)	1.81 (0.08)	0.00 (0.00)	0.08 (0.04)	0.02 (0.02)
3	2236-2 (Onion)	0.05 (0.01)	1.17 (0.03)	0.57 (0.06)	1.21 (0.05)	0.24 (0.03)	0.41 (0.05)	0.55 (0.05)
4	3959-1 (Onion)	0.01 (0.01)	0.31 (0.06)	0.25 (0.07)	1.80 (0.08)	0.07 (0.04)	0.04 (0.02)	0.97 (0.08)
5	4074-1 (china)	0.06 (0.02)	1.03 (0.17)	1.12 (0.09)	1.45 (0.09)	0.45 (0.17)	0.96 (0.15)	1.01 (0.12)
6	4074-2 (China)	1.82 (0.06)	1.86 (0.03)	0.27 (90.06)	2.12 (0.04)	0.58 (0.12)	1.82 (0.06)	1.29 (0.12)
7	4063-2 (Garlic)	0.03 (0.03)	1.16 (0.14)	0.91 (0.12)	2.18 (0.07)	0.11 (0.06)	0.24 (0.11)	0.37 (0.10)
8	2138-2	0.00 (0.00)	1.92 (0.10)	0.10 (0.06)	2.12 (0.05)	0.28 (0.11)	0.15 (0.08)	0.85 (0.15)
9	2229-1 (Onion)	0.15 (0.08)	0.85 (0.15)	1.08 (0.16)	0.00 (0.00)	1.92 (0.10)	0.10 (0.06)	2.12 (0.05)
10	2236-4 (Onion)	0.23 (0.05)	0.06 (0.04)	0.51 (0.04)	0.91 (0.10)	1.02 (0.13)	1.07 (0.09)	0.53 (0.11)

Evaluation of wild and cultivated genotypes (Field) for resistance to foliar and soil borne diseases

Fifty seven wild and cultivated genotypes obtained from HRI through NBPGR were raised in the field and the disease severity was recorded using 5 disease rating scales for both foliar pathogens and 1-10 scale for soil pathogens. The disease was not noticed even after 75 days after transplanting hence sprinkler was introduced to modify microclimate with the result disease development took place and the data was recorded.

Mean and standard error (in parenthesis) of severity of *Alternaria porri* and *Stemphylium vesicarium* on *Allium* genotypes

CGN NO	Botanical Name	Names	*Stemphylium vesicarium*	*Alternaria porri*
CGN 18761	*Allium cepa* X *fistulosum*	Beltsville Bunching	0.06 (0.01)	0.00 (0.00)
CGN 16381	*Allium ampeloprasum* Group Leek	Hafnia	0.03 (0.03)	0.00 (0.00)
CGN 18724	*Allium ampeloprasum* group Kurrat	Balady	0.00 (0.00)	0.00 (0.00)
CGN 16374	*Allium ampeloprasum* (Leek)		0.02 (0.01)	0.00 (0.00)
CGN 14718	*Allium ampeloprasum*	Blauwgroene Winter Catalina	0.11 (0.06)	0.11 (0.06)
CGN 16387	*Allium ampeloprasum* group Leek	Arial	0.06 (0.02)	0.46 (0.10)
HRI	*Allium ampeloprasum*	Blue Gree	0.46 (0.10)	0.00 (0.00)
HRI	*Allium ampeloprasum*	Swiss giant	0.02 (0.01)	0.07 (0.04)
HRI	*Allium fistulosum*	White speech	0.05 (0.01)	0.06 (0.02)
ALL 750	*Allium fistulosum*		0.02 (0.01)	0.02 (0.01)
All 646	*Allium fistulosum*		0.08 (0.04)	0.24 (0.03)
HRI	*Allium fistulosum*	Chinese chive	0.59 (0.05)	0.24 (0.03)
CGN 20779	*Allium tuberosum*	Hanzong winter	0.00 (0.00)	0.00 (0.00)
HRI	*Allium tuberosum*	Welsh Onion	0.00 (0.00)	0.00 (0.00)
CGN 16412	*Allium tuberosum*	Kui Chaii	0.00 (0.00)	0.00 (0.00)
CGN 15749	*Allium tuberosum*	Bawang kukai	0.00 (0.00)	0.00 (0.00)
CGN 16373	*Allium tuberosum*	Kui chaii	0.00 (0.00)	0.00 (0.00)
CGN 14769	*Allium altaicum*		0.04 (0.02)	0.00 (0.00)
CGN 14770	*Allium altaicum*	Fra	0.58 (0.12)	0.00 (0.00)
HRIGRU 11292	*Allium cepa*		0.01 (0.01)	0.04 (0.02)

CGN NO	Botanical Name	Names	*Stemphylium vesicarium*	*Alternaria porri*
HRI	*Allium cepa*	Sarand	0.06 (0.02)	0.96 (0.15)
ALL 1595	*Allium cepa*		0.03 (0.03)	1.82 (0.06)
ALL 37	*Allium cepa*	Spasskij	0.96 (0.15)	0.23 (0.03)
HRI	*Allium cepa*	Pompei	0.24 (0.11)	0.57 (0.06)
HRI	*Allium cepa*	Goudami	0.15 (0.08)	0.25 (0.07)
HRI	*Aallium cepa*	Brown span	0.23 (0.03)	1.12 (0.09)
HRI	*Allium cepa*	Oum Zouer	0.00 (0.00)	0.27 (0.06)
ALL 158	*Allium cepa*	Vertjuzanskij	0.24 (0.03)	0.91 (0.12)
HRI	*Alllium cepa*	Sajovamos	0.07 (0.04)	0.10 (0.06)
HRI	*Allium cepa*	Beth Alpha	0.45 (0.17)	0.28 (0.11)
HRI	*Allium cepa*	Ben Shemen	0.28 (0.11)	0.23 (0.03)
HRI	*Allium cepa*	Shakespeare	0.48 (0.06)	0.00 (0.00)
HRI	*Allium cepa*	Makoi Bron	0.57 (0.06)	0.06 (0.01)
HRI	*Allium cepa*	HRIGRU 11295	0.25 (0.07)	0.03 (0.03)
HRI	*Allium cepa*	Babosa jena	1.12 (0.09)	0.05 (0.01)
HRI	*Allium cepa*	New Mexico	0.27 90.06)	0.01 (0.01)
HRI	*Allium cepa*	Summer Island	0.91 (0.12)	0.06 (0.02)
HRI	*Allium cepa*	Angaco	0.10 (0.06)	0.02 (0.01)
HRI	*Allium cepa*	HRIGRU11296	0.28 (0.11)	0.03 (0.03)
HRI	*Allium cepa*	Early Red	0.48 (0.06)	0.00 (0.00)
HRI	*Allium cepa*	HRIGRU2427	0.12 (0.05)	0.20 (0.03)
HRI	*Allium cepa*	Malakoff	0.06 (0.01)	0.08 (0.04)
HRI	*Allium cepa*	Red synthetic	0.03 (0.03)	0.41 (0.05)
HRI	*Allium cepa*		0.05 (0.01)	0.04 (0.02)
HRI	*Allium cepa*	HRIGRU 12488	0.01 (0.01)	0.96 (0.15)
HRI	*Allium cepa*	Californian	0.02 (0.01)	0.15 (0.08)
HRI	*Allium cepa*	Sajovomos	0.03 (0.03)	0.23 (0.03)
ALL 1587	*Allium cepa*		0.02 (0.01)	0.15 (0.08)
HRI	*Allium cepa*	Rijnsburger	1.17 (0.03)	0.00 (0.00)
HRI	*Allium cepa*	Djabal maro	1.03 (0.17)	0.02 (0.01)
HRI	*Allium cepa*	Mitzari haem	1.86 (0.03)	0.03 (0.03)
HRI	*Allium cepa*	Pukekohe	1.16 (0.14)	0.00 (0.00)

Allium altaicum

1. *A.fistulosum*
2. *A.tuberosum*

Field resistance to foliar diseases

Among the eighteen wild *Allium* genotypes belonging to four species, *Allium fistulosum, A.altaicum, A.ampeloprasum and A.tuberosum, A.fistulosum X A.cepa (F1), Allium tuberosum* was completely free from *Stemphylium, Alternaria,* and *Fusarium* and *Pyraenochaeta* infection, where as, *A. ampeloprasum* showed varied degree of resistance to *Stemphylium* and most of the land races were resistant to *Alternaria* and none of them showed symptoms of *Fusarium* infection. Among *A.fistulosum* only one accession Balady was free from both the foliar pathogens *Alternaria* and also *Stemphylium.* Among *A.altaicum* lines, high degree of resistance to *Stemphylium* and hypersensitivity to *Alternaria* was noticed. *Allium cepa* X *A.fistulosum* showed high degree of resistance to *Stemphylium* and was free from infection from of *Alternaria*. Among cepa lines, ALL 1587 recorded least incidence of both *Stemphylium* and *Alternaria.*

Free from infection of any foliar diseases

1. *Allium cepa*
2. *A. ampeloprasum*

Basal rot of onion caused by *fusarium oxysporum* f sp *cepae*

Fungal isolation and identification : Forty-one samples each representing a single field of onion or garlic was collected from various plots across Rajgurunagar farm during the growing seasons in 2008 and 2009 The Fusarium isolates obtained from onion and garlic were purified. The fungus was then sub-cultured on potato dextrose agar (PDA) , MG Agar, Peptone PCNB and Komada medium Fusarium isolates were identified according to Nelson et al. Spores of pathogenic isolates identified as *F. oxysporum* by microscopic examination were transferred to complete medium (CM; 10) and grown for 4 days at 25°C under continuous fluorescent lights. Characteristic mycelial development with pigmentation confirmed the identity of the pathogen

