ICAR

2007-08

Annual Report

NRCOG

National Research Centre for Onion and Garlic
Rajgurunagar - 410 505, Dist. Pune (M.S.)

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.

2007-08

Annual Report

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

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कार्यकारी सारांश

राष्ट्रीय प्याज एवं लहसुन अनुसंधान केन्द्र में प्याज एवं लहसुन की अधिक उत्पादन देने वाली एवं आवश्यक उद्यानिकी गुणधर्म युक्त किस्मों के विकास का कार्य और अधिक सघन किया गया है। वर्तमान समय में जैविक खेती पर अधिक बल दिया जा रहा है। फलस्वरूप हमारे केन्द्र में भी प्याज एवं लहसुन की जैविक खेती हेतु विभिन्न जैविक खादों का उपयुक्त संयोग, उचित फसल क्रम तथा सर्वोत्तम जैव रसायन आदि सभी घटकों के संयुक्त सिफारिश हेतु प्रयास किए जा रहे है। जिससे किसान भाईयों को अधिक उत्पादन के साथ-साथ आमदनी भी प्राप्त हो सके। इस वर्ष हम दोनों ही फसलों के पादप रोगों के विभिन्न पहलुओं पर प्रमुख रूप से अनुसंधान कार्य करने में सक्षम हुए है।

विभिन्न मौसम में अधिक उत्पादन देने वाली लाल, सफेद एवं पीले रंग के प्याज की किस्मों के विकास के लिए प्रयोग किए गए। इनमें से कुछ अच्छी गुणधर्म युक्त एवं अधिक उत्पादन देने वाली किस्मों को चुना गया है। इस चुनाव में मुख्य केन्द्र बिन्दु अधिक उत्पादन, कम तोर एवं जोड प्याज तथा अधिक बिक्री योग्य प्याज वाले किस्मों का विकास है। साथही सफेद प्याज में अधिक घुलनशील ठोस वाली किस्मों के विकास के उद्देश्य से चुनी हुई जातियों का शुद्धिकरण एवं पिछले वर्षो की तुलना में मूल्यांकन का कार्य प्रगतिपर है।

चूंकि अधिक घुलनशील ठोस गुणधर्म वाले सफेद प्याज की किस्मों की उपलब्धता प्याज के निर्जलीकरण उद्योग के लिए एक प्राथमिक आवश्यकता है। जिससे निर्जलीकृत प्याज का उत्पाद अधिक प्राप्त हो सके। वर्तमान में हमारे प्रयोगों में व्यावसायिक दृष्टी से उपलब्ध किस्मों में घुलनशील ठोस का प्रमाण ८ से १२ अंश ब्रिक्स तक ही पाया गया है। हमारे केन्द्र में १८ अंश ब्रिक्स से अधिक घुलनशील ठोस वाले सफेद किस्मों का चयन किया गया है, तथा शुध्दिकरण एवं विकास कार्य प्रगती पर है। चयन की गई विभिन्न उन्नत जातियों के मूल्यांकन के प्रयोग में भीमा सुपर किस्म सर्वोत्तम पाई गई एवं इसकी सिफारिश भी इस वर्ष की गई है। पीली रंग युक्त विदेशी संकर जातियों का भी अध्ययन हमारे स्थानीय किस्म फुले स्वर्णा के साथ किया गया है। इनमें से कुछ संकर जातियों में फुले स्वर्णा की तुलना में अधिक उत्पादन प्राप्त हुआ है। संकर ओज प्रजनन हेतु प्याज के विभिन्न किस्मों में नरबंध्यता गुण लाने हेतु ''बैक क्रासिंग'' कार्य प्रगती पर है।

सफेद रंग के लहसुन के विभिन्न जातियों के मूल्यांकन में कुछ जातियाँ, सिफारिश की गई जातियों की तुलना में उपयुक्त पाई गई परंतु इसके विपरीत रंगीन जातियों के मूल्यांकन में एक भी जाती (इन) सिफारिश की गई जातियों से अच्छी नहीं पाई गई। अधिक बिक्री योग्य उत्पादन देने वाली किस्मों के विकास के लिए विदेशों से जननद्रव्य ला कर हमारे वातावरण में उनकी उत्पादन की दृष्टी से प्रयोग आवश्यक है। 'म्युटेंशन' पौध प्रजनन विधी द्वारा लहसुन की वर्तमान में सिफारिश की गई किस्मों के तुलना में अधिक उत्पादन देनेवाली कुछ किस्मों का विकास किया गया है।

विभिन्न जंगली जातियों (स्पीसीज) को अलग-अलग स्त्रौत से इस केन्द्र में लाया गया हैं तथा हमारे वातावरण में इन्हें उगाने का प्रयास किया जा रहा है। कुछ जातियों (स्पीसीज) में जैसे - *एलियम ट्यूबरोसम* तथा *एलियम चाइनेन्स* आदि में नियंत्रित वातावरणीय हरीतगृह में पुष्पन संभव होने में सफलता हाथ लगी है। जिसका उपयोग खाने वाले प्याज की जातियों में जंगली जातियों से रोग एवं कीट प्रतिरोधक जातियों के विकास एवं अनुसंधान हेतु विविधता लाने की दृष्टी से संकरण कार्य किया गया है।

जैव प्रौद्योगिकी के दृष्टी से 'गायनोजेनेसिस' विधी द्वारा प्याज में 'हेप्लाइड' विकसित किया गया है तथा इसकी उचित तकनीकि द्वारा पुष्टी भी की गई है। इन 'हेप्लाइड' को द्विगुणित करने के पश्चात प्राप्त 'डिप्लाइड' को स्थापित करने हेतु प्रयोग जारी है। प्याज में 'सोमेटिक एम्ब्रियोजनेसिस' भी किया गया है। साथ ही मॉलिक्यूलर

मार्कर' (आर.ए.पी.डी.) का उपयोग कर जातियों में आण्विक (मॉलिक्यूलर) दृष्टी से विविधता जानने हेतु रूपरेखा स्थापित की गई है।

फसल उत्पादन के प्रयोगों में, प्याज एवं लहसुन के बिक्री योग्य, सभी आवश्यक उद्यानिकी गुणधर्म से युक्त उत्पादन एवं जल की अधिक उपयोग क्षमता पाने की दृष्टीसे टपक सिचाई एक सर्वोत्तम विधि पाई गई है। बड़े फुहार सिचाई विधि के उपयोग में कंदो के भण्डारण क्षमता में अधिक नुकसान पाया गया है। टपक सिचाई विधि में जैविक खाद के साथ सिफारिश किए गए रासायनिक उर्वरकों की मात्रा का ८०% उपयोग से कन्दो के उत्पादन में सर्वाधिक वृद्धि होती पाई गई है, साथ ही प्याज एवं लहसुन के भण्डारण के समय होने वाले नुकसान में भी कमी होने में सहायक सिद्ध हुआ है।

विगत कुछ वर्षों के लहसुन आधारित फसल क्रम प्रयोगों में पाया गया है कि, खरीफ मौसम मे सोयाबीन के बाद रबी मौसम में लहसुन लगाया जाना सबसे अच्छा फसल क्रम है, जिससे अधिक उत्पादन व मुनाफा के साथ-साथ पोषकतत्त्वों का उपयुक्त उपयोग एवं प्रबंध होता है। अधिक बिक्री योग्य उत्पादन के दृष्टी से प्याज में जैविक मल्च-धान का पैरा तथा लहसुन में लकडी का बुरादा का मल्च के रूप में उपयोग अधिक लाभदायक पाया गया है। प्याज एवं लहसुन के जैविक उत्पादन प्रयोगों में विभिन्न पहलुओं पर तुलनात्मक रूप से कोई भी समाधानकारक अंतर नहीं पाया गया है। प्याज के बीजोत्पादन प्रयोगों में बीज भण्डारण हेतु नमी सोखने वाले 'डेसिकेटरर्स' में भण्डारित रखने पर भण्डारण के २१ माह बाद भी बीजों में ७०% अंकुरण क्षमता बरकरार रखी जा सकती है। सामान्य भण्डारण की दशा में बीजोंको अधिक समय तक अच्छी तरह भण्डारित रखने के लिए बीज में ५% नमी लाने तक सुखाने के बाद एल्युमिनियम आच्छादित थैलियों में वायुरहित बंद कर भण्डारित रखना सर्वाधिक लाभदायक पाया गया है। पादप संरक्षण प्रयोगों के अंतर्गत लहसुन में अवरोधी फसल का उपयोग थ्रिप्स की संख्या कम करने में प्रभावी पाया गया है। इस हेतु मक्काऔर गेंहू की एक एक कतार, मक्के के दो कतार के अवरोधी फसल के तुलना में अधिक उपयुक्त पाई गई है। जैविय कीट नियंत्रण के अंतर्गत लहसुन में थ्रिप्स प्रबंधन हेतु 'एन्थोकोरिड' ब्लाप्टोस्टेथस' मित्र कीट का प्रयोग अधिक प्रभावी पाया गया है। विभिन्न रंगो के प्याज की किस्मों में पीले रंग के प्याज की किस्में थ्रिप्स के लिए अधिक संवेदनशील पाई गई है। लहसुन में भी थ्रिप्स के लिए 'म्यूटेन्ट' प्रतिरोधी जातियाँ प्राप्त हुई है।

प्याज एवं लहसुन उत्पादन किए जाने वाले विभिन्न क्षेत्रों का सर्वेक्षण कर खेतों में लगने वाली बीमारियों का अध्ययन किया गया है। मृदा से '*अल्टरनेरिया पोरी*' नामक कवक को अलग करने के लिए टी.बी. झेड. युक्त एक विशेष माध्यम स्थापित किया गया है। प्याज एवं लहसुन रोग प्रबंधन में गैर रासायनिक विधियों में जैविक रोग रोधी 'सेफ' अन्य उपचारों की तुलना में उपयुक्त पाया गया है। रासायनिक रोग नियंत्रण में विभिन्न रासायनिक यौगिकों का उपयोग अलग-अलग रोग नियंत्रण में लाभदायक है, परंतु ऐसा कोई भी एक यौगिक नहीं है जो एक साथ सभी बीमारियों के प्रति सुरक्षा प्रदान कर सकें। मृदा जनित रोग प्रबंधन हेतु खरीफ मौसम में तंदुरुस्त पौध उत्पादन हेतु सौर्य विकिरण से उपचारित कर 'ट्राइकोडर्मा' या स्यूडोमोनास' का उठी हुई क्यारियों में उपयोग लाभदायक सिध्द हुआ है। परंतु पछेती खरीफ में सर्वाधिक अंकुरण क्षमता सूर्य किरण एवं ट्राइकोडर्मा से उपचारित क्यारियों तथा बीजों को केप्टान एवं कार्बेन्डाझिम से उपचारित कर लगाने में पाया गया है।

विभिन्न क्षेत्रों में उत्पादित प्याज एवं लहसुन से चार रोग प्रतिरोधी स्पीसीज *टाइकोडर्मा हरझीयानम, टाइकोडर्मा व्हिरीडी, टाइकोडर्मा स्पूडोकोनींगी* एवं *टाइकोडर्मा फेसिकुलेटम* की पहचान की गई है। लहसुन के भण्डारण में लहसुन का खोखला या पोचा होने हेतु रोग जनक जानने के लिए अध्ययन किया गया और पाया गया कि कवक फ्युजेरियम स्पीसीज का इसके लिए सबसे अधिक योगदान है।

अंत में यह कहा जा सकता है कि यह वर्ष प्याज एवं लहसुन अनुसंधान में फलदायक साबित हुआ है। इस वर्ष अधिक उत्पादन देनेवाली, अधिक घुलनशील ठोस तथा अन्य गुणधर्म युक्त जातियों का चुनाव किया गया है। जैविक खेती हुते प्रयोग सही दिशा में चल रहे हैं तथा इस दिशा में कुछ जैव रसायन एवं जैविक खाद सफलतापूर्वक चुने गए है। ट्राइकोडर्मा की नई स्पीसीज खोज निकाली है, साथ ही लहसुन के भण्डारण में खोखले पन हेतु रोगजनक पहचाना गया है।

Executive Summary

In our centre, research on onion and garlic has been intensified to develop varieties having higher yield with suitable horticultural traits. With the people being sensitized towards organic cultivation, we at this centre are trying to identify a combination of organic manure, cropping sequence and best organic chemicals for developing a package to get organic onion and garlic which can compete in terms of yield and quality with the non organic grown onion to make it lucrative for the farmers. This year saw the major work on pathology aspect and we were able to work on different aspects of pathology related research in both the crops.

In crop improvement, experiments of red, white and yellow onion in all the seasons were conducted and some of the lines showing superior performance were identified. The focus is more on higher yield, with less bolters, doubles and higher marketable yield in red onion whereas in white onion, some of the lines having high TSS are being evaluated to evaluate their performance over years in order to identify the high TSS lines. High TSS in white onion is a prerequisite for onion dehydration industry to get more dehydrated product from the initial material. At present, the commercial varieties have TSS of 9-12° B. In our trials, lines having TSS higher than 18°B have been identified and are being maintained. Among the elite lines evaluation, Bhima Super is showing promising results and this variety has been released. Yellow exotic hybrids were evaluated with our indigenous Phule Suwarna and some of the hybrids recorded higher yield than the check variety. In heterosis breeding, transfer of male sterility in various backgrounds is in progress.

In garlic some of the white garlic lines showed superior performance over their respective check varieties but in coloured garlic, none of the lines were significantly superior than the check variety. In order to get varieties with higher marketable yield, it is important to introduce material from abroad and check their viability under our conditions. Some of the garlic lines, obtained through various mutagenic treatments, are showing higher net yield than the local check variety.

A number of wild species were received from different sources and the efforts were made to grow them under our conditions. Some of the lines viz., *A. tuberosum* and *A. chinense* were able to flower under the environmentally controlled greenhouse conditions and crosses were attempted between onion and the wild species.

In biotechnological applications, haploid induction via gynogenesis has been achieved and confirmed through appropriate techniques. The haploids were diplodised and further establishment of the dihaploids is underway. Somatic embryogenesis of onion was done and molecular markers i.e., RAPD was used for molecular profiling of onion varieties.

In crop production, drip irrigation was adjudged as the best method in terms of marketable yield, overall horticultural traits and also for the water use efficiency. Big

sprinkler system was observed to lead to high storage losses. Use of organic manures along with 80% recommended dose of fertilizers through drip irrigation was found to be optimum for increased bulb yield and also helped in curtailing the storage losses in onion and garlic.

Experiments on the garlic based cropping sequences over the past couple of years has revealed that soybean (*kharif*) followed by garlic (*rabi*) is the best combination for optimization of nutrient inputs and obtaining good yield. In onion, organic mulch-paddy straw and in garlic saw dust were found to be superior in terms of higher marketable yield. Studies on organic production in onion and garlic revealed no significant differences in all the parameters studied. Research on the onion seed production revealed that storing seeds in desiccators with moisture absorbent is the best option for maintaining the seed germination of 70% even after 21 months of storage. Under ambient storage conditions, the best option is to maintain the seed moisture at 5% and then packing them in laminated aluminium bags with vacuum packing.

In crop protection, barrier crops was found effective in reducing the thrips population in garlic and Maize wheat row was found more suitable than the two rows of maize. In the feasibility studies and evaluation of anthocorids for the management of thrips, *Blaptostethus* was found to effectively control thrips in garlic. Screening against thrips revealed that yellow onion was more susceptible to thrips and a mutant garlic line was identified to be resistant to thrips.

A survey of major onion and garlic growing areas was conducted and the major diseases occurring in different location were recorded. Selective media using TBZ was standardized for the isolation of *Alternaria porri* from the soil. Management of onion and garlic diseases through non chemical methods revealed that botanical pesticide-Safe was superior as compared to other treatments. Management through chemical methods revealed that different chemicals are useful for different results and there was not a single chemical formulation responsible for overall safety against all the pathogens. For management of soil borne diseases, raised beds were at par with solarized beds amended with *Trichoderma* or *Pseudomonas* in *kharif* season but in late *kharif* highest seed germination was recorded in solarized beds amended with *Trichoderma* followed by seed treatment of captan And carbendazim.

Isolation of antagonists from onion and garlic growing areas was undertaken and four species viz., *Trichoderma harzianum*, *T. viride*, *T pseudokoningii* and *T. fasciculatum* were identified. A study was conducted to know the pathogenic cause of hollow/chaffy garlic bulbs and it was observed that *Fusarium spp.* was mostly involved.

To conclude, it was a fruitful year for onion and garlic research and we were able to identify some good yielding lines with higher yield, TSS and other traits in onion. Also strategy for organic cultivation of onion is underway and in this direction some chemicals and organic manures with appropriate strategy have been identified. New strains of *Trichoderma* have been isolated and also the causal organism for hollow garlic has been identified.

Executive Summary

Contents

Introduction

The Indian Council of Agriculture 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. The Centre has made tremendous progress in the last ten years of its inception.

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.

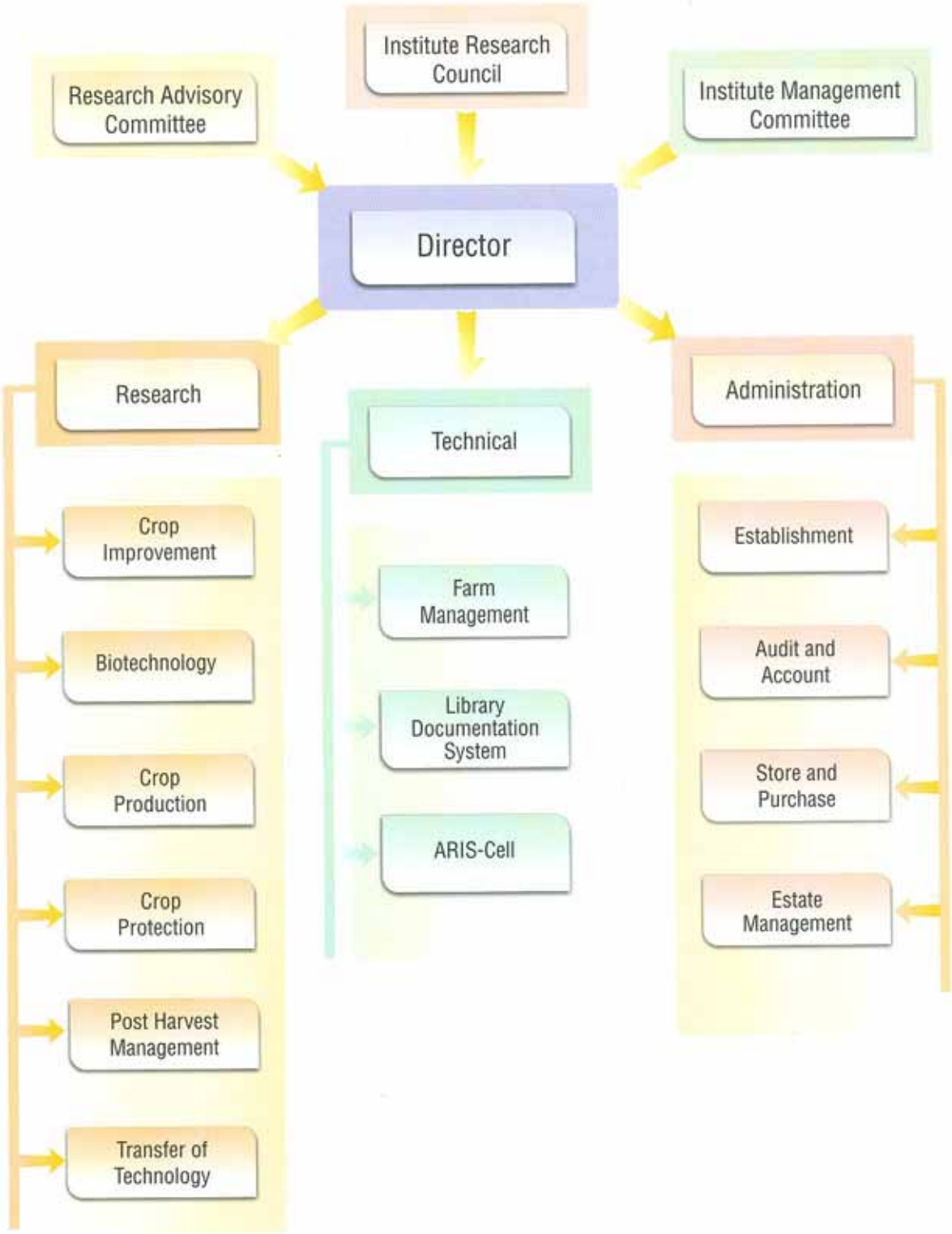
Mandate

- 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 547 books, 20 national and 10 international journals, CD server, CD-ROMs of relevant literature on Alliums, Hort-CD 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 06-07

55 red onion germplasm lines were evaluated during late *kharif* in 1 sq. m plots in 3 replications along with 3 checks. Percentage A grade bulbs in the germplasm ranged from 0 to 79.3% with 0 to 54.2% double bulbs, 0 to 45.5% bolters and 27.3 to 96.8% marketable bulbs against the check variety Bhima Super which recorded 48.3% A grade bulbs, 17.7% doubles, 5.4% bolters and 80.7% marketable bulbs. Marketable yield varied from 6.2 to 58.5 t/ha and total yield from 15.0 to 64.5 t/ha in the germplasm against check which recorded 45.3 and 56.0 t/ha, respectively. 3 lines gave higher marketable yield more than 50.0 t/ha over the check Bhima Super. Average bulb weight was maximum at 82 g as compared to Bhima Super (65 g).

Evaluation of red onion germplasm during *rabi* season 06-07

93 red onion germplasm were evaluated during *rabi* season along with 3 check varieties in 3 replications in 1 sq. m. plots. Percentage A grade bulbs were higher in 22 lines (37.3 to 49.9%) than the check N-2-4-1 (33.3%). No doubles and bolters were recorded in 14 and 52 lines, respectively. Percentage marketable yield in the germplasm ranged from 21.7 to 99.5% as compared to the check N-2-4-1 (82.8%). Marketable yield was high in 3 lines, which ranged from 35.4 to 44.5 t/ha than the check (32.1 t/ha) and 14 lines had at par yield. Total yield in the germplasm varied from 15.1 to 48.1 t/ha against check, which had 38.8 t/ha. Only one line gave higher yield than the check and 9 lines were at par with the check for total yield.

Evaluation of red onion germplasm during *kharif* 07

During *kharif* season, 34 red onion germplasm lines were evaluated along with one check Bhima Super in 1 sq. m. plots in 2 replications. Due to heavy rains and diseases, yield in all the germplasm lines including the check were quite less. Percentage marketable yield in the germplasm ranged from 0 to 100% and in check it was 69.3% only. Average bulb weight was also affected and it was maximum 57.7 g in the germplasm as compared to the check (39.5 g). More than 10.0 t/ha marketable yield was recorded in 4 lines, whereas more than 14.0 t/ha of total yield was noted in three lines against the check Bhima Super which yielded 9.3 t/ha marketable bulb and 12.4 t/ha total yield.

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 06-07

15 red elite onion lines were evaluated in 3 x 2 m plots in 3 replications during late *kharif* season in flat beds along with the check variety Bhima Super. Percentage A grade bulbs, percentage doubles, percentage bolters and percentage marketable bulbs were maximum up to 48.4%, 12.4%, 8.8% and 94.4% in these elite lines, whereas it was 44.1%, 1.4%, 2.0% and 93.0% in check variety Bhima Super. Marketable yield ranged from 26.4 to 40.2 t/ha and total yield from 30.7 to 43.0 t/ha in red elite lines against the check Bhima Super which recorded 38.2 and 41.1 t/ha, respectively. One elite line yielded higher marketable bulbs and 3 lines had higher total yield than the check variety Bhima Super.

Evaluation of red onion elite lines during *rabi* season 06-07

Red elite onion lines (19) along with check N-2-4-1 were evaluated during *rabi* season in plot size of 3 x 2 m in 3 replications. Percentage A grade bulbs in elite lines ranged from 32.0 to 75.4%, percentage doubles from 0 to 7.2%, percentage bolters from 0 to 2.8% and percentage marketable bulbs from 87.9 to 98.4% as compared to the check N-2-4-1 where it was 52.3%, 2.5%, 1.4% and 95.0%, respectively. Marketable yield and total yield was higher in 3 lines and ranged between 49.8 to 50.9 t/ha and 52.4 to 55.5 t/ha than the check which recorded 45.8 and 48.2 t/ha, respectively. 8 lines recorded more than 40.0 t/ha marketable yield and more than 45.0 t/ha total yield was recorded in 6 lines.

Project 1.3: Heterosis breeding in red onion

Crosses between red onion and exotic onion varieties were made with the object to transfer desirable characters into onion. Back crosses between red varieties and MS lines are in progress to transfer male sterile genes into red onion varietal background. Maintenance and multiplication of MS lines showing 100% sterility is in progress. For population improvement and to create wide variability, open crosses were made between dark red and light red onion varieties with the objective to transfer dark red colour of bulbs (having less storage life) into light red onion, late *kharif* and *rabi* elite lines, which have better storage life, as the demand for dark red colour bulbs with better storage life is increasing.

Project 1.4: Breeding red onion varieties resistant to biotic and abiotic stresses

Response of thrips to different colors of onion during *rabi* 2006

In India four types of onions are grown - dark red, light red, white and yellow in different seasons for different purposes. However, their reaction to thrips was never studied so far. Therefore, during *rabi* 2006 a field trial was conducted to evaluate the effect of thrips on different colored onions. Leaf curling was more in yellow and white onions. Highest LCR of 4.03 was recorded in yellow and 3.95 in white onions. Leaf damage was more in case of yellow and light red onions. Therefore, yellow onions were subjected to more leaf curling as well leaf damage (8.3) followed by light red. Lowest damage was recorded in dark red.

When varieties were considered individually, Acc.1168 and B-780 recorded the lowest plant damage of 7.2 and 7.4 respectively, highest being 8.7 in Arka Pitambar and Pusa Madhavi (8.6). Highest marketable yield of 4.1 kg/ sqm was recorded in Acc. 1168, a dark red onion line.

The study suggested that yellow onions are more susceptible to thrips. Yield losses due to thrips are more in white and yellow onions.

Screening onion germplasm for resistance to thrips

In red onion, Acc. 1051 and Acc. 1095 recorded the lowest total damage rating of 7.0 (3.2 LCR + 3.8 LIR). The variety N-2-4-1 recorded 7.7 (3.6 LCR + 4.1 LIR) and marketable yield of 3.0 kg/sqm. The other 15 lines that recorded higher yields were - Luxus (4.8), Acc.1007 (4.15), 1050 (4.15), Mercedes (4.05), 1077, 767 (3.6), 741 (3.4), hy bss441 (3.3), Acc14-2Wpc, hy bss442, 65ax14-2w (3.1), 1095, 878, 202p, 1054 (3.0).

Programme 2: Development of white and yellow onion varieties / hybrids 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* 06-07.

During late *kharif* season 65 germplasm along with check Phule Safed were evaluated in RBD in 3 replications in plot size of 1 sq m. 19 lines had significantly high percentage of A grade bulbs above 35.0% to 65.7% as compared with the check Phule Safed (31.3%). 28 lines had doubles between 0 to 19.9% whereas it ranged up to 55.5% in the germplasm and it was 22.9% in Phule Safed. There was a wide range for bolters in the germplasm (0 to 49.8%). 29 lines had no bolters against Phule Safed which had 6.4%. 30 lines had more than 73.0% significantly higher percentage of marketable bulbs, which ranged up to 98.8%, whereas in check it was 68.9% only. Marketable yield was higher in 18 lines (ranging from 24.5 to 42.9 t/ha) than the check Phule Safed (23.0 t/ha) and total yield was higher in 16 lines which ranged from 35.2 to 45.6 t/ha against check (33.8 t/ha). Total soluble solids in the germplasm ranged from 8.8 to 11.8% and 6 lines had at par TSS with Phule Safed. Days to maturity varied from 110 to 135 days after transplanting in the germplasm lines. 3 lines were 8 days early in maturity than the check which took 120 days to harvest.

Evaluation of white onion germplasm lines during *rabi* season 06-07

86 white onion germplasm were evaluated during *rabi* season in 1 sq m plot in 3 replications along with the check variety Phule Safed. Percentage of doubles, bolters and A grade bulbs and marketable bulbs in these lines ranged from 0 to 94.9%, 0 to 27.2%, 0 to 66.6% and 1.3 to 99.7%, respectively against the check variety where it was 6.6%, 4.0%, 46.9% and 86.7%, respectively. Days to harvest in the germplasm varied from 104 to 117 days after transplanting, whereas, check variety took 117 days for harvesting. TSS in the germplasm was 9.5 to 12.8% and in check Phule Safed it was 10.7%. Marketable yield and total yield was 31.9 and 36.4 t/ha in check variety whereas it ranged from 0.3 to 51.4 t/ha and 15.1 to 52.8 t/ha, respectively. 42 lines yielded higher marketable yield and 39 lines, higher total yield than the check variety. 11 lines were early in maturity and harvested between 104 to 110 days after transplanting.

Evaluation of white onion germplasm during *kharif* season 2007

36 white onion germplasm and breeding lines were evaluated during *kharif* season in 3 replication in plots of 1 sq m along with 3 white check varieties. This year due to heavy rains and severe attack of

diseases the yield was affected and bulb development was restricted mostly to B grade. Under such situations, some the lines performed well and yielded up to 22.6 t/ha total yield and 20.8 t/ha marketable yield with 100% marketable bulbs in some of the entries. Maximum marketable yield and total yield in white varieties were 6.7 and 10.1 t/ha, respectively. Percentage A grade was maximum 23.5% in germplasm whereas it was 0 in the varieties. Percentage of B grade bulbs in germplasm ranged from 0 to 63.6% against the check varieties where it was 12.5 to 25.0% only. Losses due to rotting were maximum up to 34.9% in the germplasm. High marketable yield (more than 14.0 t/ha) and total yield was recorded in 8 lines.

Evaluation of late *kharif* white onion germplasm and breeding lines in storage (07)

65 late *kharif* white onion germplasm were stored in the month of February to see the storage performance along with 5 white varieties. Total weight loss was recorded after 4 months of storage. It ranged from 13.0 to 58.1% in white germplasm and 29.6 to 45.3% in white varieties. Losses due to sprouting were maximum up to 19.4% whereas losses due to rotting and weight loss were 48.6% in the germplasm lines. Total weight loss, less than 30.0% was recorded in 18 lines whereas in check Phule Safed, total loss was 45.3%. 11 germplasm lines had better storage life and total weight losses were less than 25.0% after 4 months of storage. Similarly 19 white onion late *kharif* breeding lines were evaluated for storage performance and 10 lines recorded less than 25.0% storage losses after 4 months of storage.

Evaluation of *rabi* white onion germplasm lines in storage 07

White onion *rabi* germplasm (54) were evaluated for storage performance along with 5 white check and 2 red check varieties. Total weight loss after 5 months of storage (i.e. in the month of October), ranged from 22.3 to 98.9% in white germplasm and 78.9 to 92.0% in white variety. In check Phule Safed, total weight losses were 81.4%, in ALR it was 59.8% and in N-2-4-1 it was 67.3%. This year, overall losses in storage were quite high due to heavy rains and high humidity. Less than 50.0% losses were recorded in 8 lines, less than 40.0% losses in 6 lines and less than 30.0% losses in 2 lines.

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

Evaluation of white onion elite lines during late *kharif* 06-07

Nine elite lines along with 5 checks were evaluated during late *kharif* in 2 x 2 m plots with three replications. Percentage A grade bulbs in these lines ranged from 15.9 to 54.0% against the checks, where it was 10.9 to 35.7%. Percentage doubles in check varieties varied from 16.0 to 41.0% and in elite lines it was maximum up to 24.0%. 4 lines recorded bolters less than 2.0% while in check varieties maximum was 8.4%. Marketable percentage of bulbs ranged from 63.9 to 87.0% in these lines against the check varieties (48.0 to 71.0%). TSS was at par in all the lines and ranged between 9.8 to 11.2%. Marketable yield and total yield was higher in 5 lines, which ranged from 28.0 to 38.9 t/ha and 33.7 to 46.1 t/ha, whereas in check Phule Safed it was 24.2 and 33.8 t/ha, respectively.

Evaluation of varieties and advance lines in demonstration trial during late *kharif* 06-07

Advance lines of white (3) and red (13) onion along with varieties (8) and exotic hybrids (9) were evaluated in the demonstration blocks, in bigger plots of 1 x 25 m size, in 2 replications during late *kharif*. Percentage marketable yield in varieties ranged from 45.7 to 96.6%, in exotic hybrids from 55.7

to 97.8%, in red onion lines from 58.3 to 94.4% and white lines from 69.1 to 84.9%. Marketable yield in varieties, exotic hybrids, red lines and white lines varied from 13.3 to 40.7, 14.5 to 58.6, 25.1 to 43.0 and 25.8 to 40.7 t/ ha, respectively. Percentage of bolters in varieties was 1.1 to 25.0% whereas it was 0 to 7.1% in exotic hybrids, 0.5 to 12.7% in red lines and 5.9 to 14.8% in white lines. Maximum double bulbs in varieties was up to 33.5%, in exotic hybrids up to 39.4%, in red lines up to 26.8% and in white lines it was up to 18.2%. Red variety Bhima Red gave high marketable yield up to 40.7 t/ha and total yield of 42.1 t/ha. Percentage of bolters and percentage double bulbs in this variety was 1.1% and 0.54%, respectively with high percentage of marketable bulbs (96.6%). There is scope to improve the share of marketable bulbs in some of the lines giving high total yield and less marketable yield.