Top and bottom view *Fusarium oxysporum* f sp *cepae* in culture

Pathogenicity test

The spore concentration was adjusted with a haemocytometer to approximately 107 conidia ml^{-1}. Selected healthy seedlings of onion for the pathogenicity test were obtained from sterilized seeds after three weeks of cultivation in sterile soil. Onion seedlings were soaked in the conidial suspension of each isolate of Fusarium for 24 h and then planted in trays with sterile soil. Plants were maintained in a net house Tests were replicated four times. Symptoms on onion plants were observed three weeks after inoculation. Golden to yellowish brown (occasionally light to dark pink) lesions appeared on roots of onion. Seedling assay performed by using inoculums multiplied on sterile sorghum grains in flasks and incorporated to sterile soil in trays. This can also serve as a good screening method for onion and garlic genotypes for resistance against the disease

Seedling assay tray method for Fusarium susceptibility

1. With inoculum
2. without inoculum

Disease Progression Study

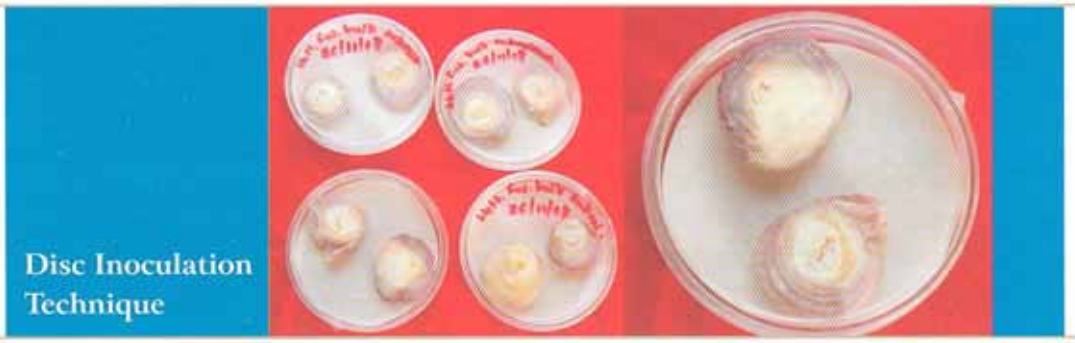
Disease progression for mature bulbs was evaluated to determine if the pathogen was present in the basal plate but not causing symptoms. After the initial rating was taken, bulbs were stored at ambient conditions in paper bags for four weeks at laboratory conditions. Bulbs that were rated as 9 were not stored. At two and four weeks, basal plates were re-cut and rated for Fusarium Basal Rot (FBR) severity. After the two week observations were taken, bulbs were returned to storage for reevaluation at four weeks. A mean incidence for each cultivar was calculated from the average FBR incidence per plot. After four weeks in storage, FBR severity increased for all cultivars. However cultivars differed in their disease progression trends over their four week storage period. The cultivar B 780 harvested during *kharif* showed a low severity at harvest (1.46) but progressed in its severity after four weeks in storage (7.1). White variety showed a high severity rating at harvest (2.20) but had a low rate of disease progression over four weeks (3.1). Bhima Red had a high FBR severity rating at harvest (4.06) and had a high rate of disease progression over four weeks (7.1). N-2-4-1 00-25 had a low FBR severity at harvest and had a low rate of disease progression over four weeks (3.2). Rose onion, multiplier onion and Bhima Super had some of the lowest FBR severities at four weeks.

FBR Disease progress

Genotype	Disease severity		
	Harvest	2 weeks	4 weeks
B 780	1.46	4.5	7.1
Bhima Red	4.06	3.6	7.1
N-2-4-1	2.25	2.7	3.2
Bhima Super	2.0	2.20	3.2
Rose Onion	1.8	2.1	2.25
Multiplier onion	1.0	2.20	2.5
W-448 BR-3	2.20	2.5	3.1

Disc Inoculation Technique

The infected basal plate and roots of the individual onion samples were collected, pulverized under aseptic conditions to produce inoculum. Sterile distilled water (5 ml) was added to each gram of pulverized tissue and the resulting suspension was spread over the onion slices. *F. oxysporum* colonies that developed on onion slices at 25°C after 5 to 7 days of incubation on a lab bench under continuous fluorescent light provided evidence of isolate's pathogenicity according to the methodology of Abawi and Lorbeer. Spores of pathogenic isolates identified as *F. oxysporum* by microscopic examination were transferred to complete medium (CM; 10) and grown for 4 days at 25°C under continuous fluorescent lights.



Disc Inoculation Technique

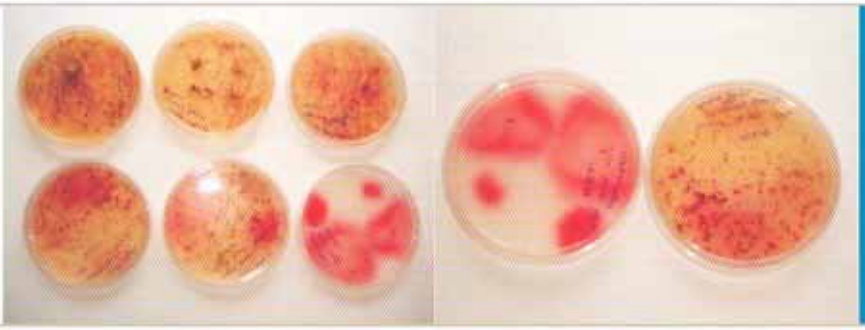
Pink Root Disease

Pyraenochaeta terrestris (Hansen) Gorenz, J. C. Walker, & Larson causes pink root disease on a wide range of plants. Onions, garlic, and shallots are most susceptible. The disease was first noticed at Rajgurunagar Farm in 2005 and at a very severe condition in the 2008-2009 Rabi nurseries in D 1-1 plot.

Severely affected nursery due to pink root of onion with typical tip burn symptoms

Isolation of the causal agent.

It is very difficult to isolate, identify and characterize pink root pathogen as it is always associated with Fusarium, pathogenic and non pathogenic forms. In order to isolate, characterize and identify the pathogen, diseased roots of onion were washed with tap water for 1 hour and cut into 5 mm length. The diseased root pieces were washed again for 24 hours with running tap water and surface-disinfected with 0.5% NaOCl for 5 minutes. The root pieces were rinsed with sterilized water, cut into 2-3 mm length, and placed on Wheat straw agar, water agar with Streptomycin and tetracycline (pH 5.0) at 20°C. Alternatively, the basal plate infected was surface sterilized as described above and plated on to wheat straw agar and water with antibiotics. The fungal isolates grown on the medium were cut and transferred to potato dextrose agar (PDA)



Pink coloration on Wheat straw medium and new media with roots and root disc

Characterization of the causal agent

To initiate pycnidial formation of the isolates, one per ten isolates was cultured on wheat straw agar for 10 days in alternating cycles of 12 hours near ultraviolet light (NUVL) and 12 hours darkness, 24 hours NUVL, 24 hours fluorescent light and 24 hours darkness. The morphological characteristics on the medium were examined by light microscope and compared with those of *Pyraenochaeta terrestris* (Hansen) Gorenz, Walker & Larson described by Punithalingam and Holliday. The pigmentation of agar by the fungus was investigated by placing diseased root tips on

water agar and also affected disc with pink roots directly on water agar plates and incubating plates at 25°C for 10 days. Growth tests of the pathogen on growth media mycelial growth of the fungus on culture media (Wheat straw agar, PDA, malt agar, V8 agar, and Czapek-Dox agar) was investigated by measuring colony diameter of each isolate.

Soil Culture

Actively growing cultures were transferred to screw-top test tubes (about 25 X 150 mm) of sterile loam soil. The isolates of the pink root fungus were allowed to grow at room temperature until they reached the bottoms of the soil tubes. This took approximately one month. Soil cultures were then placed in cold storage. The viability and pathogenicity of various isolates of the fungus may be maintained for at least a decade by this method if the cultures do not dry out. The plastic trays containing sterile soil inoculated with the soil culture can be utilized for seedling assays. This technique can be utilized for screening genotypes against pink pathogen

1. Soil inoculation for culture maintenance
2. Inoculum multiplication on sorghum

1. Tray inoculation
2. Diseased

Cultural characteristics

The pathogen grew best on PDA, followed by malt agar, V8 agar, and Czapek-Dox agar. It grew well at temperature range of 20-30°C with optimum temperature of 25°C, and on media with broad pH range of 4.0-10.0

Pathogenicity: Surface sterilized onion seeds were sown in trays with inoculums and and kept in a net house under controlled conditions for 25 days , while color changes of onion roots elongating from the germinated seedlings were observed and confirmed for infection. The seedlings uprooted from the test trays confirmed pink root in seedlings, these inoculated on wheat straw medium expressed pink coloration characteristic of the fungus confirming pathogenicity Surface sterilized corn seedlings were kept in contact with the

culture on wheat straw agar and also in pycnidial spore suspension and transplanted in plastic pots containing sterile soil. Plants were uprooted 75 days after planting and observed for the characteristic pink root symptoms for confirming the pathogen ability to cross infect maize.

Infected corn roots after cross inoculation

Project 10.2 Suppression of soil borne diseases of onion through composting

Onion culls were composted using a combination of Onion culls (20 kg)+ Vermicompost (5 kg) + Trichoderma (50 g) in crates under semi anaerobic conditions for 30 days. The compost thus obtained was used for isolation of microorganisms and also for studying the effect on survival of sclerotia of *Sclerotium cepae*. To compare the microbe composition with that of NADEP pit, samples were drawn from both the composting sources following standard protocols.

The NADEP and onion culls composting samples taken to enumerate the microorganisms, revealed 6 Fungi, 5 Actinomycetes and 4 bacterial species from onion compost mixture and 3 Fungi 2 Actinimycetes and 5 bacteria from the NADEP samples.