Evaluation of white onion elite lines during *rabi* 06-07

24 white onion elite lines including 4 high TSS lines along with 4 check varieties were evaluated during *rabi* season in 2 x 2 m plots in 3 replications. Percentage A grade bulbs (65.9%) and percentage marketable yield (97.0%) was maximum in the elite lines whereas it was 43.6 and 73.3% in the check variety Phule Safed, respectively. Marketable yield ranged from 16.7 to 56.5 t/ha and was high in 8 lines, whereas, total yield was higher in 2 lines over check Phule Safed (35.6 & 49t/ha, respectively). Total yield was more than 45.0 t/ha in 8 lines and was maximum up to 63.0 t/ha. TSS in elite lines ranged from 9.6 to 18.1% and out of 4 high TSS lines, 2 lines recorded TSS more than 18.0% against check variety, which recorded 11.25%. Marketable yield in high TSS lines ranged from 18.6 to 19.8 t/ha and total yield from 20.0 to 30.6 t/ha, hence, there is scope to improve the marketable yield in these lines.

Evaluation of varieties and advance lines in demonstration trial during *rabi* season 06-07

Overall 29 entries including varieties (6), advance lines of red (15) and white onion (5) and yellow onion exotic hybrids (3) were evaluated in bigger plots of size 1 x 26 m in two replications in demonstration trial during *rabi* season on drip irrigation. Percentage A grade bulbs in red lines was maximum at 69.6%, in white lines 56.5%, in yellow hybrids 65.4%, in red varieties 55.7% and white varieties 24.3%. Similarly, percentage marketable bulbs were maximum up to 98.9%, 94.1%, 99.0%, 97.3% and 62.5%, respectively. Marketable yield and total yield ranged between 35.3 to 44.5 and 37.1 to 48.3 t/ha in red lines, 25.5 to 59.2 and 32.6 to 59.9 t/ha in yellow hybrids, 36.6 to 39.9 and 42.1 to 51.1 t/ha in white lines, 28.1 to 41.8 and 30.6 to 43.8 t/ha in red varieties and 25.7 and 41.2 t/ha in white varieties, respectively. More than 40.0 t/ha marketable yield was recorded in 8 lines and more than 50.0 t/ha total yield in 7 lines. One of the yellow exotic hybrid had the highest marketable yield of 59.2 t/ha and total yield of 59.8 t/ha.

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

21 entries which included 8 red varieties, 5 white lines, 1 white variety and 7 red lines were evaluated in demonstration trial during *kharif* in 3 replications in 1 x 10 m plots. Percentage A grade bulbs in varieties were 0 to 21.7%, in white lines 0.6 to 16.8% and in red lines it was 6.4 to 18.4% against the check Bhima Super (20.5%). Percentage double and percentage rot were maximum at 37.4 and 23.2% in red varieties, 3.1 and 15.2% in white lines and 7.5 and 17.0% in red lines as compared to the check Bhima Super with 0.2 and 1.8% and Phule Safed 3.1 and 3.7%, respectively. Marketable yield was maximum at 25.3 t/ha in variety Bhima Super with a total yield of 27.0 t/ha, whereas it was 20.1 t/ha

marketable yield and 22.5 t/ha total yield in white lines. In red lines, maximum marketable yield was 18.7 t/ha and total yield 22.8 t/ha. In white variety Phule Safed marketable and total yield was 6.8 and 11.9 t/ha, respectively. 4 white lines were high yielders than the white check whereas none of the red lines were superior to the check variety Bhima Super.

Evaluation of white onion high TSS lines during *rabi* 06-07

29 white onion high TSS lines were developed from single bulb to row selection and further multiplied by massing. After third cycle of massing, these lines were evaluated during *rabi* season. Out of 29 lines, 8 lines were evaluated in 1 sq m plot with 3 replications along with 5 check varieties. Due to less seeds, only TSS was recorded in rest of the lines and bulbs were selected on the basis of TSS for further multiplication. TSS in these 8 lines ranged from 14.2 to 18.5% whereas in the varieties it ranged from 9.8 to 11.2%. Total yield in these lines varied from 11.4 to 24.3 t/ha against varieties, where it was 24.6 to 31.8 t/ha.

After third cycle of selection more than 15% TSS was recorded in 18 lines, where more than 50.0% bulbs had TSS above 15.0% and 7 lines had more than 90.0% bulbs with TSS above 15.0%. Similarly in 21 lines, more than 10.0% bulbs had TSS above 18.0%. 8 lines had mean population TSS above 17.0%. In one of the high TSS lines, where out of 174 bulbs, 60.0% bulbs had more than 18.0% TSS and the mean population TSS was 18.4%. In 9 white onion varieties TSS ranged from 9.5 to 11.1% only. This clearly indicated the scope for the development of high TSS white onion varieties suitable for processing from short day Indian genotype.

Evaluation of late *kharif* demonstration varieties and advance lines in storage 07

Varieties of onion and advanced lines, which were evaluated in demonstration trials during late *kharif*, were evaluated for their storage performance. 10 kg bulbs of each entry (33) were kept in storage in three replications. Final observations on total storage losses on weight basis were recorded after 4 months of storage. In red lines, maximum total weight loss was up to 35.7%, whereas in white lines it was 31.7%, in red varieties it was 50.3% and in exotic hybrids it was 74.7%. Total weight losses in variety Bhima Super were 14.7%, in Agrifound Light Red (ALR) it was 11.7% and in Phule Samarth the losses were 34.3%. 5 red lines had less storage losses and was at par with ALR and in white lines, one entry recorded losses up to 19.5%.

Evaluation of *rabi* demonstration varieties and advance lines in storage 07

Varieties and advance lines of onion evaluated in demonstration trials during *rabi* season were evaluated for storage life. 10 kg bulbs from each (27) entries were kept in storage during May 07 and observations were recorded after 4 months of storage. Total weight loss in 14 red lines varied from 12.7 to 96.0%, in 6 red varieties from 20.2 to 90.7%, in 5 white lines from 67.0 to 85.7% and in exotic hybrid Mercedes and Liberty it was 87.3 and 98.8%, respectively, whereas in N-2-4-1 Br-2 total weight loss was 20.2% only after 4 months of storage. 3 red lines were superior in storage as compared to the check N-2-4-1 Br-2.

Project 2.3: Collection, evaluation and maintenance of yellow onion germplasm

Evaluation of yellow onion germplasm & breeding lines during *rabi* season 06-07

Yellow onion germplasm were multiplied after selection from the red segregating population. 11

germplasm and breeding lines were evaluated during *rabi* along with check variety Phule Suwarna in 3 replications in 1 sq m plots. Percentage marketable yield in the germplasm varied from 41.1 to 100.0% while it was 69.3% in the check. Average bulb weight, percentage A grade bulbs, percentage doubles and percentage bolters ranged from 7.4 to 62%, 0 to 56.4% and 0 to 1.4%, respectively in the germplasm lines, whereas it was 18.0%, 5.8% and 17.7%, respectively in the check variety. 9 germplasm had high marketable yield (29.1 to 39.8 t/ha) than the check (26.1 t/ha) and 4 lines recorded more than 33.0 t/ha marketable yield. Total yield ranged from 22.0 to 43.1 t/ha in the germplasm compared to the check, where it was 38.4 t/ha.

Project 2.4 : Development of yellow onion varieties suitable for export

Evaluation of exotic onions during late *kharif* 06-07

Eight exotic hybrids along with check variety Phule Suwarna were evaluated during late *kharif* in 2 x 2 m plots with 3 replications. There were 4 yellow and 4 red exotic hybrids. Average marketable bulb weight in these hybrids ranged from 57.5 to 94.3 g/bulb, whereas it was 46.2 g in the check variety. Percentage marketable yield was maximum at 98.3% in the hybrids as compared to the check (49.6%). In some of the exotic hybrids also percentage doubles and bolters were high (29.3 and 4.5%, respectively)and the bulbs were not of uniform size which is evident from the percentage of marketable bulbs and percentage A grade, doubles and bolter bulbs. Percentage marketable yield was minimum at 62.2 %. Marketable yield was higher in all the hybrids and ranged from 26.0 to 54.5 t/ha against the check 16.2 t/ha, whereas in case of total yield it varied from 29.9 to 55.7 t/ha. 5 hybrids gave higher total yield (34.7 to 55.7 t/ha) than the check Phule Suwarna (32.5 t/ha).

Evaluation of exotic onion during *rabi* season 06-07

10 exotic hybrids were evaluated during *rabi* season along with yellow check Phule Suwarna in 3 replications in 3 x 2 m plots. All hybrids were not uniform. The average bulb weight ranged from 39.3 to 120.7 g in the hybrids with 10.2 to 71.6% of A grade bulbs, 0 to 19.0% double bulbs, 0 to 1.3% bolters, 69.4 to 96.8% marketable bulbs and 5.9 to 15.5% TSS, whereas it was 16.7%, 14.9%, 15.5%, 67.2% and 10.9%, respectively in check variety Phule Suwarna. Percentage TSS was high (15.5%) in hybrid White Creole only but marketable and total yield was very less (15.0 & 22t/ha, respectively). Marketable yield and total yield was higher than the check in 8 hybrids and more than 65.0 and 70.0 t/ha was recorded in two exotic hybrids, respectively, whereas it was 23.1 and 34.5 t/ha in the check variety Phule Suwarna.

Project 2.5 : Heterosis breeding in white and yellow onion

Crosses between Indian white and yellow onion were made with exotic onion to transfer desirable characters to Indian short day onion and for creation of variability and further selection. White onion exotic varieties were forced to flower for seed production and crosses with short day Indian varieties were made. A promising yellow onion variety was introduced from Egypt and was forced to flower. Crosses were made with Indian varieties for further selection. Back crossing programme with MS lines is in progress to transfer male sterility to red, white and yellow onion varietal background. Population improvement with exotic and other indigenous promising lines is in progress. For creation of wide variability, bulbs of short day white and yellow onions were planted with exotic onion and red onion

varieties having better storage life in open crosses. Forced flowering of exotic hybrids / varieties is in progress to transfer desirable traits in short day onions.

Project 2.6 : Breeding white and yellow onion varieties resistant to biotic and abiotic stresses

Screening onion germplasm for resistance to thrips

Among the 50 white onion lines screened, W401 recorded the lowest curling (2.6) and leaf injury (3.6), which amounted to a total rating of 6.2. The LCR ranged from 2.6 - 4.8, while LIR ranged from 3.6 - 4.8, amounting to a total rating of 6.2 - 9.4. Commercial variety Phule Safed recorded a total rating of 8.3 and marketable yield of 2.9 kg/sqm. Acc. W401 and W332 recorded highest yield of 3.2 kg/sqm. The other lines that recorded higher yields despite having higher thrips damage rating were, W440, W220, W119, and W329.

Programme 3 : Improvement of garlic through conventional and biotechnological approaches

Project 3.1 : Collection, evaluation and maintenance of garlic germplasm

White garlic germplasm: A total of 118 lines were evaluated for yield and other horticultural traits. The experiment was laid out in a randomized block design with a spacing of 1m x 1m area for each genotype. On the basis of analysis it was found that genotype 74-5 (0.81 kg sq. m^{-1}), 183-4-1 (0.68 kg sq. m^{-1}) and 201 (0.68 kg sq. m^{-1}) recorded significantly superior yield than the local check G-41 (0.50 kg sq. m^{-1}).

Red garlic germplasm: Out of 113 lines evaluated for yield and other desirable traits, no lines were found to be significantly superior to the local checks *viz*., G 41 and Godavari. Some of the accessions which performed at par with the varieties were Acc. No. 49, 155, 349. 59 and 316-8-3, 279-11, 341, 44-5, 114, 312, 401, 358, 174-11-1, 321-2-A. Yield ranged from 0.69 - 0.61 kg sq. m^{-1} for these accessions whereas G-41 and Godavari recorded the maximum marketable yield of 0.61 kg sq. m^{-1} and 0.59 kg sq. m^{-1}, respectively.

Elite lines: Some of the lines which have shown improved performance over the last couple of years were evaluated in 3 x 2 m plots in a randomized block design to assess for their high performance *vis*. a *vis*. G-41. It was observed that Acc . No 316 recorded the highest yield of 3.6 t/ha but the yield was at par with Godavari (a local check variety). Other genotypes were not encouraging with regards to their yield performance.

AICVIP AVT-II: In this experiment, there were four replications and the trial was laid out in randomized block design. AC 200 and RAU-G-5 performed better than any other genotype in terms of marketable yield (0.40 Kg sq. m^{-1}).

NBPGR germplasm: In NBPGR trial NBG 193 performed better (0.52 Kg sq. m^{-1}) than G-41. In New NBPGR experiment, New NBG58, 17, 22, 03, 04, 77 and 38 performed better than G 41 and the yield ranged from 0.58 to 0.35 kg sq. m^{-1}.

In DGR germplasm trial, DGR 78 recorded higher yield (0.49 Kg sq. m^{-1}) than G-41, whereas no line was found to perform higher than the check variety G 41 in NBPGR1, NBPGRNewVT and NBPGRVT

trials. In bulb to row progeny experiment, which was laid in augmented design, 37 accessions exhibited higher marketable yield than the check varieties G 41 and Godavari. These lines will be again evaluated for identification of best lines exhibiting superior yield than the check varieties.

Screening of garlic germplasm against thrips during *rabi* 2006

Around 133 lines of garlic germplasm were evaluated for screening against thrips during *rabi* season. Damage rating was given based on a rating scale of 1-5 depending on the percentage of damage due to thrips. Among the lines, a mutant accession SA 0.02% was found resistant to thrips. Apart from that, 25 lines were found moderately resistant, 58 susceptible and 49 highly susceptible to thrips.

Screening of garlic germplasm for disease resistance

One hundred and thirty two advanced lines of garlic were planted for disease screening, out of that only 72 survived. Twenty-six lines were found highly susceptible, 43 susceptible, whereas only 3 lines moderately susceptible. Plant mortality varied from 18.3 % (RG49) – 81.6 % (DGR49). Lowest Percent Diseases Index (PDI) was recorded in RG77 (48), while highest was in RG-91 (100). Yield varied from 0.01 Kg/m^2 (DGR49) - 0.26 kg/m^2 (RG36). All lines produced only C grade bulbs. RG-27 and RG-118 was found tolerant, as they provided good yield in spite of higher PDI than check var. G-41.

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

Mutation breeding studies in garlic

Four varieties were subjected to different mutation doses of colchicine, EMS and sodium azide to identify a line having higher yield than the parent cultivar. At present some of the mutated lines are surviving in the field and yield and other characteristics will be recorded in the next year.

Evaluation of garlic lines obtained from mutation treatments during *rabi* 06-07

Mutation treatments were given in garlic variety G-41 using sodium azide (SA), colchicine (Col) and ethyl methyl sulphonate (EMS) and bulb to row progenies were multiplied. Out of a large number of progenies, 72 lines from Col treatments, 53 lines from SA treatments and 12 lines from EMS treatments were selected and evaluated in M4 generation in plots of size 1 sq. m. in 2 replications during *rabi* season along with 4 check varieties including G-41. In plant height, there was variation from 48.7 to 56.5 cm, 45.0 to 56.2 cm and 44.8 to 53.2 cm in Col, SA and EMS treatments, respectively. Similarly, number of leaves also varied from 9.1 to 11.1, 9.1 to 11.8 and 9.8 to 11.5, respectively as compared with variety G-41 where it was 52 cm plant height and 10.4 number of leaves per plant. Leaf length was minimum 31.1 in SA to maximum 40.5 cm in Col treatments against G-41, which had 34.5 cm. Leaf width in G-41 was 1.33 cm while it ranged from 1.08 cm in Col to 1.71 cm in SA treatments. Fresh yield along with foliage was 7.8 to 15.9 t/ha in Col treatments, 5.7 to 14.0 t/ha in SA treatments and 7.6 to 11.2 t/ha in EMS treatments as compared with the varieties where it was 7.2 to 9.8 t/ha (G-41). Average bulb weight was maximum 17.8 g in Col treatments, 16.5 g in SA treatments and 13.6 gm in EMS treatments against G-41, which had 13.8 g per bulb. Net yield was recorded after one month of curing without leaves. It ranged from 5.0 to 10.5 t/ha in Col treatments, 4.2 to 9.6 t/ha in SA treatments and 5.7 to 8.4 t/ha in EMS treatments as compared to G-41 (6.8 t/ha). Overall, 39 lines gave

higher net yield (cured without leaves) than the check G-41 and out of these, 6 lines from Col treatment and 3 lines from SA treatment recorded net yield more than 9.0 t/ha than G-41 (6.8 t/ha).