Sclerotium cepae (White rot of onion)

Pathogenicity experiment

An experiment was set up to see the pathogenicity of four *S. cepivorum* isolates obtained from different onion production areas in Maharastra, as well as to compare the white rot susceptibility of genotypes. Fungus isolates were obtained from a composite soil sample taken from a single plot of approximately one ha; in each of the four localities NHRDF field two Isolates, Jalgaon Jain irrigation field 1 and Rajgurunagar one. Black plastic pots , used as plant containers, were filled with 5 kg of sterilized infested with three sclerotia g^{-1} of soil. Sclerotia for inoculation were produced on autoclaved sorghum, seeds, and wheat straw incubated at 19 °C for 20 days. The formed sclerotia were harvested and used to infest the soil. For each combination disease incidence was recorded every three days, and severity was determined at the end of the experiment using an arbitrary index from 0 to five, where 0=0% of onion bulb surface affected and 5=86 to 100% of onion bulb surface affected by the fungus. A difference in seedling emergence was evident. There were also clear differences regarding root development. The fungus isolates of NHRDF induced the highest final incidence and severity of white

rot, followed by Jalgaon and Rajgurunagar. All isolates induced final incidences over 50%.

The sclerotia were mass multiplied on wheat straw, harvested sclerotia were embedded in onion compost mixed with onion growing soil (@ 10t/ha), onion growing soil and Vermicompost in mesh bags to facilitate easy recovery of sclerotia at monthly intervals. The sclerotia thus recovered periodically were plated on to 2% water agar for rating viability. The sclerotia of *A.cepa* did not survive in onion compost where as it survived up to 80% in vermicompost alone and 100% in field soil. Differences in survival rates of sclerotia in onion compost for different isolates have been noticed and needs to be verified for all the isolates.

Survival of sclerotia in composts

Compost Treatment	Duration Monthly intervals											
	Jan 2009	Feb 2008	Mar 2008	Apr 2008	May 2008	Jun 2008	Jul 2008	Aug 2008	Sep 2008	Oct 2008	Nov 2008	Dec 2008
Only Vermicompost	90%@	90%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
Grow Onion Field Soil	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Onion Compost	Nil	60%	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

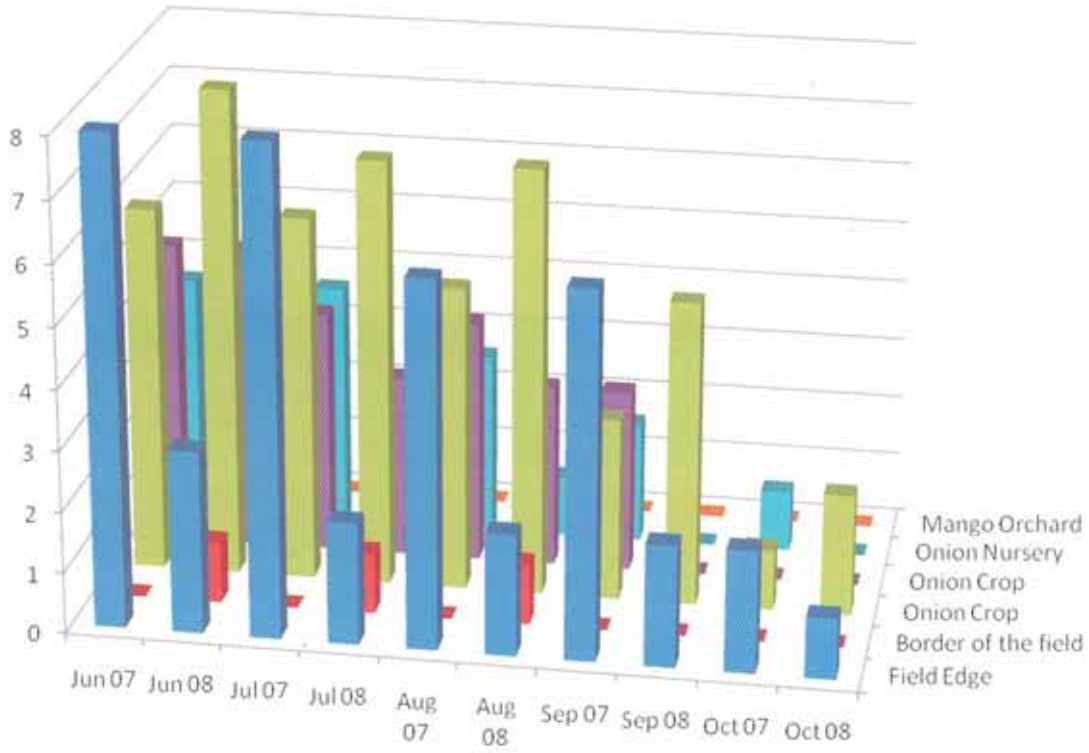
Percentage : refers to viability of sclerotia determined by their germinability on 2% water agar

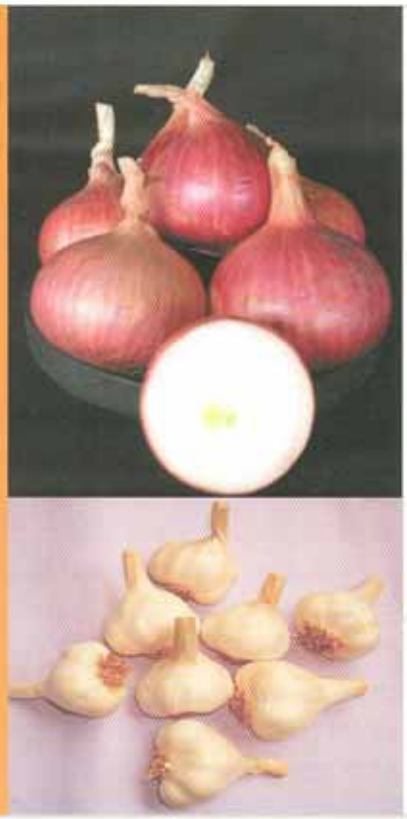
Project 10.3 Pathogenic diversity and Management of Iris Yellow Spot (IYS) in Onion

To understand the epidemiology of the virus including the role of thrips vectors and alternate hosts in disease outbreaks an experiment was laid during 2007-08 in the field to collect the data on emergence of thrips even after the crop is harvested. Six locations representing probable thrips infestation were selected. Soil sampling technique using Funnel (2007-08) and PVP tubes with thrips proof cover were used. The locations from where samples were collected have been described. Overwintering locations of onion thrips were determined by collecting soil from experimental onion fields located in Rajgurunagar The number of sites sampled per year included the field edge (first the crop extending from the edge into the field), field interior, random locations throughout the field where cull onions were found, and habitats adjacent to the field (i.e., the near the border of the field)., Samples taken from the field edges was with out any vegetation and bare , where as from the field interior and outside the field had weedy vegetation.

The adults start emerging in the first week of June in both 2007 and 2008.The total adult emergence varied among sites and also between the years. In 2007 more adults emerged from the field than in 2007 and also comparison to other sampled sites. The adults emerged till Oct and their number decreased towards October.

Monthly emergence of Thrips





New Varietal Release

During the AICRP (VC) group meeting, onion variety "Bhima Red" and garlic variety 'Bhima Omkar' developed by this centre were identified for release at National level and recommended for zone VII (Maharashtra and Madhya Pradesh) and zone VI (Haryana, Rajasthan, Gujarat and Delhi) respectively.

Bhima Red : This variety has been developed through bulb to row selection method from a base population of cv. B-780. After transplanting, it takes 120-140 days for harvesting. The bulbs possess attractive red colour, round shape with higher percentage of marketable bulbs. This variety yields around 30 t/ha in *rabi* season.

Bhima Omkar : This line has been identified for high yield and better quality. It has been developed through clonal selection. The bulbs are medium in size, compact and white in colour. Average marketable yield is 7.7 t/ha with an average of 18-31 cloves per bulb.

ON GOING PROGRAMMES AND PROJECTS AT DOGR

Programme 1	Development of red and light red onion varieties/ hybrids suitable for different seasons having resistance to biotic and abiotic stresses
Scientist	Dr. AJ Gupta, PI
Project 1.1	Collection, evaluation and maintenance of red onion germplasm
Project 1.2	Development of onion varieties suitable for different seasons for year round availability
Project 1.3	Heterosis breeding in red onion
Project 1.4	Breeding red onion varieties resistant to biotic and abiotic stresses

Programme 2	Development of white and yellow onion varieties/ hybrids for processing and export having resistance to biotic and abiotic stresses
Scientist	Dr. V Mahajan, PI
Project 2.1	Collection, evaluation and maintenance of white onion germplasm
Project 2.2	Development of high TSS white onion varieties suitable for different seasons and processing
Project 2.3	Collection, evaluation and maintenance of yellow onion germplasm
Project 2.4	Development of yellow onion varieties suitable for export
Project 2.5	Heterosis breeding in white and yellow onion
Project 2.6	Breeding white and yellow onion varieties resistant to biotic and abiotic stresses

Programme 3	Improvement of garlic through conventional and biotechnological approaches
Scientist	Dr. A Khar, PI
Project 3.1	Collection, evaluation and maintenance of garlic germplasm
Project 3.2	Development of high yielding garlic varieties suitable for different production areas
Project 3.3	Studies on somaclonal variations in garlic
Project 3.4	Production of virus free garlic through in vitro meristem tip culture
Project 3.5	Somatic hybridization in garlic to generate novel cybrids
Project 3.6	Molecular analysis of genetic diversity in garlic
Programme 4	Onion improvement through biotechnological approaches
Scientist	Dr. A Asha Devi, PI
Project 4.1	Induction of haploids in onion
Project 4.2	Micropropagation studies in onion
Project 4.3	DNA profiling of onion lines using molecular markers
Programme 5	Collection, characterization and screening of wild species for *Allium* improvement
Scientist	Dr. A Khar, PI
Project 5.1	Screening of wild species for biotic and abiotic stresses and introgression of desirable genes in *Allium cepa*
Programme 6	Integrated nutrient management for onion and garlic
Scientist	Dr. A. Thangasamy, PI
Project 6.4	Studies on nutrient deficiency symptoms in garlic
Project 6.5	Assessment of nutrient requirement for garlic
Project 6.6	Nutrient uptake studies in garlic