Evaluation of garlic elite lines obtained from mutation treatments during *rabi* 06-07

Mutation treatments were given in garlic variety G-41 using sodium azide (SA), colchicine (Col.) and ethyl methyl sulphonate (EMS) and bulb to row progenies were multiplied. Out of a large number of progenies, 13 lines were selected and evaluated in M4 generation in plots of size 2 x 2 m in 3 replications during *rabi* season along with 7 varieties including G-41. Percentage A grade bulbs in these lines ranged from 34.9 to 58.1% and percentage B grade from 25.1 to 41.7%, whereas in varieties it ranged from 23.5 to 41.2% and 14.6 to 44.5%, respectively. Fresh yield with foliage in mutated elite lines varied from 7.5 to 10.7 t/ha whereas it was maximum 8.4 t/ha in the varieties, with G-41 recording 7.7 t/ha. Marketable yield was recorded after one month of curing and without foliage which ranged from 5.6 to 8.4 t/ha in these lines, whereas in varieties it was 2.3 to 6.0 t/ha (G-41) in the varieties. Top five lines yielded 7.1 to 8.4 t/ha of net yield.

Project 3.6 : Molecular analysis of genetic diversity in garlic

Use of molecular markers for assessing genetic diversity achieves significance because of its versatility to detect variability at molecular level and also the neutral effect of environmental variation in detecting diversity. In the present project, RAPD markers were used to detect variability. Previously identified RAPD primers were used for analyzing diversity. It was found that the quality of the amplicons was not good. Hence an experiment was conducted to standardize the optimum DNA (20 ng), primer (800 M), Magnesium chloride and annealing temperature to get sharp amplicons. In addition to RAPD, work on identifying ISSR primers was carried out in garlic. A set of 10-12 primers exhibiting amplicons in garlic were identified. These primers (RAPD and ISSR) will be used for estimation of genetic diversity in varieties identified under DUS.

Programme 4 : Onion improvement through biotechnological approaches

Project 4.1 : Induction of haploids in onion

Haploid induction *via* gynogenesis

An experiment was initiated for the induction of haploids from unopened flower bud culture *via* gynogenesis. This method was chosen after preliminary experiments *via* androgenesis failed to give any results. For gynogenesis, three explants *viz.*, ovary, ovules and unopened flower buds were tried. Amongst these, unopened flower buds were found the most easiest and reliable, giving rise to haploid plants.

Experiments initiated to study the effect of different hormonal regimes and media during *rabi* 06-07, resulted in the induction of a number of haploid plants formed directly from the ovary of the unopened flower bud explants. Five onion varieties (*viz.*, N241, B-780, Arka Bindu, Arka Niketan and Agrifound White) and four MS lines (MS 48 / 65 A & B lines) were tried. The results showed that genotypic effect plays a very important role in *in vitro* gynogenesis as in other *in vitro* responses. Study on the effect of sucrose (3-10%) showed that sucrose (5%) along with other growth regulators was able to enhance the induction of plantlets in many cases.

Gynogenesis in onion was successfully achieved. Ploidy analysis using ploidy analyzer (PA II, Partec, Germany) at NRC for Medicinal and Aromatic Plants, Anand showed that about 72.5% of plantlets analyzed were haploids, 17.5% dihaploids and 10% mixoploids. Haploid induction through gynogenesis in short day onion is reported here for the first time in India.

Efforts are on to diploidise the haploids using chemical treatment. Few treated plants were analysed and it was observed that approximately 66% was diploidised. Further establishment experiments are in progress.

Haploid induction *via* 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 colchicine and planted in the green house during *rabi* 07-08. The resulting plants show phenotypic variation in a few. Ploidy of these was assessed using Ploidy Analyser (PA II, Partec, Germany). It was reported that most of them were diploids. The resultant plants could be used in further breeding programs.

Similar crossing experiments were repeated in *rabi* 06-07 and the few seeds obtained were sown in *rabi* 07-08.

Project 4.2: Micropropagation studies in onion

Somatic embryogenesis in onion

Different combinations of 2,4-D alone (1-3 mg/l) and in combination with 3 cytokinins were tried for somatic embryogenesis. Apart from this, two different solidifying agents (agar and phytagel) was used along with 2,4-D. Four varieties (AFW, N241, ALR and Phule Safed) were tried and all of them showed callus induction and regeneration instead of embryogenesis in experiments consisting of cytokinins + 2,4-D. However, 2,4-D derived callus was friable, but could not differentiate to form embryoids. Further experiments to identify a suitable maturation medium for embryogenesis are underway.

Project 4.3: DNA profiling of onion lines using molecular markers

Preliminary report of DNA profiling of onion including varieties and advanced lines using RAPD

DNA profiling studies of 18 onion varieties and four advanced lines along with two garlic varieties (as out groups) was initiated using RAPD. A total of 100 RAPD primers (Operon Technologies, USA) were screened of which 26 was short listed. Preliminary reports suggest that the variability within onion is less as evidenced by RAPD.

Identification of male sterile and maintainer lines using molecular markers

In this experiment, use of molecular markers to identify male sterile and fertile lines was the objective. A number of primers, previously reported by different authors, were used to identify male sterile and fertile line in our germplasm. Some primers have been identified. Now the next programme will be to develop primers for maintainer lines in onion.

Programme 5: Collection, characterization and screening of wild species for *Allium* improvement

Project 5.1: Screening of wild species for biotic stresses and introgression of desirable genes in *Allium cepa*

In this project, a number of wild species *viz., A. fistulosum, A. royleii, A. galanthum* and *A. tuberosum* were received from different sources and were tried to grow under our own conditions. But none of the wild species were able to survive under our greenhouse conditions. One line of *A. tuberosum* and *A. chinensis* (brought from North Eastern States) were able to flower and crossing with onion to obtain some interspecific hybrids was done. In addition to this, previously developed interspecific hybrid between *A. fistulosum* and onion was backcrossed with onion to generate backcross hybrids.

Programme 7 : Enhancement of production of onion and garlic through agronomic innovations

Project 7.2 : Studies on onion and garlic based cropping sequences

Studies on garlic based cropping sequences

Studies on sequential cropping of well-delineated agro ecological zone would help for optimization of nutrient inputs thereby minimizing the external inputs. In recent years, soil fertility - fertilizer use research is focused on cropping sequences. Escalated chemical fertilizer production cost, impaired quality of produce, degraded soil and polluted surroundings necessitated the practice of cropping systems for vegetable production in recent years. So far, there is no prominent cropping system for garlic. Garlic is a short duration, spicy vegetable crop commercially grown in India. The productivity of garlic could be increased through improved agronomic practices especially through different cropping pattern. Garlic based cropping system is to grow two or more crops in a sequential order in a year from the same piece of land. However, the available information on similar aspects in garlic is very meager. Hence an experiment was conducted in garlic at NRCOG, Rajgurunagar to study the garlic based cropping systems to get higher yield and net profit per unit area per unit time.

The present investigation was carried out during *kharif, rabi* and summer seasons to find out the most economically viable, environmentally suitable and socially acceptable garlic based cropping systems under western Maharashtra conditions. The selected cropping systems were soybean-garlic, groundnut-garlic, potato-garlic, pea-garlic, mung bean-garlic, bajra – garlic and cucumber - garlic along with traditional cropping systems like bajra (summer) - garlic and groundnut (summer) - garlic.

Among the various sequences evaluated during the last four years, the highest marketable bulb yield of garlic (6.6 t/ha) was noticed in soybean (*kharif*) – garlic (*rabi*) sequences. The next best combination is groundnut in summer followed by garlic in *rabi* season (6.4 t/ha). Moreover, it was found that the higher B: C ratio was noticed in groundnut (2.65) (summer) - garlic (*rabi*) followed by soybean (2.58) in *kharif* season and garlic in *rabi* season.

Apart from yield and B: C ratio, there was slight improvement in physical and chemical properties of soil in legume based cropping sequences, particularly available N, P & K content of the soil. It is a well known fact that cultivation of legumes increased the available N content in soil. The increased

available N showed the biological N fixation by the root nodules of soybean / groundnut / mungbean / pea by microbial decomposition and mineralization. This would have helped slow and sustained release of N and enhanced availability of nutrients in the soil, which promoted the vegetative and reproductive phase of garlic. The results of soil chemical properties revealed that there was a slight improvement in organic carbon, organic matter, soil available N, P and K content of the soil in legume based cropping systems like soybean followed by garlic and groundnut (summer) followed by garlic (*rabi*) than other sequences evaluated.

Project 7.3 : Micro irrigation and fertigation studies in onion and garlic

Comparison of irrigation systems in onion

Effect on growth and yield of onion: Different irrigation systems *viz*. drip, big sprinkler, mini sprinkler and surface irrigation, were used to test their efficacy in onion during *rabi* seasons 2004-05,05-06 and 06-07.The results revealed that drip irrigation method produced significantly higher marketable bulb yield than other methods of irrigation. The yield in other treatments *viz*. surface, big sprinkler and mini sprinkler was statistically similar. The percentage of bigger bulbs (>60mm diameter) was higher in drip irrigation, while percentage of medium sized bulbs was almost similar in all the treatments. The percentage of small bulbs (35 to 50 mm diameter bulbs) was lowest in drip irrigation while it was highest in mini sprinkler irrigation. There was no statistical difference in doubles and bolters in different irrigation systems. The percentage of rotted bulbs was higher in big sprinkler irrigation systems.

As far as the equatorial, polar diameters and neck thickness of bulbs are concerned these were higher in drip irrigation system and there was a significant difference in neck thickness of the bulbs in different irrigation systems. As far as total soluble solids were concerned, there was no difference among the various irrigation systems evaluated.

Water use efficiency & economics : The amount of water applied during the crop period was highest in surface irrigation (87.5 ha cm) while lowest water was required in drip irrigation system (62.5 ha cm). There was around 30 percent water saving in drip irrigation system as compared to surface system while it was between 10 to 15 percent in sprinkler irrigation systems. The highest water use efficiency was recorded in drip irrigation system. The economics of different irrigation systems was calculated assuming the market rate of Rs.2 per kg of onion bulbs. The highest B:C ratio was found in drip irrigation which was 1.92 followed by surface irrigation (1.35).The lowest B: C ratio was found in mini sprinkler (1.05)

Storage losses : The onions produced in different irrigation methods were stored in bottom ventilated storage structures from May to November 2007 to study the effect of various types of storage losses. It was found that highest storage losses after 3 months and 6 months of storage were recorded in onion produced in big sprinkler system. The rotting losses were highest in big sprinkler while other losses were almost at par in all the treatments. The lowest storage losses were found in onion produced in drip irrigation followed by surface irrigation.

Studies on combined effect of organic manures and water soluble fertilizers on growth, yield and quality of onion and garlic

The importance of organic manure has been well recognized in the cultivation of vegetable crops long back. Organic manures play a vital role in maintaining the soil fertility and also to improve the yield and quality of the vegetable produce. Combined application of organic manures and fertilizers can help in improving the nutrient uptake and mitigate the losses of plant nutrients when applied to the soil. In recent years, greater importance has been given to increase the efficiency of irrigation water and nutrients. In drip system, water and nutrients are supplied at the root zone of the crop with the help of emitters and a network of pipes, which ensures supply of water and other nutrients at the right time in a right/required quantity at the root zone. Keeping this in view, to maximize the fertilizer use efficiency, the drip fertigation experiment was started to find out optimum nutrient requirement of onion and garlic through drip fertigation combined with different organic manures and biofertilizers

The present experiment was conducted in split plot design with main plots and sub plots. The main plot consisted of split application of N through drip irrigation & 80 % recommended dose of water soluble fertilizers (best results obtained from fertigation trial) through drip fertigation. The sub plot included different kinds of organic manures along with foliar application of polyfeed, micronutrients and Multi K. Biofertilizers (*Azospyrillum* and *Phosphobacteria*@ 10 kg each/ha) were applied uniformly to all treatments.

The results revealed that combined application of different organic manures (farmyard manure, poultry manure and vermicompost) along with 80 % recommended dose of water soluble fertilizers through drip fertigation recorded higher plant growth and number of leaves in both the crops. However, there was no significant difference noticed in main plot, subplot and their interactions. The higher marketable bulb yield (53.8 t/ha) of onion was noticed in M2S2 plot (combination of poultry manure 10 t/ha + 80% recommended dose of water soluble fertilizers through drip) followed by M2S4 (combination of FYM + poultry manure + vermicompost along with 80% recommended dose of water soluble fertilizers through drip) with marketable bulb yield of 53.3 t/ha. There were no significant differences observed in subplots and their interactions.

The same trend was observed in garlic also. Application of poultry manure 10 t/ha + 80% recommended dose of water soluble fertilizers through drip irrigation improved the marketable bulb yield of garlic (4.6 t/ha) followed by M2S1 (FYM 20 t/ha +80% recommended dose of water soluble fertilizers through drip irrigation) with a yield of 4.4 t/ha. From the results it was seen that no significant difference was noticed in main plot, subplot and their interactions. Likewise, there was no significant effect on yield contributing characters like percentage of A, B and C grade bulbs, equatorial and polar diameter of bulbs in both crops. The increased bulb yield in onion and garlic was mostly due to the favourable effect of combined application of poultry manure along with 80% recommended dose of water soluble fertilizers through drip fertigation at the right time in a required quantity during the entire growth period.

With regards to storage life, there was significant effect noticed in total losses of six months stored onion bulbs under well ventilated ambient storage conditions. The maximum storage losses (51.4 %) 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 (43.1 %) was 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, the minimum physiological loss of weight (19.0

%) was noticed in M2S2 (80 % of recommended dose of fertilizers in the form of water soluble fertilizers through drip irrigation + poultry manure @ 10 t/ha).

Project 7.4: Studies on organic production in onion and garlic

Onion cv.N-2-4-1 was planted under two preceding crops *i.e.* bajra and soybean and four fertilizer/manure combinations during *rabi* season (December - 2006).The results revealed that there was no difference in plant height and number of leaves among crop sequences and manure/fertilizer treatments. As far as yield in concerned, the total yield and marketable yield was significantly lower in recommended practices as the crop was severely affected by root rot disease in the early stages than organic treatments. Among the organic treatments, higher yield was recorded in poultry manure (10 t/ha) applied plots (31.9 t/ha) followed by poultry manure (5 t/ha) and farmyard manure (10 t/ha) combination with an yield of 31.3 t/ha. The percentage of A grade bulbs were higher in organic treatments. The equatorial diameter, polar diameter and neck thickness of bulbs were similar in all treatments. The onion produced in various crop sequences and manure treatments were stored from May to Oct 07 to study various types of storage losses. It was found that there was no significant difference in total storage losses among various treatment combinations after 6 months of storage.

Garlic cv. G-41 was planted under four preceding crops *i.e.* mungbean, french bean, bajra and soybean and four fertilizer / manure combinations in October 2006. The results reveals that crop sequences and the fertilizer/manure treatment did not show any statistical difference for plant height and number of leaves per plant. The bulb yield was significantly higher (6.6 t/ha) in FYM (10 t/ha) + poultry manure (5 t/ha) combination. All the organic treatments were statistically similar for yield. As for the effect of preceding crops, the higher marketable bulb yield was noticed in soybean followed by garlic sequence. The garlic produced under various preceding crops and manure treatments were kept for storage studies up to 6 months with intact leaves under ambient conditions. It was found that the storage losses were lower in poultry manure (10 t/ha) applied plots with preceding crop of french bean.

Project 7.5: Weed management studies in onion and garlic

Integrated weed management studies in onion seed crop

An experiment on integrated weed management practices in onion seed crop was initiated by using different organic and synthetic mulches along with herbicide application. The organic mulches included paddy straw, soybean husk and saw dust and inorganic mulches like transparent polythene, black polythene and bicolor polythene sheets were used. The herbicides used were Goal, Stomp and combined application of Goal and Stomp. The variety used for this experiment was N-2-4-1 and recommended cultural practices were followed uniformly for all treatments. The field was irrigated by drip irrigation method.

There was significant effect on growth characters influenced by various mulching materials and herbicide application. Among the various treatments, it was observed that black colour polythene mulch recorded higher seed yield (7.6 q/ha) followed by bicolor (7.4 q/ha) sheet mulches. There was no significant effect on in between treatments but there was effect on mulching and herbicide application when compared to control plot. Moreover organic mulches are on par with each other.

The highest benefit cost ratio (4.02) was noticed in two sprays of stomp application (one at planting time and another spray at 50-60 days after planting) @ 2.5 l/ha.