Programme 7	**Enhancement of production of onion and garlic through agronomic innovations**
Scientist	**Dr. V Sankar, PI**
Project 7.2	Studies on onion and garlic based cropping sequences
Project 7.3	Microirrigation and fertigation studies in onion and garlic
Project 7.4	Studies on organic production of onion and garlic
Project 7.5	Weed management studies in onion and garlic
Project 7.6	Studies on foliar feeding of nutrients and growth regulators in onion and garlic
Programme 8	**Onion seed production technology**
Scientist	**Dr. V Sankar, PI**
Project 8.1	Integrated weed management studies in seed crop
Project 8.2	Micro-irrigation and fertigation studies in onion seed crop (AICRP)
Programme 9	**Integrated pest management in onion and garlic**
Scientist	**Dr. PS Srinivas, PI**
Project 9.1	Population dynamics of thrips in onion and garlic
Project 9.2	Development and evaluation of cultural methods for management of thrips in onion and garlic
Project 9.3	Biological control of thrips in onion and garlic
Project 9.4	Management of thrips through chemical control methods
Project 9.5	Monitoring and detection of pesticide residues in onion and garlic
Programme 10	**Integrated disease management in onion and garlic**
Scientist	**Dr. CR Ramesh, PI** **Dr. RP Singh, PI (Project 10.4)**
Project 10.1	Geospatial pathogenic and molecular characterization of fungal diseases in onion and garlic detection, management and risk analysis

Project 10.2	Suppression of soil borne diseases of onion through composting
Project 10.3	Pathogenic diversity and management of Iris Yellow Spot (IYS) In onion
Project 10.4	Management of major diseases of onion and garlic through non-chemical methods
Project 10.5	Management of foliar diseases of onion and garlic through chemical methods
Project 10.6	Management of soil borne diseases of onion and garlic
Project 10.7	Isolation, characterization and evaluation of antagonists against onion and garlic pathogens

Programme 11	Reduction of post- harvest losses in onion and garlic
Scientist	Sr. Scientist (Hort.), PI Dr. V Sankar

Project 11.1	Studies on effect of pre- harvest practices on storage life of onion and garlic
Project 11.2	Effect of different storage environments / structures on storage life of onion and garlic

Programme 12	Seed quality management in onion and garlic
Scientist	Dr. MK Kuchlan, PI

Project 12.1	Seed packing and storage studies
Project 12.2	Improvement of seed quality by invigoration
Project 12.3	Disease free seed production
Project 12.4	Studies on seed pelleting in onion

Externally funded projects

	Central Sector Scheme
Project	Implementation of PVP and FR legislation and DUS testing in onion and garlic
Scientist	V Mahajan

	Mega Seed Project, ICAR
Project	Seed production in agricultural crops and fisheries
Scientist	KE Lawande and V Sankar

LIST OF PUBLICATIONS

Research Papers

Khar A, Asha Devi A and KE lawande. 2008. Analysis of genetic relationships among Indian garlic (*Allium sativum* L.) cultivars and breeding lines using RAPD markers . *Ind. J. Gen.* 68: 52-57.

Mahajan V, J Jakse, MJ Havey and KE Lawande. 2009. Genetic fingerprinting of onion cultivars using SSR markers. *Ind. J. Hort.*, 66 (1), 62-68.

Sankar V, D Veeraragavathatham and M Kannan. 2008. Studies on organoleptic evaluation of organically produced white onion. *Allium Newsletter*, 17: 1-6

Sankar V, D Veeraragavathatham and M Kannan. 2008. Post harvest storage life of white onion influenced by organic farming practices. *Allium Newsletter*, 17: 45-54

Sankar V, KE Lawande and PC Tripathi. 2008. Effect of micro irrigation practices on growth and yield of onion. *Ind. J. Agr. Sci.*, 78(7): 584-588

Sankar V , KE Lawande and PC Tripathi. 2008. Effect of micro irrigation practices on growth and yield of garlic. *Journal of Spices and Aromatic Crops*. 17(3): 230-234

Sankar V, D Veeraragavathatham, M Kannan, V Prakasam and K Subbiah. 2008. Studies on organic practices on growth and yield of yellow onion. *Journal of Maharashtra Agricultural Universities*. 33(2): 255-257

Sankar V, D Veeraragavathatham, M Kannan. 2009. Studies on organic farming practices in white onion. *Journal of Ecofriendly Agriculture*. 4(1) 17-21.

Verma VD, K Pradheep, Anil Khar, KS Negi and JC Rana. 2008. Collection and Characterization of *Allium* Species from Himachal Pradesh. *Ind. J. of Plant Genetic Resources*. 21(3): 225-228.

Papers / Abstracts / Posters presented in conferences

Mahajan V & KE Lawande. 2008. *Rangda kandhyache bharghosh utpadan* In : Souvenir "Rajya Stariya Charcha Satra – *Bhajipala utpadan, kadhniche tantragyan aani beejoutpadan*" held at Baramati from 31 March -1 April, 2008, 1-14.

Mahajan V & K.E. Lawande. 2008. *Lahasoon utpadanache sudharit tantragyan* In : Souvenir of "Rajya Stariya Charcha Satra – *Bhajipala utpadan, kadhniche tantragyan aani beejoutpadan*" held at Baramati from 31 March -1 April, 2008, 13-22.

Mahajan V & K.E. Lawande. 2008. Recent advances, problems and prospects of onion cultivation in India. In Souvenir : "Recent trends in research on spices and aromatic plants-National Seminar" held on 10 – 12 September, 2008 at CCH HAU, Hisar, P 91-101.

Mahajan V, V. Sankar & K.E. Lawande . 2008. Post harvest handling of onion & garlic. In Souvenir: "Recent trends in research on spices and aromatic plants, National Seminar" held on 10 – 12 September, 08 at CCH HAU, Hisar, 150-155.

Tripathi P.C., V. Sankar, V Mahajan & K.E. Lawande. 2008. Response of gama irradiation on post harvest losses in onion varieties. In 3rd Indian Horticulture Congress on New research & development initiatives in horticulture for accelerated growth & prosperity held at Bhubneswar on 6-9 November, 2008.

Mahajan V. 2009. Onion Seed production, problems & prospects presented at National Seminar on "Vegetable seed production-Integrated approaches, issues and strategies" at NHRDF Chitegaon, Nashik from 27-28 Feb., 2009.

Sankar V , PC Tripathi and KE Lawande. 2008. Post harvest technology in onion and garlic . Paper presented in Interactive Review Meeting on Post Harvest Technology in Horticultural Crops held at IIHR, Bangalore.

Popular articles

Mahajan V & KE Lawande. 2008. *Kanda sathavanukiche niyojan* Part-2. Agro-1, 22 April, 2008.

Mahajan V & KE Lawande. 2008. *Kandha sathavanukiche sutre* Part-3. Agro-1, 27 April, 2008.

Mahajan V & KE Lawande. 2008. *Kandhyasathi namunedar sathavangruhachi ubharni* Part-4. Agro-1, 29 April, 2008.

Lawande KE & V Mahajan. 2008. *Kharif kandhyachi ropvatika*. Agro-1, 4 May 2008.

Lawande KE & V Mahajan. 2008. *Kanda lasun - sathavan & prakriya*. Godwa Sheticha, May 2008, 71-78.

Mahajan V & KE Lawande. 2008. *Kharif Kandhyachi Lagwad* Part-1. Agro-1, 1st June, 2008.

Mahajan V & KE Lawande. 2008. *Kanda bee perun lagwad*- Part-3. Agro-1, 4 June, 2008.

Mahajan V & KE Lawande. 2008. *Kharif kandhyache darjedar utpadan*. Lokmangal Sheti Prateek, June 2008, 48-50.

Mahajan V & KE Lawande. 2008. *Rabi kanda utpadan*. Sheti Pratik, Sep. 2008, 14-18.

Mahajan V & KE Lawande. 2008. *Rabi Kanda utpadan*. Shetakari, Sep. 2008, 28-28.

Mahajan V & KE Lawande. 2008. *Sudharit tantragyan – Lasun utpadanache*. Lokmangal Sheti Prateek, Sep. 2008, 40-42.

Mahajan V & KE Lawande. 2008. *Lasun utpadanache che sudharit tantragyan*. Shetakari, October, 2008, 10-13.

Mahajan V & KE Lawande. 2008. *Lasun utpadan – tantragyan*. Annadata, October 2008, 45-47.

Lawande KE & V Mahajan. 2008. *Rabi kanda utpadan tantragyan*. Annadata, October 2008, 51-55.

Mahajan V & KE Lawande. 2008. *Rabi kanda va lasun rog va kidinche ekatmik vyavasthapan*. Annanadata, November 2008, 45-47.

Mahajan V & KE Lawande. 2008. *Kanda sathavanukisathi kadhani nantarche tantragyan*. Annanadata, March 2009, 52-55.

Sankar V and KE Lawande. 2009. Standardization of garlic mother clove for successful cultivation. Spice India ,Volume 22(1) 17-21

Research bulletins

Lawande KE & V Mahajan. 2008. *Kanda Beejoutpadan* published by Directorate of Onion & Garlic Research.

Lawande KE. 2008. DOGR-At a glance published by Directorate of Onion & Garlic Research.

Mahajan V & KE Lawande. 2008. *Pyaj Ka Beejoutpadan* published by Directorate of Onion & Garlic Research.

Mahajan V & KE Lawande. 2008. *Pyaj Ki Unnat Kheti* published by Directorate of Onion & Garlic Research.

Mahajan V & KE Lawande. 2008. *Lahsoon ki kheti* published by Directorate of Onion & Garlic Research.

Book chapter

Khar A, Lawande KE and A Asha Devi. 2009. Biotechnological approaches in garlic (*Allium sativum* L.) - Past, Present and Future. In : Malik CP, Wadhwani Chitra and Kaur B (eds.). Crop Breeding and Biotechnology. Aavishkar Publications, Jaipur, Rajasthan, India.

Mahajan V & KE Lawande. 2008. *Lahasun Ki Kheti* in Hindi book "*Sabjiyo Ki Aadhunik Utpadan Taknique*, Eds. Rai *et al.*, IIVR, International Book Distributing Co. Publishing Division, Varanasi, 297-307.

KE Lawande & V Mahajan. 2008. *Pyaj Ki Kheti* in Hindi book "*Sabjiyo Ki Aadhunik Utpadan Taknique*, Eds. Rai *et al.*, IIVR, International Book Distributing Co. Publishing Division, Varanasi, 308-331.

Mahajan V guided one student from Vidya Pratisthan School of Biotechnology, Baramati on the project "Physio-chemical properties of Onion" for the post graduate Degree in Applied Biotechnology for 4 months.

Mahajan V guided one student from Vidya Pratisthan School of Biotechnology, Baramati on the project "Physio-chemical properties of Garlic" for the post graduate Degree in Applied Biotechnology for 4 months.

Khar A and Asha Devi guided one student from Modern College, Bangalore on the project "Diversity assessment on Onion and garlic using RAPD Technique" for the post graduate degree in Biotechnology for 6 months.

TRANSFER OF TECHNOLOGY

Lectures delivered

Dr. KE Lawande

Topic	Sponsors	Date & Venue
Onion & Garlic - Production & Productivity status	Dept. of Agriculture, Maharashtra	19 & 23 Mar. 2009 DOGR
Onion seed production	Dept. of Agriculture, Maharashtra	19 & 23 Mar. 2009 DOGR
Onion seed production	Dept. of Agriculture, Amravati Division, Maharashtra	21 Feb. 2009 DOGR
Present scenario of Onion & Garlic	Dept. of Agriculture, Amravati Division, Maharashtra	20 Feb. 2009 DOGR
Status and need for mechanization of production and postproduction operations in onion and garlic	One-day interaction on 'Tools and Machinery for Development of Horticulture' at CISH, Lucknow 18.1.2008	Jan 18, 2009 CISH, Lucknow
Onion seed production	BAYER crop science Limited, Maharashtra	9 Jan. 2009 DOGR
Present scenario of Onion & Garlic	BAYER crop science Limited, Maharashtra	8 Jan. 2009 DOGR
Onion seed production	Dept. of Agriculture, Bhusawal Maharashtra	24 Dec. 2008 NRCOG
Introduction - Onion & Garlic	Dept. of Agriculture, Bhusawal Maharashtra	23 Dec. 2008 NRCOG
Onion seed production	Dept. of Agriculture, Maharashtra under ATMA	25 Nov. 2008 NRCOG
Introduction Onion & Garlic	Dept. of Agriculture, Maharashtra under ATMA	24 Nov. 2008 NRCOG
Onion - An Indian Perspective	3rd Indian Horticulture Congress 2008 on 'New R&D initiatives in horticulture for accelerated growth and prosperity'	Nov. 6-9, 2008 OUAT, Bhubaneshwar

Topic	Organizer(s)	Venue & Date
Onion seed production	Deepak Fertilizers Ltd.	23 Sep. 2008 NRCOG
Present scenario of Onion & Garlic	Deepak Fertilizers Ltd.	22 Sep. 2008 NRCOG
Impact of Climate Change on Onion and Garlic Production.	Brain-storming session on 'Impact assessment of climate change for research priority planning in horticultural crops' CPRI, Shimla	Sep. 6-7, 2008 CPRI, Shimla
Onion seed production	State Agriculture Dept., Jalgaon, under ATMA	25 Apr. 2008 NRCOG

Dr. CR Ramesh

Management of fungal & viral diseases in onion & garlic	Dept. of Agriculture, Maharashtra	20 & 24 Mar. 2009 DOGR
Management of diseases in onion and garlic	Dept. of Agriculture, Amravati Division, Maharashtra	21 Feb. 2009 DOGR
Management of fungal & viral diseases in onion & garlic	Dept. of Agriculture, Bhusawal Maharashtra	24 Dec. 2008 NRCOG
Management of fungal & viral diseases in onion & garlic	Dept. of Agriculture, Maharashtra under ATMA	25 Nov. 2008 NRCOG
Management of diseases in onion & garlic	Deepak Fertilizers Ltd.	23 Sep. 2008 NRCOG
Management of viral diseases in onion & garlic	State Agriculture Dept. , Jalgaon, under ATMA	25 Apr. 2008 NRCOG
Management of fungal diseases in onion & garlic	State Agriculture Dept. , Jalgaon, under ATMA	25 Apr. 2008 NRCOG

Dr. Vijay Mahan

Processing/value addition of onion and garlic	Dept. of Agriculture, Maharashtra	20 & 24 Mar. 2009 DOGR
Onion bulb production	Dept. of Agriculture, Maharashtra	19 & 23 Mar. 2009 DOGR
Processing/value addition of onion and garlic	Dept. of Agriculture, Amravati Division, Maharashtra	21 Feb. 2009 DOGR
Onion bulb production	Dept. of Agriculture, Amravati Division, Maharashtra	20 Feb. 2009 DOGR

Topic	Organizer(s)	Venue & Date
Onion bulb production	BAYER crop science Limited, Maharashtra	9 Jan. 2009 DOGR
Processing/value addition of onion and garlic	BAYER crop science Limited, Maharashtra	9 Jan. 2009 DOGR
Onion bulb production	Dept. of Agriculture, Bhusawal Maharashtra	23 Dec. 2008 NRCOG
Processing/value addition of onion and garlic	Dept. of Agriculture, Bhusawal Maharashtra	23 Dec. 2008 NRCOG
Onion bulb production	Dept. of Agriculture, Maharashtra under ATMA	24 Nov. 2008 NRCOG
Processing/value addition of onion and garlic	Dept. of Agriculture, Maharashtra under ATMA	24 Nov. 2008 NRCOG
Kanda utpadan tantragyan	Dept. of Agriculture, Rajgurunagar	15 Nov., 2008 Rajgurunagar Panchayat
Kanda va lasoon Utpadan, sathavan, rog va keed niyantran	Department of Agriculture, Rajgurunagar	22 Oct., 2008 Gosavi
Kanda utapadan, sathavan, rog va keed	Deepak Fertilizers Pvt. Ltd.	22 Oct., 2008 Kherenagar, Tal. Shirur
Processing/value addition of onion & garlic	Deepak Fertilizers Ltd.	23 Sep., 2008 NRCOG
Onion bulb production	Deepak Fertilizers Ltd.	22 Sep., 2008 NRCOG
Kanda va lasoon utapadan	Mahashtra State Agriculture Department	2 June, 2008 Chandoli
Kanda peek lagwad tantragyan, peek poshan va peek sanrakshan & kanda pratvari va sathavan	Dept. of Agril., Dhule.	3 May, 2008 Krishi Chikitsalaya Dhule
Processing/value addition of onion and garlic	State Agriculture Dept., Jalgaon, under ATMA	25 Apr. 2008 NRCOG
Onion bulb production	State Agriculture Dept. , Jalgaon, under ATMA	24 Apr. 2008 NRCOG

Dr. Asha Devi

Garlic production	State Agriculture Dept. , Jalgaon, under ATMA	24 Apr. 2008 NRCOG
Biotechnology in Onion & Garlic	Deepak Fertilizers Ltd.	23 Sep. 2008 NRCOG

Topic	Organizer(s)	Venue & Date
Dr. Anil Khar		
Biotechnology in Onion & Garlic	Dept. of Agriculture, Maharashtra	20 & 24 Mar. 2009 DOGR
Garlic production	Dept. of Agriculture, Maharashtra	19 & 23 Mar. 2009 DOGR
Garlic production	Dept. of Agriculture, Amravati Division, Maharashtra	20 Feb. 2009 DOGR
Garlic production	BAYER crop science Limited, Maharashtra	9 Jan. 2009 DOGR
Biotechnology in Onion & Garlic	BAYER crop science Limited, Maharashtra	9 Jan. 2009 DOGR
Garlic production	Dept. of Agriculture, Bhusawal Maharashtra	23 Dec. 2008 NRCOG
Garlic production	Dept. of Agriculture, Maharashtra under ATMA	24 Nov. 2008 NRCOG
Garlic production	Deepak Fertilizers Ltd.	22 Sep. 2008 NRCOG
Dr. PS Srinivas		
Management of insect pests in onion & garlic	Dept. of Agriculture, Maharashtra	20 & 24 Mar. 2009 DOGR
Management of insect pests in onion and garlic	Dept. of Agriculture, Amravati Division, Maharashtra	21 Feb. 2009 DOGR
Management of insect pests in onion and garlic	BAYER crop science Limited, Maharashtra	9 Jan. 2009 DOGR
Management of diseases in onion and garlic	BAYER crop science Limited, Maharashtra	9 Jan. 2009 DOGR
Management of insect pests in onion & garlic	Dept. of Agriculture, Maharashtra under ATMA	25 Nov. 2008 NRCOG
Management of insect pests in onion & garlic	Deepak Fertilizers Ltd.	23 Sep. 2008 NRCOG
Management of insect pests in onion & garlic	State Agriculture Dept., Jalgaon, under ATMA	25 Apr. 2008 NRCOG
Dr. V Sankar		
Nursery management & Micro Irrigation	Dept. of Agriculture, Maharashtra	20 & 24 Mar. 2009 DOGR

Topic	Organizer(s)	Venue & Date
Post harvest management	Dept. of Agriculture, Maharashtra	20 & 24 Mar. 2009 DOGR
Post harvest management	Dept. of Agriculture, Amravati Division, Maharashtra	21 Feb. 2009 DOGR
Nursery management & Micro-Irrigation	Dept. of Agriculture, Amravati Division, Maharashtra	20 Feb. 2009 DOGR
Nursery management & Micro Irrigation	BAYER crop science Limited, Maharashtra	8 Jan. 2009 DOGR
Post harvest management	BAYER crop science Limited, Maharashtra	8 Jan. 2009 DOGR
Post harvest management	Dept. of Agriculture, Bhusawal Maharashtra	24 Dec. 2008 NRCOG
Micro irrigation, INM, PGR	Dept. of Agriculture, Bhusawal Maharashtra	23 Dec. 2008 NRCOG