The common weeds found in seed crop are *Cyperus rotundus, Cynodan dactylon, Portulaca, Chenopodium album, Ipomea, Digitaria, Convolvulus, Trianthema portulacastrum* and *Amranthus sp.* With regards to weed population, the maximum number of weeds was present in the control plot (42.3 Nos/m2) and minimum weed population (5.0 Nos/m2) was noticed in black polythene mulch applied plot. The highest weed control efficiency of 88.2 % was recorded in T3 – black polythene mulch applied plot.

Mulching studies in onion and garlic bulb crops

Mulching is one of the important practices in weed control method followed in most of the commercial vegetable crops. It is very efficient, socially acceptable and eco friendly in nature too. Information on this aspect is very meager in onion and garlic bulb crops. Mulches can either be organic or inorganic. It reduces the weed population in crop field, conserves the soil moisture, protects the soil from erosion, maintain the soil temperature and also increases the crop yield. Keeping in view these facts, an experiment was initiated in onion bulb crop to study the effect of different mulching materials on growth, yield and weed control. In this experiment, the organic mulches included are paddy straw, soybean husk, bajra husk and saw dust and inorganic mulches were transparent polythene, black polythene and bicolor polythene sheets. The variety used for this experiment was N-2-4-1 in onion and G.41 in garlic and recommended cultural practices were followed uniformly for all treatments. The field was irrigated by drip method.

Among the mulching treatments, based on the last two years studies, it was observed that organic mulch - paddy straw (39.0 t/ha) was found to be superior in terms of higher marketable bulb yield followed by saw dust (38.6 t/ha) than control and other mulches evaluated. The increased yield may be due to favourable soil moisture and constant/optimum soil temperature during the entire crop growth period. The highest weed control efficiency was noticed in black colour polythene mulch (90.9 %).

In case of garlic, based on the last two years results, it was concluded that among the different mulching materials evaluated, it was observed that organic mulch material, saw dust (8.8 t/ha) was found to be superior in terms of higher marketable bulb yield in garlic followed by paddy straw mulch (8.7 t/ha).There was no significant difference between treatments. The minimum number of weeds and the highest weed control efficiency (86.1 %) were noticed in black colour mulch treatment.

Programme 9: Integrated pest management in onion and garlic

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

Barrier cropping for the management of thrips in garlic

The barrier crops consisting of two rows of maize (2M) and one row of maize and one row of wheat (MW) were planted along with garlic crop. Initially, the desired height of the barrier crop was not achieved to block the thrips. After the first spray, thrips population became significantly low in 2M and MW. Thrips multiplied faster and reached to 47.5/plant in 20 days in check plots whereas in 2M and

MW thrips were only 18.8 and 20/plant. This clearly suggested that the barriers were effectively blocking the migration of thrips from the surrounding plots and thereby kept the thrips population low.

During the entire crop period only two sprays were given in plots with barrier whereas in check, 3 sprays were given. Overall, average thrips population was 10.9/plant in 2M and 16.0/plant in check plots. Control plots recorded as high as 80.6 thrips / plant. More number of adults per plant was found in check plots and control compared to barrier plots. It was noticed that after each spray re-infestation of thrips was more in a short period in plots where barriers were not there (12.1.07, 2.02.07) compared to barrier plots. In the month of March, purple blotch incidence was very severe in the barrier plots particularly in 2M. Disease incidence was relatively less in check and even in control plots. As a result, marketable yield was hampered in 2M. The plots recorded only 2.6 t/ha (weight recorded one month after curing) and was at par with the yield of control plots. Highest yield of 3.4 t/ha was recorded in check plots followed by MW (2.9 t/ha). The bulb size got reduced in 2M because of high incidence of purple blotch resulting in just 19.6 % A grade bulbs and more of C grade bulbs (34.2 %).

When economics were calculated, highest B:C ratio was obtained with check plots (4.5) followed by MW (2.2). Crop with 2M recorded a net loss of Rs. 1600. The study suggested that among the barriers, MW may be more suitable to garlic compared to 2M.

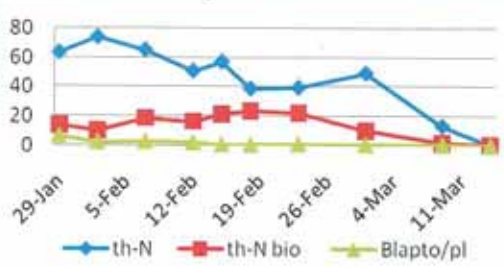
Project 9.3: Biological control of thrips in onion and garlic

Feasibility studies and evaluation of anthocorids for the management of thrips The anthocorid predator *Blaptostethus pallescens* was tested on onion and garlic for the control of *Thrips tabaci*. Two modes of release were made during *rabi* season.

Fig. 1:
***Blaptostethus* feeding on thrips**

Single release : The anthocorids actively fed on thrips and brought down the thrips from 42 nymphs to 3 nymphs within a day. Thrips population was kept under check *i.e.* below 20 /plant throughout the crop period. It was noticed that *Blaptostethus* per plant came down gradually, suggesting repeated release of predators will be useful. Also, the predators were not multiplied fast enough on the garlic plants. On average, thrips population was just 18/plant and the *Blaptostethus* were 1.5/plant. It was observed that predators moved on to new plants.

Fig. 2: Feeding potential of *Blaptostethus* on thrips in repeated release

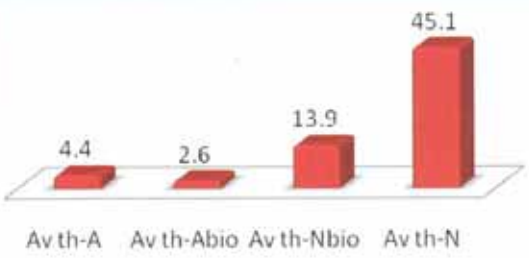


Repeated release : After single release, thrips population in bio-control plot was 4 times less than control. In subsequent releases, thrips population was increased but not beyond

23.6/plant. On average, predators brought down the thrips by 69.2% over control. Thrips population was 13.9/plant compared to 45.1/plant in control plots.

The study suggests that the predator, *Blaptostethus* can be effectively used to control thrips in garlic. However no recovery was observed from onion plants throughout the crop period.

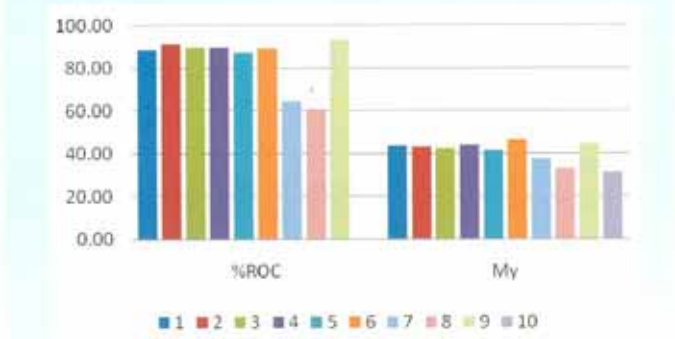
Fig. 3: Average thrips in biocontrol plots vs control



Project 9.4 : Management of thrips through chemical control methods

Evaluation of some new insecticides against thrips on onion

Fig. 4: Efficacy of insecticides-reduction over contol



Four insecticides (Methomyl, Alphamethrin, Deltamethrin and Clothianidin) were evaluated against onion thrips during *rabi* season. Eight treatments along with a chemical (Cypermethrin) control and absolute control were tested.

During the season, 5 rounds of new insecticide sprays were given at 15 days interval. All the insecticides tested against thrips were found significantly superior over control in all 5 rounds of sprays. Among the insecticides Methomyl @ 400 g ai/ha was found effective in bringing down the thrips population well below the ETL and was at par with the check treatment, Cypermethrin @ 60 g ai/ha. Although Clothianidin was found effective in the first two sprays it failed to keep thrips population down in subsequent sprays. If the performance was averaged over the 5 sprays, Methomyl was found effective in bringing down the thrips but only after the check. Except Clothianidin, all other insecticides were at par with each other. With regards to yield, higher marketable yields were recorded in all insecticides except Clothianidin (41.4 - 46.3 t/ha). Total yield was also recorded in all the treatments except Clothianidin. Lowest marketable and total yield of 31.1 t/ha and 32.6 t/ha respectively were recorded in control plots.

Management of thrips damage on bulbs in storage

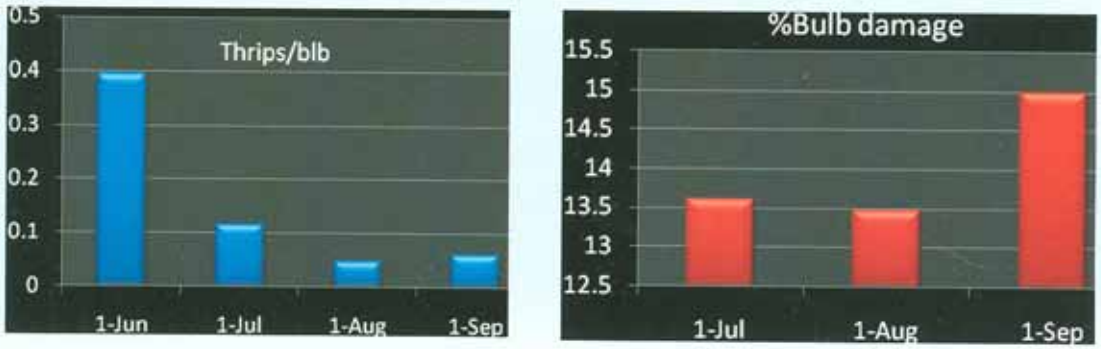
Onion is an export oriented commodity often attracting markets world wide. Apart from this, onions are stored for longer period for domestic consumption. But in storage, skin damage was noticed on bulbs many times. Therefore, a study was conducted in the field and store to assess the damage on bulbs due to thrips.

In field, thrips damage was noticed on 100 day old standing crop (N-2-4-1). Thrips damage was mostly restricted to the portion wherever scales were split open. 17.0% damage was recorded on bulbs from control plots compared to 13.0% in insecticide sprayed plots. Different pre- harvest treatments with spray on bulbs only, spray on leaves only, spray on bulbs+leaves, were given to 100 and 110 days old crop. At harvest, splitting of scales ranged from 87.5 - 100% and damage was restricted to the upper portion of the bulbs. Thrips were found on scale 1 and 2 only. Pre treatments had no effect on the number of thrips on bulbs. At harvest, irrespective of treatments, bulb damage of 4.5 - 5.87% was recorded.

Storage studies : The observations were recorded up to 5 months. After 2 months, damage was noticed on 90.0% of the bulbs. As time progressed, the damage proportion on the bulbs was reduced. On average, occurrence of bulb damage was 62.1%. The damage on the upper portion was more than lower portion.

On average, number of thrips on bulbs was 0.4/bulb. However, the number of thrips reduced drastically by 3rd month and reached to 0.06/bulb after 5 months. This clearly suggests that thrips are not multiplying in the bulbs. To confirm this, bulb samples were taken regularly and tested for the presence of eggs on bulbs using acid fuchsin method. However, no eggs were detected on bulbs at any period of storage.

Fig. 5: Thrips damage to onion bulbs in stores during *rabi* 2006



Irrespective of treatments, depth of damage never crossed 2 scales. Although depth of damage was more initially, it reduced gradually over the period. The damage occurring on the bulbs did not increase with increase in the period of storage. This suggested that the damage occurring in the initial period of storage is important.

The study indicated that bulb damage occurs in field itself and thrips are carried to the stores. However, thrips were not multiplying on bulbs in stores. Thrips never penetrated beyond 2 scales and their number got reduced drastically after 3 months of storage. Pre harvest sprays did not help in reducing thrips damage to bulbs in storage.

Programme 10 : Integrated disease management in onion and garlic

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

Survey of major onion and garlic growing areas in Maharashtra, Karnataka, Tamil Nadu and Gujarat has been completed. Samples of disease of onion and garlic have been collected from 15 GPS sites across Maharashtra (Sangli and Satara), 30 in Tamil Nadu, 64 in Karnataka and 86 in Gujarat from major production domains, district wise. 5500 isolations were made and 1247 isolates were obtained. Out of which, 658 Stemphylium blight, 62 Anthracnose, and 527 of Purple blotch pathogen have been obtained. The GPS sites district wise is mapped(Maps-GPS sites) and origin of number of isolates statewise is in Table 1 for each pathogen is marked in the map. Seed component analysis following

Fig. 6:
GPS sites in Karnataka where survey was done

ISTA procedure revealed seed, endosperm and embryo infection by *Alternaria porri* and *Stemphylium* in seeds collected from Haryana, West Bengal and Maharashtra. Percentage infection of each seed component by different fungi other than *Stemphylium* and *Alternaria* is also given (Table 1). Hoagland solution test also proved seed infection by *Alternaria porri*. Floral part infection by the pathogens revealed that seed isolate can cause higher percent of style and ovary infection. 312 Stemphylium and 112 *Alternaria porri* has been single spored.

A total of 12 isolates collected from field sites in Maharastra over the past 1 year were tested for pathogenic variation on eight differential genotypes of onion using a seedling bioassay. One reference isolate, representing the Lucerne pathogenic race was included in the bioassay for comparison. 7 genotypes were based on color of the bulb along with *A. fistulosum*, were used as differentials. Race typing of isolates from Lucerne, garlic and onion were used. None of the isolate showed high susceptibility and as such could not be grouped due to lack of proper host genotypic reaction. Selective media using TBZ has been standardized for isolation of *Alternaria porri* from the soil.

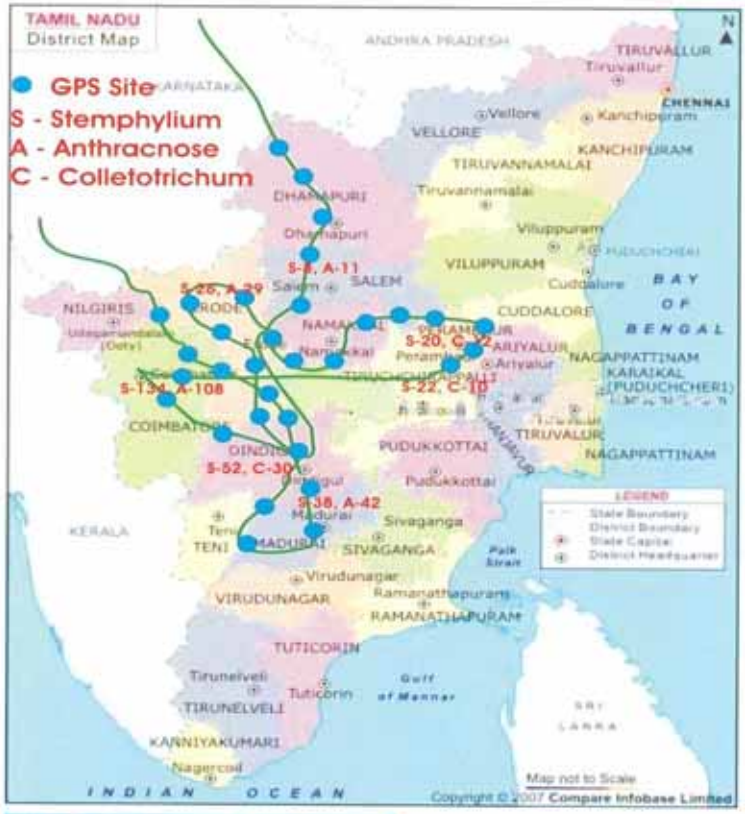


Fig. 7: GPS sites in Tamil Nadu

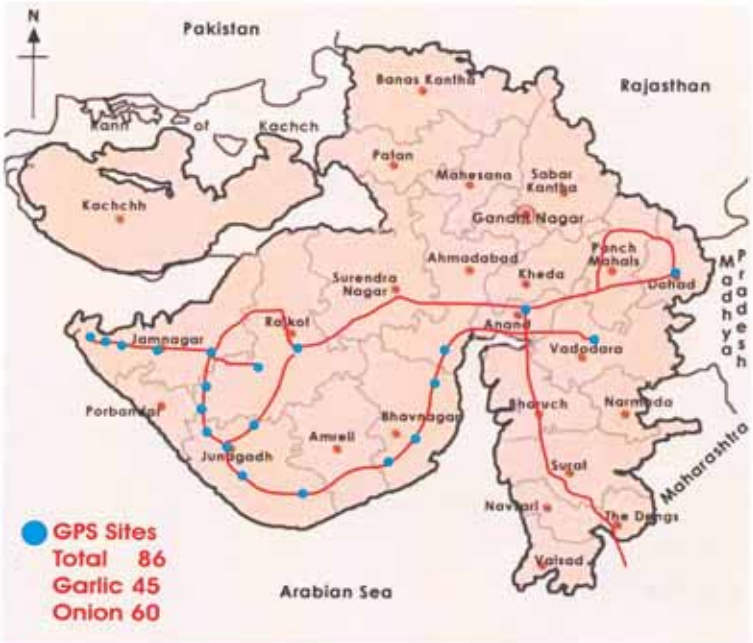


Fig. 8: GPS sites in Gujarat

Table 1: Percentage of the parts on onion seeds infested with various fungi

Region	Seed Part	*A. alternata*	*A. flavus*	*C. cladosporioides*	*Stemphylium vesicarium*	*Alternaria porri*	*Fusarium* spp
N-2-4-1	Emb	Nil	Nil	Nil	Nil	Nil	Nil
	End	Nil	0.1	0.1	Nil	Nil	Nil
	Seed	Nil	20	Nil	0.2	0.1	Nil
B-780	Emb	0.1	Nil	Nil	Nil	Nil	Nil
	End	0.1	Nil	Nil	0.1	Nil	Nil
	Seed	Nil	15.0	Nil	Nil	Nil	Nil
HS-2	Emb	Nil	Nil	Nil	Nil	Nil	Nil
	End	Nil	Nil	Nil	Nil	Nil	Nil
	Seed	Nil	20.0	Nil	Nil	Nil	Nil
Mikandor	Emb	Nil	Nil	Nil	Nil	Nil	Nil
	End	Nil	Nil	Nil	Nil	Nil	Nil
	Seed	Nil	30.0	Nil	0.1	Nil	Nil
Local Hawsi	Emb	Nil	Nil	Nil	Nil	Nil	Nil
	End	Nil	0.5	Nil	Nil	Nil	Nil
	Seed	0.1	Nil	Nil	0.5	0.1	Nil
Sukh Sagar	Emb	Nil	Nil	Nil	0.1	Nil	Nil
	End	Nil	Nil	Nil	Nil	0.1	Nil
	Seed	Nil	20	10	10	5	Nil
Hissar Farmer A	Emb	Nil	Nil	Nil	Nil	Nil	Nil
	End	Nil	Nil	Nil	Nil	Nil	Nil
	Seed	Nil	15	Nil	0.1	0.5	Nil
Hissar Farmer B	Emb	Nil	Nil	Nil	Nil	Nil	Nil
	End	Nil	5	Nil	0.1	Nil	0.1
	Seed	Nil	20	Nil	Nil	0.5	Nil
Hissar Farmer C	Emb	Nil	Nil	Nil	Nil	Nil	Nil
	End	Nil	10	Nil	Nil	Nil	Nil
	Seed	Nil	30	Nil	Nil	5	Nil