Dr. A. Thangasamy

Integrated Nutrient Management	Dept. of Agriculture, Maharashtra	19 & 23 Mar. 2009 DOGR
Integrated Nutrient Management	Dept. of Agriculture, Amravati Division, Maharashtra	20 Feb. 2009
Integrated Nutrient Management	BAYER crop science Limited, Maharashtra	8 Jan. 2009
Integrated Nutrient Management	Deepak Fertilizers Ltd.	22 Sep. 2008 NRCOG

Participation in Exhibitions

Names	Organizer(s)	Venue & Period
All Scientists	Agriculture Exhibition- 2009 during National Seminar on Onion & Garlic organized by NRCOG, ISA & NHRDF	Jan. 30-31, 2009 DOGR
Mahajan V and staff members	KISAN 2008 organised by Kisan Forum Pvt. Ltd.	17-21 Dec. 2008 Moshi, Pune
Mahajan V and staff members	Krishi Mahoutsav- 2008 organized by Maharashtra State, Dept. Of Agriculture, Rajgurunagar	June 2, 2008 Chandoli, Rajgurunagar
	"Krishi Mahotsav- 2008" organized by Maharashtra State, Dept. Of Agriculture, Rajgurunagar.	June 2, 2008 Rajgurunagar

HUMAN RESOURCE DEVELOPMENT

Participation of scientists / staff in conferences / courses / meetings / seminars / symposia / workshops / trainings etc. during 2008-09

Title and Venue	Name	Period
Agromet Advisory Service Meeting held at IMD, Pune	Dr. V Sankar Dr. A. Thangasamy	Apr. 22, 2008
One-day state level conference on 'National Foreign Trade Policy and Agri Exports from Maharashtra' YASHADA, Pune organized by Agri Policy Researcher, Nashik.	Dr. KE Lawande	Jun. 2, 2008
Interactive meeting on "Nutrient Dynamics in Horticultural Crops" held at Indian Institute of Horticultural Research, Bangalore	Dr. A. Thangasamy	June 14-15, 2008
One week training on Remote sensing application on area and acreage estimation and Digital analysis of ground truth data of onion" at Space application Centre, Ahmedabad	Dr. A. Thangasamy	June 27, 2008
One day seminar on 'Agricultural Mechanisation' at Pune organized by John Deere Equipment Pvt. Ltd., Sanaswadi, Pune.	Dr. KE Lawande	Jul. 1, 2008
Review meeting on **Post Harvest Technology in Horticultural Crops** held at IIHR, Bangalore.	Dr. V. Sankar	Aug. 23 -24, 2008
Brainstorming session on 'Impact assessment of climate change for research priority planning in horticultural crops' organized by CPRI, Shimla.	Dr. KE Lawande	Sep. 6-7, 2008
Seminar on 'Road map for biotechnological research in Maharashtra' at Rahuri organized jointly by MPKV and Maharashtra Society of Genetics and Plant Breeding, MPKV, Rahuri	Dr. KE Lawande	Sep. 27, 2008

Title and Venue	Name	Period
Brainstorming session on 'Structure of R&D facility, research priorities, laboratory facilities, database and other facilities' organized by Deepak Fertilizers and Petro Chemicals Corporation Ltd., Pune.	Dr. KE Lawande	Sep. 30, 2008
3rd Indian Horticulture Congress on 'New R&D initiatives in horticulture for accelerated growth and prosperity' at Bhubaneswar organized by ICAR Horticulture Division, New Delhi, OUA&T, Bhubaneswar and Indian Horticulture Congress, New Delhi.	Dr. KE Lawande	Nov. 6-9, 2008
National guava symposium on 'Improvement, Production and Utilization' on Production Technology' organized by Guava Growers Association of India in collaboration with CISH, Lucknow and MPKV, Rahuri.	Dr. KE Lawande	Nov. 25, 2008
Winter school on "Post Harvest Management of Seed" at IARI Regional Station, Karnal	Dr. MK Kuchlan	Dec. 6-26, 2008
Global Potato Conference at NASC, New Delhi organized by IPA, Shimla, CPRI, Shimla and ICAR, New Delhi	Dr. KE Lawande	Dec. 9-12, 2008
Divisional meeting of Horticulture at NASC, New Delhi organized by Horticulture Division and ICAR Hqrs., New Delhi.	Dr. KE Lawande	Jan. 14, 2009
Directors' Conference at NASC, New Delhi organized by Horticulture Division and ICAR Hqrs., New Delhi.	Dr. KE Lawande	Jan. 15-16, 2009
Brainstorming session on 'Research Needs for Seed Spice Crops' at Ajmer organized by NRC Seed Spices, Ajmer	Dr. KE Lawande	Mar. 21-22, 2009
PVP&FR meeting at MPKV, Rahuri	Dr. V Mahajan	Apr. 16, 2008
Three days ICAR Training-Cum-Workshop on IP and Technology Management at Central Institute for Fisheries Education, Mumbai 400 061	Dr. V Mahajan Dr. V Sankar	Jun. 10-12, 2008

Title and Venue	Name	Period
DUS task force meeting at Division of Seed Technology, IARI, New Delhi	Dr. V Mahajan	Jul. 28, 2008
National Seminar on Recent Trends in Research on Spices and Aromatic plants at CCS HAU, Hisar.	Dr. V Mahajan	Sep. 10-12, 2008
DUS task force meeting at Division of Seed Technology, IARI, New Delhi	Dr. V Mahajan	Oct. 24, 2008
National Seminar on Onion & Garlic (Krishak Sanghosthi) held at DOGR.	All Scientists	Jan. 30-31, 2009
National Seminar on "Vegetable seed production - Integrated Approaches, issues and strategies" held at NHRDF Chitegaon, Nashik	Dr. V Mahajan	Feb. 27-28, 2009
New Initiative to promote the Horticultural crops in Bihar & Project Launching at RAU Samastipur.	Dr. V Mahajan	Mar. 6-7, 2009
XXVII - AICRP Group Meeting / Workshop in Vegetables held at TNAU, Coimbatore organized by IIVR, Varanasi & TNAU, Coimbatore	KE Lawande, V Mahajan, A Khar, PS Srinivas, V Sankar, MK Kuchlan	Feb. 12-15, 2009
48th Personal Assistant (Refreshers) course, Institute of Secretarial Training & Management, New Delhi	DB Mundharikar	Mar. 16-27, 2009

Recognitions

Lawande KE. 2009. Acted as Chairman, Technical Session 'Onion and Garlic' in XXVIth Workshop of AICRP (VC) at Coimbatore from 12-15th Feb., 2009 organized by IIVR, Varanasi and TNAU, Coimbatore

Lawande KE. 2009. Acted as Chairman for the Technical session-III – Production Technology in National guava symposium on "Improvement, Production and Utilization" at Shirdi on 25th November 2008 organized by Guava Growers Association of India in collaboration with CISH, Lucknow and MPKV, Rahuri.

Sankar V. 2008. Fellow of Hind Agri Horticultural Society

Sankar V. 2008. Best Poster Presentation Award from **The Horticultural Society of India at Third Indian Horticulture Congress** held at November 6-9, 2008, Bhubaneswar (Authors P.C.Triptahi, **V.Sankar**, V.Mahajan and K.E.Lawande)

Training programmes organized

NRC Onion and garlic conducted following training programmes for the dissemination of technology related to onion and garlic.

- Four days training programme on 'Scientific Cultivation of Onion & Garlic' to the farmers of Maharashtra from 24 – 27 April, 2008 sponsored by Dept. of Agriculture, *Jamner* Taluka, Jalgaon under ATMA .
- Three days training programme on "Scientific Cultivation of Onion & Garlic" at NRCOG to Officers from Deepak Fertilizers & Pvt. Ltd., Maharashtra sponsored by Deepak Fertilizers & Petrochemicals Pvt. Ltd. from 22-24 September, 2008
- Two days training programme on "Scientific cultivation of Onion & Garlic" to farmers from Maharashtra, Satara at NRCOG sponsored by Dept. of Agriculture, Satara under ATMA from 24-25 November, 08
- Two days training programme on "Scientific cultivation of Onion & Garlic" to the farmers from Maharashtra, Bhusaval at NRCOG sponsored by Dept. of Agriculture, Bhusaval under ATMA from 22-24 December, 08.
- One day training programme on "Cultivation of Onion & Garlic" to the Women Farmers from Maharashtra in December, 08 at NRCOG sponsored by Chaitanya Farmers Club, Otur, Maharashtra
- Two days training programme on "Scientific cultivation of Onion & Garlic" to the Officers of BAYER Crop Science Pvt. Ltd. from different parts of India, at NRCOG sponsored by BAYER Crop Science Pvt. Ltd. from 8-9 January, 09.
- Three days training programme on "Onion & Garlic production technology" to the Agricultural Officers of Dept. of Agriculture, Maharashtra at NRCOG sponsored by Maharashtra Horticulture and Medicinal Aromatic Plant Board under NHM from 19-21 March, 09.
- Three days training programme on "Onion & Garlic production technology" to the Agricultural Officers of Dept. of Agriculture, Maharashtra sponsored by Maharashtra Horticulture and Medicinal Aromatic Plant Board under NHM from 23-25 March, 09.

INSTITUTIONAL ACTIVITIES

Scientific and Management Meetings

Public- private initiative: Signing of MoU with Bejo Sheetal

In accordance with the mutual desire to promote cooperation between the National Research Centre for Onion and Garlic, Rajgurunagar, and Bejo Sheetal Seeds Pvt. Ltd., Jalna, a MoU was signed for the purpose of onion improvement through hybrid development *via* conventional breeding. The MoU signing was effected on 18 Nov. 2008 between the two organizations at NRCOG. The occasion was graced by Dr. RB Deshmukh, Vice Chancellor, Mahatma Phule Krishi Vidyapeeth, Rahuri and Mr. Piet Barten, Director, Bejo Zaden, The Netherlands along with other dignitaries from the two organizations.

Commercial hybrids in onion are not common in India mainly due to the difficulty encountered in the availability of male sterile lines in short day onions, required for heterosis breeding. The cross pollinated nature of the crop and the inherent inbreeding depression adds to the woe of the breeder. Present day commercial varieties are mostly selections, which suffer from variability in size, shape and colour of the bulbs. Hybrids on the other hand offer uniformity in bulb colour, shape and size, which are highly desirous traits from production and market point of view. Hence, a five year project was formulated for the

development of hybrids in onion through conventional breeding using male sterile (MS) lines from Bejo Sheetal and C lines from NRCOG.

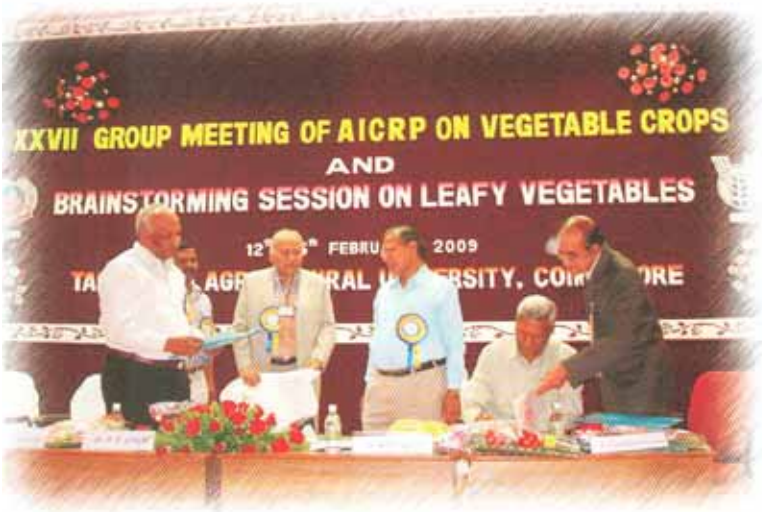
The major advantage is that Bejo has short day type male sterile and maintainer lines along with the necessary experience in the field of onion hybrid seed production and marketing. They are the only seed company in India who have commercialized short day onion hybrids (Bombay Red type) in the country. NRCOG on the other hand has very good C lines with many desirable horticultural traits such as single centeredness, good storability and high yield along with suitability for the different seasons.

With this collaboration, we aim to incorporate the desired traits into the new

hybrids, the commercialization of which will be taken care of by the Bejo. A successful venture between the two organizations will see an overall increase in onion production and productivity in India.

All India Network Research Project on Onion And Garlic Launched

National Research Centre for Onion & Garlic was upgraded to Directorate of Onion & Garlic Research. This network project was launched during XXVIII AICRP (VC) group meeting at TNAU, Coimbatore by Dr. H.P. Singh, Deputy Director General (Horticulture) on 12.2.09 before the august gathering that included dignitaries like Dr. P. Santhana Krishnan, Vice Chancellor (Acting), TNAU, Coimbatore, Dr. Mathura Rai, Director, IIVR, Varanasi, Dr. K. E. Lawande, Director, DOGR. The new network project will operate from the main centre DOGR, Rajgurunagar with 12 additional centres distributed in different parts of the country. Dr. K. E. Lawande briefed the genesis of Directorate and appreciated and thanked ICAR for taking keen interest in initiation of the network project. On this event a publication 'DOGR at a Glance' was released. An MOU between TNAU and DOGR was also signed on the same day.



All Indian Network Research Project on Onion & Garlic

National Seminar and Kisan Mela

National Seminar and Kisan mela

National Seminar on Onion & Garlic production technology and Agriculture Exhibition was organized on 30-31 January, 09 at NRCOG campus in collaboration with NHRDF, Nashik and Indian Society of Alliums, Rajgurunagar. The event was inaugurated by the Chief Guest, Shri Balasaheb Thorat, Honourable Minister of Agriculture, Government of Maharashtra. Shri Shivajirao Adhalrao Patil, MP, Shri Dilip Mohite Patil, MLA and Shri Vijayrao Kolte, Vice Chairman, M.C.A.E.R graced the occasion. The inaugural session was conducted under the Chairmanship of Shri Vijayrao Kolte. Dr. K.E. Lawande, Director, DOGR, in his welcome address briefed on research and other activities carried out by the centre and dissemination of knowledge to the farmers.

During the 2 days seminar, lead lectures on various topics of onion & garlic related to varieties, crop production, crop protection, storage and marketing etc were delivered by key speakers. Some progressive farmers also shared their experience with fellow growers who attended the seminar. On this occasion three progressive farmers Dr. Dattatray Vane, Sh Sawaleram Padekar and Sh Vikram

Avachat were felicitated for their excellence in producing good quality of onion by adopting of technologies developed by DOGR. Agriculture exhibition was also organized during the seminar. Government organisations like agriculture department, NHRDF and DOGR and 22 private companies dealing with agro-inputs participated in the exhibition. Around 2000 farmers from different parts of the country participated and got benefited from the lectures, field visits and exhibition.

Institute Management Committee (IMC)

The XIII Institute Management Committee meeting was held on 12 January 2009 at Rajgurunagar under the chairmanship of Dr. K.E. Lawande, Director. Official members Dr. Umesh Srivastava, ADG (H-II), ICAR, New Delhi, Dr. R.L. Sapra, PS, IARI, New Delhi, Dr. S.J. Singh, Ex-Head, IARI RS, Pune, Dr. C.R. Ramesh, PS, NRCOG, Dr. P.S. Srinivas, I/c AFAO, NRCOG, as Invitee and Mr. N. Gopal, AAO & Member Secretary, NRCOG attended the meeting. The committee examined the items proposed in agenda and recommended approvals accordingly.

Institute Research Council (IRC)

Institute Research Council meeting was held on 6-7 February 2009 at Rajgurunagar, under the chairmanship of Dr. K.E. Lawande, Director. All the scientists presented the results of the projects and after thorough discussion the technical programme was finalised for the coming season.

Research Advisory Committee (RAC)

The 12th Research Advisory Committee meeting of was held on 2-3 March 2009 at Rajgurunagar. Dr. Brahm Singh, former-Director, Agriculture Life Sciences, DRDO, Delhi chaired the meeting. Other members Dr. K. E. Lawande, Director, DOGR, Rajgurunagar, Dr. P. L. Tandon, Ex-PS, Entomology, PDBC, Bangalore, Dr. R.D. Rawal, Ex-PS, Plant Pathology, IIHR, Bangalore, Dr. Kalyan Singh, Professor & Head, Agronomy, BHU, Varanasi, non-official member Sh. Dilip Mohite Patil, MLA, Khed-Alandi, and Sh. V.T. Awachat, Otur and Dr. C.R. Ramesh, PS & Member Secretary attend the meeting. All the scientists presented their scientific achievements and future line of work. On the second day, the committee visited the farmers' fields to interact with the farmers. The committee discussed the research issues at length and made appropriate suggestions.

Research Advisory Committee (RAC)

हिन्दी पखवाड़ा

राष्ट्रीय प्याज एवं लहसुन अनुसंधान केन्द्र, राजगुरूनगर में दिनाँक १५.९.२००८ से २९.०९.२००८ तक हिन्दी पखवाड़ा मनाया गया, जिसके दौरान हिन्दी प्रश्न मंजुषा, हिन्दी पठन, निबंध, वाद-विवाद, कविता पाठ एवं सुलेखन प्रतियोगिताओ का आयोजन किया गया था। हिन्दी पखवाड़ा समापन समारोह दिनाँक २९.०९.२००८ को सम्पन्न हुआ। जिसमें मुख्य अतिथि श्री राजेन्द्र प्रसाद वर्मा, सहायक निदेशक (हिन्दी) टंकण एवं आशुलिपिक, हिन्दी शिक्षण योजना, पुणे का डॉ. के. ई. लवाण्डे, निदेशक, राष्ट्रीय प्याज एवं लहसुन अनुसंधान केन्द्र, राजगुरूनगर ने शाल, श्रीफल,

पुष्प गुच्छ एवं मोमेन्टो भेट दे कर स्वागत किया। निदेशक, राष्ट्रीय प्याज एवं लहसुन अनुसंधान केन्द्र, राजगुरूनगर ने स्वागत भाषण में अपने विचार प्रकट किये। उसके पश्चात मुख्य अतिथि महोदय ने हिन्दी प्रबोध, प्रवीण एवं अंग्रेजी से हिन्दी में भाषान्तर की सी. डी. का प्रयोग करके दिखाया। भाषान्तर से शत प्रतिशत कार्य हिन्दी में किया जा सकता है इसकी जानकारी के साथ अमल में लाने पर बल दिया । इस अवसर पर प्रथम, द्वितीय एवं तृतीय स्थान प्राप्त प्रतियोगियों को पुरस्कार प्रदान किये गये । अन्त में डॉ. वी. महाजन ने आभार प्रकट किया ।

Institute Committees

Institute Management Council (IMC)

Name	Designation	Status	Address
Dr. KE Lawande	Director	Chairman	DOGR, Rajgurunagar
Dr. Umesh Srivastava	ADG (H-II)	Member	ICAR, New Delhi
Dr. RL Sapra	Pr. Scientist	Member	IARI, New Delhi
Dr. SJ Singh	Ex-Head, IARI RS, Pune	Member	Pune
Dr. CR Ramesh	Pr. Sci.	Member	DOGR, Rajgurunagar
Dr. PS Srinivas	I/C AFAO	Invitee	DOGR, Rajgurunagar
Mr. N. Gopal	AAO	Member Secretary	DOGR, Rajgurunagar

Institute Research Council (IRC)

Name	Designation	Status	Address
Dr. KE Lawande	Director	Chairman	DOGR, Rajgurunagar
Dr. CR Ramesh	Pr. Sci.	Member Secretary	DOGR, Rajgurunagar
All Scientists		Members	DOGR, Rajgurunagar

Research Advisory Committee (RAC)