Region	Seed Part	*A. alternata*	*A. flavus*	*C. cladosporioides*	*Stemphylium vesicarium*	*Alternaria porri*	*Fusarium* spp
Pune	Emb	Nil	0.5	Nil	Nil	Nil	Nil
Fursungi	End	Nil	Nil	Nil	Nil	Nil	Nil
	Seed	Nil	20	Nil	Nil	0.1	Nil
ALR	Emb	Nil	Nil	Nil	Nil	Nil	Nil
	End	Nil	Nil	Nil	Nil	Nil	Nil
	Seed	5	15	Nil	Nil	2	Nil
Hissar	Emb	Nil	Nil	Nil	Nil	Nil	Nil
Farmer D	End	Nil	05	05	0.5	0.1	Nil
	Seed	Nil	10	Nil	1	0.5	Nil
Bhivani	Emb	Nil	Nil	Nil	Nil	Nil	Nil
	End	Nil	Nil	Nil	Nil	Nil	Nil
	Seed	Nil	20	Nil	Nil	Nil	Nil

Project 10.2: Suppression of soil borne diseases of onion through composting

Onion culls augmented with combinations of BAM and antagonists with vermicompost, mushroom spent and FYM were incubated for 30 days under semi anaerobic and anaerobic conditions. Combinations of onion culls, *Trichoderma* and vermicompost resulted in 100% composting. Onion culls were treated with different combinations of organic manure and antagonists in different combinations- onion culls, vermicompost with *Trichoderma* in the ratio of 4:2:0.25 resulted in only 70% and 90% composting respectively in anaerobic and semi anaerobic conditions followed by mushroom spent and FYM. The sclerotia of Scope survived after 6 months in onion compost out of vermicompost and *Trichoderma* followed by mushroom spent and FYM three and one month respectively

Project 10.3: Pathogenic diversity and management of Iris Yellow Spot (IYS) in onion

Biological and molecular characterization and control of *Iris yellow spot virus* in onion. A rapidly emerging tospovirus in India

IYS samples from seed crop and bulb crop at Rajgurunagar, Ganesh Khind and Manjri farm, Anand, Kolar and Namakkal has been collected and stored at -80°C for further processing. The suspected bulb crop was grown under controlled conditions with a net to observe the development of the disease. Samples collected from Rajgurunagar and Manjri showed symptoms of IYS late in the season. An experiment has been laid to study the overwintering of thrips in onion and garlic field, Rajgurunagar. Thrips were collected from 15 widely separated GPS sites from Gujarat and sent for identification of composition of sex ratio to IIHR Bangalore. Attempts were made to identify indicator plants for presence and absence of viruliferous vectors in the field using Faba bean, cow pea and Petunia.

Project 10.4 : Management of major diseases of onion and garlic through non-chemical methods

Management of onion diseases under organic cultivation

During late *kharif* season a trial was conducted to manage the diseases under organic cultivation of onion. Lowest PDI (38.3) was recorded in *Trichoderma*, which provided 34.3% disease control over check. Highest total and marketable yield was found in botanical pesticide-Safe that was 77.5% higher as compared to control.

Project 10.5 : Management of foliar diseases of onion and garlic through chemical methods

Evaluation of fungicides for managing diseases of *kharif* onion

During *kharif* 2007 different fungicides were screened to see its efficacy in controlling the major foliar diseases. Lowest plant mortality was observed in Hexaconazole (21.2%), while minimum PDI was in Tricyclazole (57.3). Highest total and marketable yield was recorded in Mancozeb plus Carbendazim, which was 255.3% higher than control. Minimum bulb rotting (7.1%) was found in Penconazole, Hexaconazole and Metiram.

Chemical control of major onion diseases in *rabi* season

During *rabi* 2006-07 different control measures were tested to control the major foliar diseases of onion. Lowest PDI (42.2) was found in Mancozeb, which provided 41.3% control over check. Highest total marketable yield (32.7 t/ha) was recorded in Penconazole and Tricyclazole, while Hexaconazole provided highest marketable yield, which was 37.6% above control.

Spray scheduling of Mancozeb for managing onion diseases

Total 22 treatments including 1 to 5 sprays of Mancozeb @ 0.25% at different intervals were evaluated. PDI varied from 78.4 to 55.4 (4 sprays at 40, 50, 60, 70 days after transplanting). Four sprays at 30, 45, 60, 75 DAT provided maximum total yield (20.0 t/ha) and marketable yield (18.9 t/ha), it was 45.0 % higher over control. Three sprays at 45, 65, 85 DAT and 2 sprays at 45, 75 DAT was at par with above.

Project 10.6 : Management of soil borne diseases of onion and garlic

Management of soil borne diseases of *kharif* onion

Raised and flat beds followed by solarization and subsequently amended with different measures were tried. Incidence of twister disease varied from 8.8 - 36.2%. It was found lowest in raised beds. Low mortality and high yield was found in raised beds. Solarized flat beds amended with either *Trichoderma* or *Pseudomonas* was found at par with raised beds. In solarized flat bed, percentage of marketable yield and bulb rotting was at par with raised beds.

Management of nursery diseases

The experiment was conducted in late *kharif* nursery. Highest seed germination was recorded in solarized bed amended with *Trichoderma* followed by seed treatment by Captan + Carbendazim. Hot water seed treatment reduced the seed germination. Lowest mortality (10.0 %) was recorded in seed treatment with either Raxil or *Pseudomonas*. It was 75.0 % higher over control. Solarization and soil application of *Trichoderma* increased plant stand and vigor.

Project 10.7 : Isolation, characterization and evaluation of antagonists against onion and garlic pathogens

Collection isolation and identification of antagonists from onion and garlic growing areas

For isolation of Trichoderma different selective media were screened and one medium was standardized.

Two hundred soil samples were collected from 6 States. Isolation of *Trichoderma* was done on selective media. Only 10% samples gave positive results. Four species of *Trichoderma* namely *T. harzianum, T. viride, T. pseudokoningii, T. fasciculatum* have been identified (Fig. 9)

Fig. 9: Different *Trichoderma* spp.

Effect of bulb colour on onion diseases

During *rabi* 2007-08, different colored varieties were planted to see the difference in disease incidence and intensity. Results indicated that disease intensity was lowest in treatments sprayed with both insecticide and fungicide. Lowest PDI (37.8) was in white varieties followed by red (41) and yellow (43.5), while it was highest in dark red (48.8). Total yield was highest (46.3 t/ha) in light red followed by white (44.5 t/ha), whereas highest marketable yield was found in dark red (40.5 t/ha).

Isolation from stored hollow/chaffy garlic bulbs

After storage, hollowness / chaffyness was observed in garlic. To know the pathogenic cause, if any, related to this problem 24 groups were formed based on the external damage pattern (Fig.-10). Isolations were made from each group. Fungi recovered from such isolations included *Fusarium oxysporum, Fusarium, Penicillum, Phomopsis sp.,* and *Aspergillus* along with some bacterial contamination. From dried hollow/chaffy bulbs, mostly *Fusarium* spp. was recovered (Fig.11), but pathogenesity is yet to be proved.

Fig. 10: Garlic shown hollowness /chaffyness

Fig. 11: Different fungi isolated from hollow/chaffy bulbs of garlic

Suitability of different bags for storing diseased onion samples

Onion leaves are succulent, delicate and contains high quantity of moisture, which makes the storage and transportation of onion leaf samples vulnerable to affected by saprophytic fungi. For this purpose onion leaves infected with purple blotch of onion were kept in different bags and stored at room temperature and in refrigerator and isolations were made at weekly/monthly intervals to recover the pathogen. Pathogen was easily and effectively isolated from leaf samples kept in brown paper bag and butter paper bag and stored at ambient room temperature even after 7 months (Fig. 12).

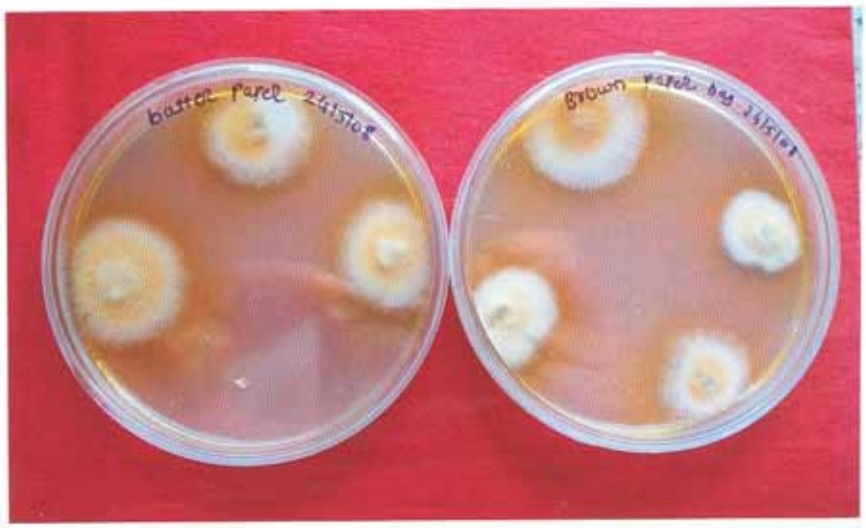


Fig. 12: Pathogens isolated from leaf samples of onion stored in butter paper bags and brown paper bags

Programme 12: Seed quality management in onion and garlic

Project 12.1: Seed packing and storage studies

Increasing the seed viability and vigour in onion seeds

The experiment on seed viability and vigour in onion seed cv. Baswant -780 was conducted during the year 2004-05 and 2005-06.The results of the experiment revealed that seed germination was more than 70 percent even after 21 months of storage in seeds stored in desiccator with moisture absorbent. This was quiet higher than the other treatments and control. The seed vigour index in desiccator stored onion seeds was also higher than other treatments. On the basis of two year's trial it can be concluded that storage of onion seeds in desiccator helps in maintaining viability and vigour of seeds for more than one and half year.

Effect of seed priming treatment on viability and vigour of onion seeds

The onion seed cv. Baswant -780 was primed with several chemicals such as para amino benzoic acid, potassium nitrate, di potassium hydrogen phosphate and poly ethyl glycol in different concentrations. These seeds were dried and packed in 400 gauge polyethylene bags and stored at ambient temperature. The results revealed that there was no difference in percent germination and seed vigour index among treatments in initial months while there was some effect of di potassium hydrogen phosphate on percent germination after 18 months.

Effect of seed moisture and packing material on viability and vigour of onion

The seeds of onion cv. Agrifound Dark Red of different moisture levels *i.e.* 5, 6, 7 and 8 percent were packed in various packing materials *i.e.* cloth bags, polyethylene bags, laminated aluminum bags and laminated aluminum bags with vacuum packing. These bags were stored at ambient condition during the years 2004 and 2005. The percent germination and viability of seed was recorded after 12, 15, 18, 21, 24 and 27 months after storage. The results indicated that in onion cv. Agrifound Dark Red, the seed germination percent and seed vigour were higher in seeds having 5 % moisture than seeds having 8 % moisture. As far as packing material is concerned, the lowest seed germination and viability was recorded in cotton cloth bags. The highest seed germination was found in laminated aluminum bags with vacuum packing. The seed packed in cloth bags lost their complete viability and vigour within 18 months of storage. Among the various treatment combinations, seeds having 5 % moisture and packed in aluminum laminated bags with vacuum packing remained viable for longer periods and the percent germination was 51.7 % after 27 months of storage.

Release of new varieties by the Centre

Three new onion varieties *viz.*, Bhima Raj, Bhima Red and Bhima Super were released by the Centre during the year 07 - 08.

Bhima Raj: This variety was identified in AICRP (VC) group meeting in the year 06-07 and recommended for release by the Central Variety Release Committee. Its bulbs are dark red in colour and oval in shape with single centre and thin neck. The TSS ranges from 10.0 to 11.0%. Suitable for *kharif* and late *kharif* seasons in the states of Maharashtra, Karnataka and Gujarat. It is also suitable for *rabi* cultivation in zone VI comprising of Rajasthan, Gujarat, Haryana and Delhi. Maturity is within 120-125 days after transplanting with absolutely no bolters. Average yield ranges from 25-30 t/ha with a highest yield potential of 40-45 t/ha.

Bhima Red: This variety was developed through bulb to row selection method and released by the Institute Release Committee, suitable for *kharif* and late *kharif* in the states of Maharashtra, Karnataka, and Gujarat. It has attractive red coloured bulbs with round shape with TSS ranging from 10.0 to 11.0%. Average yield in late *kharif* season ranges from 48.0-52.0 t/ha.

Bhima Super: This variety was developed by exercising selection pressure for single centered bulbs for eight cycles with 95% single centered bulbs. It was released by the Institute Release Committee and is suitable for *kharif* and late *kharif* cultivation in the states of Maharashtra, Karnataka, and Gujarat, has round bulbs with tapering neck. TSS is from 10-11% with an average yield of 26-28 t/ha in *kharif* and 40 to 45 t/ha in late *kharif* season. Maturity is after 110-115 days.