Name	Designation	Status	Address
Dr. Brahm Singh	Ex. OSD, President of India	Chairman	Pocket 'E', 713, Mayur Vihar, Phase- II, New Delhi
Dr. KE Lawande	Director	Member	DOGR, Rajgurunagar
Dr U Srivastava	ADG (Hort. II)	Member	ICAR, New Delhi
Dr. Kalyan Singh	Professor and Head		Department of Agronomy, Institute of Agricultural Sciences, BHU, Varanasi (Uttar Pradesh)
Dr. PL Tandon	Ex-Pr. Sci., PDBC		B2/001, White House, 6th Main, 15th Cross, RT Nagar, Bangalore
Dr. RD Rawal	Pr. Sci. (Plant Pathology)		Deptt. of Plant Pathology, IIHR, Bangalore
Dr. CR Ramesh	Sr. Sci. (Plant Pathology)	Member Secretary	DOGR, Rajgurunagar
Shri. Dilip Mohite Patil	MLA, Khed-Alandi	Non-official member	Rajgurunagar, Pune
Shri. V.T. Awachat	Farmer	Non-official member	Bramhanwada Road Otur, Pune

PERSONNEL

Recruitments

Name	Designation	Date of joining
Dr. MK Kuchlan	Scientist (Seed Technology)	16.05.2008
Dr. AJ Gupta	Senior Scientist (Horticulture)	06.12.2008

Promotions

1. Dr. Asha Devi, from Scientist Sr. Scale to Senior Scientist w.e.f. 19 .12.06
2. Dr. Anil Khar, from Scientist Sr. Scale to Senior Scientist w.e.f. 13.03.07
3. Dr. PS Srinivas, from Scientist Sr. Scale to Senior Scientist w.e.f. 30.11.07
4. Dr. V. Sankar, from Scientist Sr. Scale to Senior Scientist w.e.f. 25.11.08
5. Sh. DM Panchal , T-2 to T-1-3 (Lab Technician) w.e.f 23.04.2006.
6. Sh. PS Takale, T-2 to T-1-3 (Field/Farm Technician) w.e.f 14.05.2006
7. Sh. BA Dahale, T-2 to T-1-3 (Driver) w.e.f. 29.06.2006
8. Sh. SP Yeole, T-2 to T-3 (Driver) w.e.f. 12.08.2006

Repatriation

1. Dr. RP Singh, Senior Scientist (Plant Pathology), DOGR rejoined GB Pant Univ. of Agriculture & Technology, Pantnagar, Uttarakhand after deputation at DOGR w.e.f. 02.08.2008

Staff Position

Sl. No	Category	Sanctioned Posts	Filled up posts	Vacant Posts
1.	RMP	01	01	Nil
2.	Scientific	16	10	06
3.	Technical	10	10	Nil
4.	Administrative	09	08	01
5.	Supporting	11	11	Nil
	Total	**47**	**40**	**07**

Name	Designation
Scientific staff	
Dr. KE Lawande	Director
Dr. CR Ramesh	Principal Scientist (Plant Pathology)
Dr. V Mahajan	Senior Scientist (Horticulture)
Dr. RP Singh	Senior Scientist (Plant Pathology)
Dr. A Asha Devi	Senior Scientist (Genetics)
Dr. Anil Khar	Senior Scientist (Horticulture)
Dr. PS Srinivas	Senior Scientist (Entomology)
Dr. V Sankar	Senior Scientist (Horticulture)
Dr. AJ Gupta	Senior Scientist (Horticulture)
Dr. A Thangasamy	Scientist (Soil Science)
Dr. MK Kuchlan	Scientist (Seed Technology)
Technical staff	
Sh. VV Patil	Technical Officer T-5
Sh. NL Gore	Technical Officer T-5
Sh. HSC Shaikh	Computer Programmer T-5
Sh. RB Baria	Technical Assistant T-3
Sh. SP Yeole	T-3 (Jeep Driver)
Sh. AR Wakhare	Technical Assistant T-3
Sh. DM Panchal	Technician T-1-3
Sh. PS Takale	Technician T-1-3
Sh. BA Dahale	T-1-3
Sh. HS Gawali	Technician T-1

Name	Designation

Administrative staff

Sh. N Gopal	Assistant Administrative Officer
Sh. DB Mundharikar	PA to Director
Smt. SS Joshi	Assistant
Sh. SP Kandwal	Sr. Clerk
Sh. PS Tanwar	Sr. Clerk
Smt. MS Salve	Sr. Clerk
Smt. NR Gaikwad	Hindi Typist
Sh. RK Dedge	Jr. Clerk

Supporting staff

Sh. SK Said
Sh. PK Khanna
Sh. PR Sonawane
Sh. PE Tadge
Sh. MS Kale
Sh. RS Kulkarni
Sh. SD Waghmare
Sh. NH Shaikh
Sh. SB Tapkir
Sh. AD Fulsundar
Sh. SS Gopale

DISTINGUISHED GUESTS

1	Sh. S. P. Pathak, Director (Finance), ICAR, New Delhi	12.05.08
2	Sh. J. Ravi, Dy. Secretary, ICAR, New Delhi	09.06.08
3	Dr. Nawab Ali, DDG (Engg.), ICAR, New Delhi	01.07.08
4	Dr. R.P. Tewari, Director, NRC Mushroom, Solan	01.10.08
5	Padmabhushan Anna Hazare, Social Worker, Ralegaonsiddhi, Pune	16.11.08
6	Dr. R.B. Deshmukh, Vice-Chancellor, MPKV, Rahuri	18.11.08
7	Mr. Piet Barten, Bejo Zaden, The Netherlands	18.11.08
8	Mr. Suresh O. Agrawal, MD, Bejo Sheetal Seeds Pvt. Ltd., Jalna	18.11.08
9	Mr. A.K. Upadhyay, IAS, Additional Secretary, DARE & Secretary, ICAR, New Delhi.	01.01.09
10	Mr. Asit Tripathy, Chairman, APEDA, New Delhi.	18.03.09
	Total number of farmers visited	**5776**

Dr. Nawab Ali, DDG (Engg.)

Padmabhushan Anna Hazare

Shri. A.K. Upadhyay, IAS

FINANCES

Financial Statement for the year 2008-2009

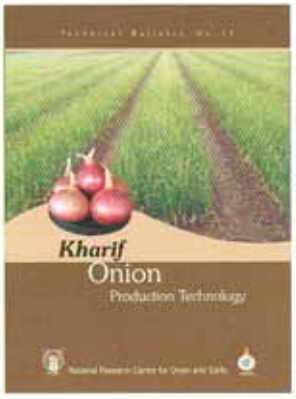
Head of Accounts	Rupees in Lakhs	
	Budget Allocation	Expenditure
Non-Plan	120.20	115.12
Plan	210.00	202.4
AINRP Project	50.00	49.56
Pension & Retirement	1.50	1.50
P-Loans & Advances	8.00	7.92
R-Deposit Scheme	37.65	34.60
Total	**427.35**	**411.1**
Revenue Receipts (Including RFS)	**37.88**	

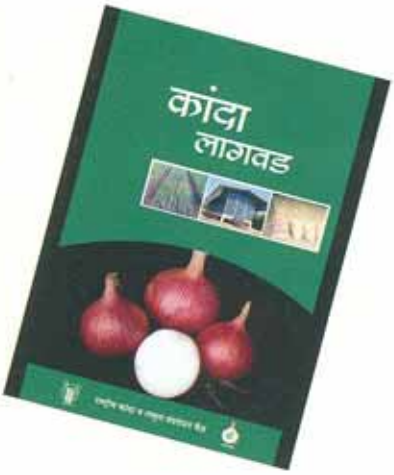
ANNEXURE -1

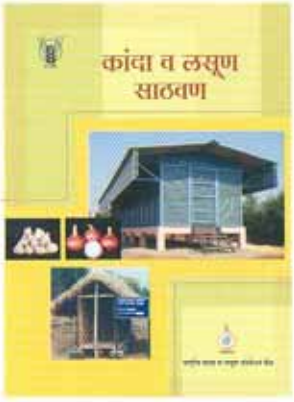
Meteorological data for the year 2008-09

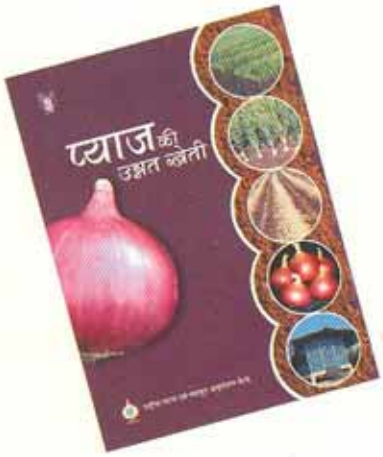
Month	Temperature (°C)		Relative Humidity (%)		Rain fall (mm)	Sunshine hours
	Max.	Min.	Max.	Min.		
April, 08	37.5	18.7	60	34	0	9.1
May, 08	37.0	21.5	68	46	18.00	10.0
June, 08	30.4	22.8	81	70	183.6	3.1
July, 08	27.8	21.8	85	76	76.2	2.1
August, 08	27.0	21.0	87	76	216.0	3.0
September, 08	29.2	20.7	88	73	292.0	4.0
October, 08	32.0	17.5	79	55	57.4	8.0
November,08	31.0	17.0	77	55	37.4	7.9
December, 08	30.0	14.3	82	41	0	8.3
January, 09	29.8	12.4	81	49	0	8.6
February, 09	33.8	12.2	73	38	0	9.4
March, 09	36.3	15.4	65	35	0	8.6

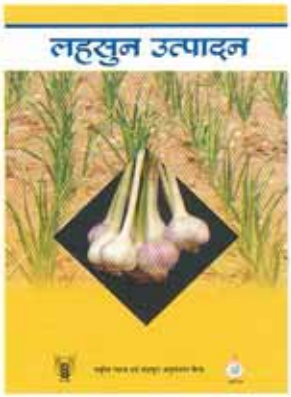
Recent Publications











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