On Going Projects

Project No.	Title	Scientists
Programme 1	Development of red and light red onion varieties/ hybrids suitable for different seasons having resistance to biotic and abiotic stresses	Pr. Scientist (Hort.), PI
Project 1.1	Collection, evaluation and maintenance of red onion germplasm	Dr. V Mahajan
Project 1.2	Development of onion varieties suitable for different seasons for year round availability	Dr. V Mahajan
Project 1.3	Heterosis breeding in red onion	Dr. V Mahajan
Project 1.4	Breeding red onion varieties resistant to biotic and abiotic stresses	Dr. V Mahajan
Programme 2	Development of white and yellow onion varieties/ hybrids for processing and export having resistance to biotic and abiotic stresses	Dr. V Mahajan, PI
Project 2.1	Collection, evaluation and maintenance of white onion germplasm	Dr. V Mahajan, PI
Project 2.2	Development of high TSS white onion varieties suitable for different seasons and processing	Dr. V Mahajan, PI
Project 2.3	Collection, evaluation and maintenance of yellow onion germplasm	Dr. V Mahajan, PI
Project 2.4	Development of yellow onion varieties suitable for export	Dr. V Mahajan, PI
Project 2.5	Heterosis breeding in white and yellow onion	Dr. V Mahajan, PI
Project 2.6	Breeding white and yellow onion varieties resistant to biotic and abiotic stresses	Dr. V Mahajan, PI
Programme 3	Improvement of garlic through conventional and biotechnological approaches	Dr. A Khar, PI

Project No.	Title	Scientists
Project 3.1	Collection, evaluation and maintenance of garlic germplasm	Dr. A Khar, PI
Project 3.2	Development of high yielding garlic varieties suitable for different production areas	Dr. A Khar, PI
Project 3.3	Studies on somaclonal variations in garlic	Dr. A Khar, PI
Project 3.4	Production of virus free garlic through in vitro meristem tip culture	Dr. A Khar, PI
Project 3.5	Somatic hybridization in garlic to generate novel cybrids	Dr. A Khar, PI
Project 3.6	Molecular analysis of genetic diversity in garlic	Dr. A Khar, PI
Programme 4	Onion improvement through biotechnological approaches	Dr. A Asha Devi, PI
Project 4.1	Induction of haploids in onion	Dr. A Asha Devi, PI
Project 4.2	Micropropagation studies in onion	Dr. A Asha Devi, PI
Project 4.3	DNA profiling of onion lines using molecular markers	Dr. A Asha Devi, PI
Programme 5	Collection, characterization and screening of wild species for Allium improvement	Dr. A Khar, PI
Project 5.1	Screening of wild species for biotic and abiotic stresses and introgression of desirable genes in Allium cepa	Dr. A Khar, PI
Programme 6	Integrated nutrient management for onion and garlic	Dr. A. Thangasamy, PI
Project 6.1	Development of INM modules for onion and garlic	Completed
Project 6.2	Nutrient uptake studies in garlic	Completed
Project 6.3	Studies on nutrient deficiency symptom in onion	Completed
Project 6.4	Studies on nutrient deficiency symptoms in garlic	Dr. A. Thangasamy, PI
Project 6.5	Assessment of nutrient requirement for Garlic	Dr. A. Thangasamy, PI
Project 6.6	Nutrient uptake studies in garlic	Dr. A. Thangasamy, PI
Programme 7	Enhancement of production of onion and garlic through agronomic innovations	Dr. V Sankar, PI
Project 7.1	Production technology for kharif onion	Completed
Project 7.2	Studies on onion and garlic based cropping sequences	Dr. V Sankar, PI

Project No.	Title	Scientists
Project 7.3	Microirrigation and fertigation studies in onion and garlic	Dr. V Sankar, PI
Project 7.4	Studies on organic production of onion and garlic	Dr. V Sankar, PI
Project 7.5	Weed management studies in onion and garlic	Dr. V Sankar, PI
Project 7.6	Studies on foliar feeding of nutrients and growth regulators in onion and garlic	Dr. V Sankar, PI
Programme 8	Onion seed production technology	Dr. V Sankar, PI
Project 8.1	Integrated weed management studies in seed crop	Dr. V Sankar, PI
Project 8.2	Micro-irrigation and fertigation studies in onion seed crop (AICRP)	Dr. V Sankar, PI
Programme 9	Integrated pest management in onion and garlic	Dr. PS Srinivas, PI
Project 9.1	Population dynamics of thrips in onion and garlic	Dr. PS Srinivas, PI
Project 9.2	Development and evaluation of cultural methods for management of thrips in onion and garlic	Dr. PS Srinivas, PI
Project 9.3	Biological control of thrips in onion and garlic	Dr. PS Srinivas, PI
Project 9.4	Management of thrips through chemical control methods	Dr. PS Srinivas, PI
Project 9.5	Monitoring and detection of pesticide residues in onion and garlic	Dr. PS Srinivas, PI
Programme 10	Integrated disease management in onion and garlic	Dr. CR Ramesh, PI
Project 10.1	Geospatial pathogenic and molecular characterization of fungal diseases in onion and garlic detection, management and risk analysis	Dr. CR Ramesh, PI
Project 10.2	Suppression of soil borne diseases of onion through composting	Dr. CR Ramesh, PI
Project 10.3	Pathogenic diversity and management of Iris Yellow Spot (IYS) In onion	Dr. CR Ramesh, PI
Project 10.4	Management of major diseases of onion and garlic through non-chemical methods	Dr. RP Singh, PI
Project 10.5	Management of foliar diseases of onion and garlic through chemical methods	Dr. RP Singh, PI
Project 10.6	Management of soil borne diseases of onion and garlic	Dr. RP Singh, PI
Project 10.7	Isolation, characterization and evaluation of antagonists against onion and garlic pathogens	Dr. RP Singh, PI

Project No.	Title	Scientists
Programme 11	Reduction of post- harvest losses in onion and garlic	Sr. Scientist (Hort.), PI
Project 11.1	Studies on effect of pre- harvest practices on storage life of onion and garlic	Dr. V Sankar
Project 11.2	Effect of different storage environments / structures on storage life of onion and garlic	Dr. V Sankar
Programme 12	Seed quality management in onion and garlic	Dr. MK Kuchlan, PI
Project 12.1	Seed packing and storage studies	Dr. MK Kuchlan, PI
Project 12.2	Improvement of seed quality by invigoration	Dr. MK Kuchlan, PI
Project 12.3	Disease free seed production	Dr. MK Kuchlan, PI
Project 12.4	Studies on seed pelleting in onion	Dr. V Sankar, PI

Externally funded projects

Title	Scientists Involved
Central Sector Scheme	
Implementation of PVP and FR legislation and DUS testing in onion and garlic	VSR Krishna Prasad (till Dec. 07) V Mahajan (from Dec. 07)
AP Cess Fund	
Evaluation of selenium status in Indian type onion and garlic - Studies on the nutritional behaviour of selenium and sulphur	AA Qureshi
Mega Seed Project, ICAR	
Seed production in agricultural crops and fisheries	KE Lawande and V Sankar

List of Publications

Research papers

1. Asha Devi A, A Khar and KE Lawande. 2007. Genotypic response of short day Indian garlic (*Allium sativum* L.) accessions to shoot multiplication. *J. Spices Arom. Crops* 16 (1): 15-21.
2. Khar A, A Asha Devi and KE Lawande. 2008. Analysis of genetic diversity among Indian garlic cultivars and breeding lines using RAPD markers. *Ind. J. Gen. Pl. Breed.* (Accepted).
3. Khar A, A Asha Devi, V Mahajan and KE Lawande. 2007. Stability analysis of some elite lines of onion in late *kharif* (*Rangda*) season. *Indian J. Hort.* 64 (4): 415 – 419.
4. Khar A, J Jakse and MJ Havey. 2008. Segregations for onion bulb colors reveal that red is controlled by at least three loci. *J. Amer. Soc. Hort. Sci.* 133 (1): 42-47.
5. Krishna Prasad VSR, KE Lawande and V Mahajan. 2005. Performance and diversity pattern in the land races of *Allium cepa* L. *Indian J. Pl. Genet. Res.* 18 (3): 217-274. (Late issue, printed in 2007)
6. Sankar V, D Veeraragavathatham, M Kannan, V Prakasam and K Subbiah. 2008. Studies on organic practices on growth and yield of onion. *J. Maha. Agric. Univ.* 33 (2): 255-257.
7. Sankar V, KE Lawande and PC Tripathi. 2008. Effect of micro irrigation practices on growth and yield of onion. *Ind. J. Agric. Sci.* 78 (7): 584-588.
8. Sankar V, KE Lawande and PC Tripathi. 2008. Effect of micro irrigation practices on growth and yield of garlic. *J. Spices Arom. Crops* (In press).
9. Srinivas PS and KE Lawande. 2007. Managing Iris yellow spot virus: a new threat to onion production. *Indian Hort.* 52 (6): 16-17.
10. Srinivas PS and KE Lawande. 2007. Seedling root dip method for protecting onion plants from thrips. *Indian J. Pl. Protection* 35 (2): 206-209.
11. Srinivas PS, A Aziz Qureshi and KE Lawande. 2008. Growth stage susceptibility of onion (*Allium cepa*) and its role in thrips management. *Indian J. Agri. Sci.* 78 (1): 98 – 101.

Papers/ Abstracts/ Posters presented in conferences

1. Mahajan V and KE Lawande. 2008. "Lahasoon utpadanache sudharit tantragyan". In: Souvenir, "Rashtriya Sanghosthi" held at NHRDF Chitegaon, Nashik from 20-21 March, 2008. P: 15-22.
2. Mahajan V and KE Lawande. 2008. "*Rangda* kandhyche bharghosh utpadan". In: Souvenir, "Rashtriya Sanghosthi" held at NHRDF Chitegaon, Nashik from 20-21 March, 2008. P: 1-14.

Popular articles

1. Lawande KE and V Mahajan. 2007. "Kanda va lasun pikantil ekatamak keed-rog niyantran". *Agro-1*, 7 February, 2008.
2. Lawande KE and V Mahajan. 2007. "Lasun utpadanache tantra". *Godwa Sheticha*, October, 2007: 102 - 105.
3. Mahajan V and KE Lawande. 2007. "Lasun pikache vyavasthapan". *Agro-1*, 30 April, 2007.
4. Mahajan V and KE Lawande. 2007. "Lasun utpadanachi shashtrouct paddhati". *Godwa Sheticha*, December 2007: 28-31.
5. Mahajan V and KE Lawande. 2007. "Lasunache Darjedar Utpadan". *Agro-1*, 25 October, 2007.
6. Mahajan V and KE Lawande. 2007. "*Rangda* hangamat uttam pratiche kanda utpadantantra". *Godwa Sheticha*, October 2007: 93 – 99 & 105.
7. Mahajan V and KE Lawande. 2007. "Shashtrouct paddhatine Lasun utpadan". *Shetkari*, November 2007: 17 - 20.

Research bulletins

1. Srinivas PS, RP Singh and KE Lawande. 2007. Integrated Pest and Disease Management in Onion and Garlic. Technical Bulletin No.17. Published by National Research Centre for Onion and Garlic.
2. Tripathi PC and KE Lawande. 2008. *Kharif* Onion Production Technology. Technical Bulletin No.18. Published by National Research Centre for Onion and Garlic.

Book chapter

1. Lawande KE and V Mahajan. 2008. "Lahasun Ki Kheti" in Hindi book edited by IIVR entitled "Subjiyo ki kheti".
2. Mahajan V and KE Lawande. 2008. "Pyaj Ki Kheti" in Hindi book edited by IIVR entitled "Subjiyo ki kheti".

Project (Student) report

1. Asha Devi A, A Khar and KE Lawande 2007 guided Ms. Pardeshi SN in the project entitled 'RAPD analysis of onion and related *Alliiums*', submitted for the partial fulfillment of BSc (Applied Biotechnology) to Vidya Pratisthan School of Biotechnology, Baramati.
2. Khar A, A Asha Devi and KE Lawande 2007 guided Mr. Naikwadi PB in the project entitled 'Callus regeneration through root tip in garlic (*Allium sativum* L.)', submitted for the partial fulfillment of BSc (Applied Biotechnology) to Vidya Pratisthan School of Biotechnology, Baramati.
3. Khar A, A Asha Devi and KE Lawande 2007 guided Mr. Kadambande in the project entitled 'RAPD analysis of garlic cultivars', submitted for the partial fulfillment of BSc Agricultural Biotechnology to the College of Agricultural Biotechnology, Loni, Pravaranagar.
4. Singh RP and KE Lawande 2007 guided Ms. Suryawanshi SA in the project entitled 'Isolation and *in vitro* evaluation of bioagents against fungal pathogens of onion' submitted for the partial fulfillment of BSc (Applied Biotechnology) to Vidya Pratisthan School of Biotechnology, Baramati.

Transfer of Technology

Lectures delivered

Topic	Organizer(s)	Venue	Date
Dr. KE Lawande			
'Production technology on vegetables'	NHRDF, Chitegaon, Nashik	Chitegaon, Nashik	20 March 2008
'Introduction on onion and garlic production technology'	Sponsored by Maharashtra Horticulture and Medicinal Aromatic Plant Board under National Horticulture Mission	NRCOG	26 December,2007; 3 and 8 January, 2008
'Onion seed production'	Sponsored by Maharashtra Horticulture and Medicinal Aromatic Plant Board under National Horticulture Mission	NRCOG	28 December,2007; 5 and 9 January, 2008
'Introduction on onion and garlic production technology'	Sponsored by Department of Agriculture, Phaltan, District Satara	NRCOG	7 February, 2008
'Onion seed production'	Sponsored by Department of Agriculture, Phaltan, District Satara	NRCOG	8 February, 2008
Dr. CR Ramesh			
'Management of viral diseases in onion and garlic'	Sponsored by Maharashtra Horticulture and Medicinal Aromatic Plant Board under National Horticulture Mission	NRCOG	3 and 9 January, 2008
'Management of viral diseases in onion and garlic'	Sponsored by Department of Agriculture, Phaltan, District Satara	NRCOG	8 February, 2008

Topic	Organizer(s)	Venue	Date
Dr. Vijay Mahajan			
"Scientific cultivation of onion"	Maharashtra State Seed Corporation Ltd.	Otur	20 April, 2007
"Cultivation of onion"	Bank of Maharashtra	Narodi, Taluka Ambegaon, Dist. Pune	22 August, 2007
"Onion and garlic production technology"	KRIBCO	Manchar, District Pune	31 August, 2007
"Kanda utpadanache yashashswi tantragyan"	Media Exhibitors	Nashik during Krishi -2007 at- International Agricultural Trade Fair" from 29 November to 3 December, 2007	29 November, 2007
"Information about onion and garlic cultivation"	Rotary Club of Chakan	Chakan	10 December, 2007
"Onion bulb production"	Sponsored by Maharashtra Horticulture and Medicinal Aromatic Plant Board under National Horticulture Mission	NRCOG	26 December, 2007; 3 and 8 January, 2008
"Processing and value addition of onion and garlic"	Sponsored by Maharashtra Horticulture and Medicinal Aromatic Plant Board under National Horticulture Mission	NRCOG	28 December, 2007; 5 and 10 January, 2008
"Kanda lagwad va sathavanuk sudharit tantragyan"	APMC	Ghodegaon, Taluka Ambegaon, Dist. Pune	25 January, 2008
"Onion bulb production"	Sponsored by Department of Agriculture, Phaltan, District Satara	NRCOG	7 February, 2008
"Processing and value addition of onion and garlic"	Sponsored by Department of Agriculture, Phaltan, District Satara	NRCOG	8 February, 2008

Topic	Organizer(s)	Venue	Date
Dr. RP Singh			
'Management of diseases in onion and garlic'	Sponsored by Maharashtra Horticulture and Medicinal Aromatic Plant Board under National Horticulture Mission	NRCOG	27 December, 2007
'Management of fungal diseases in onion and garlic'	Sponsored by Maharashtra Horticulture and Medicinal Aromatic Plant Board under National Horticulture Mission	NRCOG	4 and 9 January, 2008
'Management of fungal diseases in onion and garlic'	Sponsored by Department of Agriculture, Phaltan, District Satara	NRCOG	7 February, 2008
Dr. A Khar			
'Garlic production technology'	Sponsored by Maharashtra Horticulture and Medicinal Aromatic Plant Board under National Horticulture Mission	NRCOG	26 December, 2007; 4 and 9 January, 2008
'Garlic production technology'	Sponsored by Department of Agriculture, Phaltan, District Satara	NRCOG	7 February, 2008
Dr. PS Srinivas			
'Integrated pest management in onion and garlic'	Sponsored by Maharashtra Horticulture and Medicinal Aromatic Plant Board under National Horticulture Mission	NRCOG	27 December, 2007; 4 and 9 January, 2008
'Integrated pest management in onion and garlic'	Sponsored by Department of Agriculture, Phaltan, District Satara	NRCOG	8 February, 2008
Dr. V Sankar			
'Micro irrigation and integrated nutrient management'	Sponsored by Maharashtra Horticulture and Medicinal Aromatic Plant Board under National Horticulture Mission	NRCOG	26 December, 2007; 3 and 9 January, 2008

Topic	Organizer(s)	Venue	Date
'Post harvest management'	Sponsored by Maharashtra Horticulture and Medicinal Aromatic Plant Board under National Horticulture Mission	NRCOG	27 December, 2007; 4 and 9 January, 2008
'Micro irrigation and integrated nutrient management'	Sponsored by Department of Agriculture, Phaltan, District Satara	NRCOG	7 February, 2008
'Post harvest management'	Sponsored by Department of Agriculture, Phaltan, District Satara	NRCOG	8 February, 2008

Participation in Exhibitions

Topic	Organizer(s)	Venue	Date
Mahajan V, VV Patil, PE Tadge, NH Shaikh	National Level Agriculture Exhibition organized by Dept. of Agriculture, Maharashtra	Pandharpur	11 - 15 April, 2007
Mahajan V. VV Patil, SD Waghmare	Rashtriya Kisan Mela - 2007 organized by NRC Citrus	NRC Citrus, Nagpur	30 - 31 October, 2007
Mashajan V, P Jagtap, VV Patil, PS Takale, AR Wakhare, Bomble, SD Waghmare, PR Sonavane, PE Tadge, NH Shaikh, MS Kale	"International Agro Exhibition" organized by Sakal Agro-1 and MPKV (Rahuri)	Pune	17 - 21 November, 2007
Mahajan V, PS Takale, PE Tadge	"Krishi -2007 - International Agricultural Trade Fair" organized by Media Exhibitors	Nashik	29 November to 3 December, 2007

Names	Organizer(s)	Venue	Date
Mahajan V, VV Patil, DM Panchal, SS Gopale, Bombale, H Gawali, PR Sonavane, PE Tadge, NH Shaikh, MS Kale, SD Waghmare	Kisan - 2007 organized by "Kisan Forum", Pune	Moshi, Pune	12 - 16 December, 2007
Mahajan V, VV Patil, SD Waghmare	"Agriculture Exhibition - Science Day" organized by GMRT-Tata Institute of Fundamental Research, Narayangaon	GMRT, Khodad (Narayangaon), Tal. Junner	28 - 29 February, 2008

Mass media communications

Dr. KE Lawande, Director gave an interview to 'The Hitavada' on 'Crop policy on onion must to stabilize price' at Nagpur on 1 November 2007 on the occasion of NRC Citrus 'Kisan Mela' from 30-31 October 2007.

Human Resource Development

Participation of scientists / staff in conferences / courses / meetings / seminars / symposia/workshops/trainings etc. during 2007-08

Title and Venue	Name	Period
XXV - AICRP(VC) Group meeting / workshop held at HAU, Hissar organized by IIVR, Varanasi	KE Lawande, V Mahajan	May 3 - 6 2007
Group meeting on Biological control at ANGRAU, Hyderabad	PS Srinivas	May 18 - 19 2007
First sectorial committee meeting on Mega Seed Project - Seed Production in Agricultural Crops & Fisheries held at CISH, Lucknow	V Sankar	June 29 - 30 2007
Winter school on "Application of Molecular Tools for Crop Improvement" at Sugarcane Breeding Institute, Coimbatore, Tamil Nadu	A Khar	September 11 - October 1 2007
Special Interactive Workshop on 'Administrative and Financial Matters' at NIANP, Bangalore organized by Dy. Secy (GAC), ICAR, New Delhi	KE Lawande	October 26 - 27 2007
Attended as Guest of Honour to Inaugurate 8th Rashtriya Kisan Mela on Citrus at Nagpur organized by NRC Citrus, Nagpur	KE Lawande	October 30 2007
Symposium on Spices and Aromatic Crops (SYMSAC IV) on 'Threats and Solutions to Spices and Aromatic Crops Industry' at OUA&T, Bhubaneswar organized by Indian Society for Spices, Calicut, OUA&T, Bhubaneswar and ICAR, New Delhi	KE Lawande	November 25 - 26, 2007
Meeting on "Role of Information & Media for accelerating Agricultural growth: ICAR Efforts" at MPKV, Rahuri	V Mahajan	November 30 2007

Title and Venue	Name	Period
Brainstorming session on 'Horticulture for Livelihood and Nutritional Security in A&N Islands' at Port Blair organized by CARI, Port Blair	KE Lawande	December 2 - 3 2008
One-day interaction on 'Tools and Machinery for Development of Horticulture' at CISH, Lucknow organized by IIHR, Bangalore	KE Lawande	January 18, 2008
Short course on Strategies for Upgrading Marginal Seed Lots, held at TNAU, Coimbatore	V Sankar	January 21 - 30, 2008
Half-day Seminar on 'Quality Parameters for Export of Agri and Horticultural Produce' at Pune organized by MCCIA, Pune	KE Lawande	January 23, 2008
Meeting on DUS at New Delhi	V Mahajan	January 31, 2008
XXVI - AICRP Group Meeting / Workshop in Vegetables held at OUAT, Bhubaneswar organized by IIVR, Varanasi & OUA&T, Bhubaneswar	KE Lawande, V Mahajan, A Khar, PS Srinivas, V Sankar	February 23 - 27, 2008
Training programme on "Molecular and Serological Detection of Plant Viruses" at NBAIM, Mau, Uttar Pradesh	RP Singh	February 24 - March 1, 2008
Attended as Guest of Honour in National Seminar on 'Recent Advances in Vegetable Production, Post-Harvest Management and Marketing' at Chitegaon, Nashik organized by NHRDF, Chitegaon, Dist. Nashik	KE Lawande	March 20 - 21, 2008

Lead lectures

Lawande KE. 2007. Onion and garlic – Potential spice crops. In: National Symposium on Spices, Medicinal and Aromatic Crops – SYMSAC IV, on 'Threats and Solutions to Spices and Aromatic Crops Industry' at OUA&T, Bhubaneswar on 26 November 2007.

Lawande KE. 2008. Production technology on vegetables. In: National Seminar on 'Recent Advances in Vegetable Production, Post-Harvest Management and Marketing' at Chitegaon, Nashik on 20 March 2008.

Recognitions

Dr KE Lawande, Director acted as Chairman for the Technical Session-X: Onion and Garlic on 4 May 2008 in the XXV Group Meeting / Workshop of AICRP (VC) held at HAU, Hissar and organized by IIVR, Varanasi.

Dr. KE Lawande, Director acted as Chairman in the Technical Session: XI-Onion and Garlic' on 26 February 2008 in the XXVIth Group Meeting/AICRP (VC) Workshop at Bhubaneswar organized by IIVR, Varanasi & OUA&T, Bhubaneswar.

Training programmes organized

Three day training programme on Onion & Garlic production technology to Agriculture Officers of Department of Agriculture, Maharashtra from 26 - 28 December, 07 sponsored by Maharashtra Horticulture and Medicinal Aromatic Plant Board under National Horticulture Mission.

Three day training programme on Onion & Garlic production technology to Agriculture Officers of Department of Agriculture, Maharashtra from 3 - 5 January, 08 sponsored by Maharashtra Horticulture and Medicinal Aromatic Plant Board under National Horticulture Mission.

Three day training programme on Onion & Garlic production technology to Agriculture Officers of Department of Agriculture, Maharsahtra Horticulture and Medicinal Aromatic Plant Board under National Horticulture Mission.

Two day training programme on Onion & Garlic production technology to the farmers of Maharashtra, Phaltan, Satara on 7 - 8 February, 2008 sponsored by Department of Agriculture, Phaltan, District Satara under "ATMA".

Institutional Activities

Scientific and Management Meetings

Institute Management Committee (IMC)

The XII IMC of the center was conducted on 5 June 2007 under the chairmanship of Dr. KE Lawande, Director. Other members, Sh. CB Holkar, Sh. SG Palande, Dr. VSR Krishna Prasad and Mrs. SS Joshi, Member Secretary also attended the meeting. Members were briefed about the achievements in respect of infrastructure development and other activities. The recommendations of the recently concluded QRT were thoroughly discussed and approved. The committee examined the expressed satisfaction over the utilization and appropriate flow of funds, purchase of equipment and revenue generation *etc.*

Quinquennial Review Team (QRT)

Chairman

Dr. KV Peter, Professor of Horticulture, Kerala Agriculture University, Vellanikara, Thrissur, Kerala

Members

Dr. B Singh, OSD (Horticulture), President's Garden, Rashtrapathi Bhavan, New Delhi

Dr. AK Misra, Ex-Additional Commissioner (Horticulture), New Delhi

Dr. NS Rao, Principal Scientist, Project Directorate of Biological Control, Hebbal, Bangalore, Karnataka

Dr. Lalita Anand, Ex-Head, Division of Biotechnology, Indian Institute of Horticultural Research, Bangalore, Karnataka

Member Secretary

Dr. VSR Krishna Prasad, Principal Scientist, National Research Centre for Onion and Garlic, Rajgurunagar, Pune, Maharashtra

The QRT team headed by Dr. KV Peter, Ex- Vice Chancellor, Kerala Agricultural University visited NRCOG along with other members, Dr. Brahma Singh, Officer on Special Duty (Hort), Rashtrapati Bhavan, Dr. AK Mishra, Ex- Additional Commissioner (Hort.), Dr. Lalita Anand Ex- Head, Biotechnology, IIHR, Dr. NS Rao, Principal Scientist, PDBC and Dr. VSR Krishna Prasad, Member Secretary. The team conducted three meetings on 29-30 December 2006, 12-16 March 2007 and 15-19 April 2007 and discussed with the Scientists about the targets and achievements and assessed the progress made in their research programmes. The team also had discussion with the staff and visited experimental farms, seed production plots and farmers fields to witness the technology

dissemination. The team also visited NHRDF, Nasik, Lasalgaon, BARC irradiation center facility and agricultural marketing yards and had discussion with the officials. The team complemented the Director and scientists for achieving good results in all fronts. The team has submitted report to the ICAR.

Institute Research Council (IRC)

Chairman

Dr. KE Lawande, Director, National Research Centre for Onion and Garlic, Rajgurunagar, Pune, Maharashtra

Members

All Scientists of the Centre

Member-Secretary

Dr. VSR Krishna Prasad, Principal Scientist, National Research Centre for Onion and Garlic, Rajgurunagar, Pune, Maharashtra

Eleventh Institute Research Committee meeting was conducted on 10-12 March, 2008 under the chairmanship of Dr. KE Lawande, Director, NRCOG. Results of the projects carried out during *rabi* 2006-07, *kharif* and late *kharif* 2007 were reviewed and technical programme for coming seasons was finalized.

Research Advisory Committee (RAC)

Chairman

Dr. Brahma Singh, Pocket 'E', 713, Mayur Vihar, Phase- II, New Delhi

Members

Dr. Umesh Srivastava, Assistant Director General (Hort. II), Indian Council of Agricultural Research, Krishi Anusandhan Bhavan-II, Pusa, New Delhi

Dr. Kalyan Singh, Professor and Head, Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (Uttar Pradesh)

Dr. PL Tandon, Ex-Principal Scientist, PDBC, B2/001, White House, 6th Main, 15th Cross, R.T. Nagar, Bangalore

Dr. R. D. Rawal, Principal Scientist (Plant Pathology), Deptt. of Plant Pathology, Indian Institute of Horticultural Research, Hessarghatta Lake Post, Bangalore

Dr. K. E. Lawande, Director, NRC for Onion and Garlic, Rajgurunagar, Pune, Maharashtra

Member – Secretary

Dr. R. P. Singh, Senior Scientist (Plant Pathology), NRC for Onion and Garlic, Rajgurunagar, Pune, Maharashtra

The XI Research Advisory Committee meeting was held on 28-29 March 2008. This was the first meeting of newly constituted Research Advisory Committee under the chairmanship of Dr. Brahma Singh, Former Director, Agriculture and Life Sciences, DRDO, New Delhi. All members namely, Dr. PL Tandon, Principal Scientist (Retired) (Entomology), PDBC, Bangalore, Dr. Kalyan Singh,

Professor and Head (Agronomy), BHU, Varanasi, Dr. RD Rawal, Principal Scientist (Plant Pathology) IIHR, Bangalore, Dr. Umesh Srivastava, ADG (Horticulture) ICAR, Dr. KE Lawande, Director, NRCOG, and Dr RP Singh, Senior Scientist & Member Secretary and all the scientists attended the meeting.

Director presented an over view of the centre's research activities and technologies developed. All the scientists presented achievements of different research projects. The committee visited Otur village, where NRCOG has established linkage with farmers for the transfer of technology. The members were impressed by farmers' interaction and association of the centre with onion growers. During two-day meeting, the committee critically reviewed the progress, discussed the research projects and made recommendations for future work.

हिन्दी पखवाड़ा का आयोजन

केन्द्र पर 14 सितम्बर से 29 सितम्बर तक हिन्दी पखवाड़ा का आयोजन किया गया । इसके अन्तर्गत हिन्दी प्रश्न मंजूषा, हिन्दी पठन, कविता पाठ तथा सुलेख प्रतियोगिताएँ आयोजित की गयी। इस अवसर पर "आतंकवाद : समस्या और समाधान" विषय पर निबन्ध लेखन तथा "वर्तमान परिवेश में संयुक्त परिवार कितना सार्थक" विषय पर वाद-विवाद प्रतियोगिता का भी आयोजन किया गया । हिन्दी पखवाड़ा के समापन समारोह के अवसर पर मुख्य अतिथि, डॉ. सदानन्द शाही, प्राध्यापक, हिन्दी विभाग, काशी हिन्दू विश्वविद्यालय, वाराणसी, ने अपना व्याख्यान दिया तथा विभिन्न प्रतियोगिताओं में प्रथम, व्दितीय एवं तृतीय स्थान पाने वाले प्रतिभागियों को पुरस्कृत किया ।

Personnel

Recruitments

Name	Designation	Date of joining
Dr. A. Thangasamy	Scientist (Soil Science)	20.10.07
Sh. Shivaji Suresh Gopale	SS Gr. I	22.06.07

Promotions

1. Sh. HSC Shaikh, promoted from T-4 to T-5 w.e.f. 16.02.2007
2. Sh. RB Baria, promoted from T-2 to T-3 w.e.f. 16.02.08
3. Sh. SK Said, promoted from SS Gr. III to SS Gr. IV w.e.f. 16.02.08
4. Sh. PR Sonawane, promoted from SS Gr. II to SS Gr. III w.e.f. 16.02.08
5. Sh. RS Kulkarni, promoted from SS Gr. I to SS Gr. II w.e.f. 16.02.08

Repatriation

1. Sh. N Gopal, Assistant Administrative Officer rejoined NRCOG after deputation at DRDO, Ahmednagar as Senior Administrative Officer w.e.f. 01.03.2008

Transfers

1. Dr. PC Tripathi was selected as Principal Scientist at NRC for Women in Agriculture, Bhubaneshwar
2. Dr. Md. A Aziz Qureshi, Senior Scientist (Soil Science) was transferred to Directorate of Oilseeds Research, Hyderabad on 10.08.2007

Retirements

1. Dr. VSR Krishna Prasad, Principal Scientist (Horticulture) took Voluntary Retirement on 05.12.2007 (F.N.)

Staff Position

Sl. No	Category	Sanctioned Posts	Filled up posts	Vacant Posts
1.	RMP	01	01	Nil
2.	Scientific	16	11	05
3.	Technical	10	10	Nil
4.	Administrative	08	08	Nil
5.	Supporting	11	11	Nil
	Total	**46**	**41**	**05**

List of Staff

Name	Designation
Scientific staff	
Dr. KE Lawande	Director
Dr. CR Ramesh	Principal Scientist (Plant Pathology)
Dr. VSR Krishna Prasad	Principal Scientist (Horticulture)
Dr. PC Tripathi	Senior Scientist (Horticulture)
Dr. V Mahajan	Senior Scientist (Horticulture)
Dr. RP Singh	Senior Scientist (Plant Pathology)
Dr. AA Qureshi	Senior Scientist (Soil Science)
Dr. A Asha Devi	Scientist Senior Scale (Genetics)
Dr. Anil Khar	Scientist Senior Scale (Horticulture)
Dr. PS Srinivas	Scientist Senior Scale (Entomology)
Dr. V Sankar	Scientist Senior Scale (Horticulture)
Dr. A Thangasamy	Scientist (Soil Science)
Technical staff	
Sh. VV Patil	Technical Officer T-5
Sh. NL Gore	Technical Officer T-5 (Field / Farm)
Sh. HSC Shaikh	Computer Programmer T-5 (Computer)
Sh. RB Baria	Technical Assistant T-3 (Field / Farm)

Name	Designation
Sh. AR Wakhare	Technical Assistant T-3 (Field / Farm)
Sh. DM Panchal	Technician T-2 (Lab)
Sh. PS Takale	Technician T-2 (Field / Farm)
Sh. BA Dahale	T-2 (Tractor Driver)
Sh. SP Yeole	T-2 (Jeep Driver)
Sh. HS Gawali	Technician T-1 (Field / Farm)

Administrative staff

Sh. N Gopal	Assistant Administrative Officer
Smt. SS Joshi	Assistant Administrative Officer (till 29.02.08) and Assistant
Sh. DB Mundharikar	PA to Director
Sh. SP Kandwal	Assistant (till 29.02.08) and Senior Clerk
Sh. PS Tanwar	Senior Clerk
Smt. MS Salve	Senior Clerk
Smt. NR Gaikwad	Senior Clerk (till 29.02.08) and Junior Clerk
Sh. RK Dedge	Junior Clerk

Supporting staff

Sh. SK Said	SS Gr. IV (Beldar)
Sh. PK Khanna	SS Gr. III (Messenger)
Sh. PR Sonawane	SS Gr. III (Lab Attendant)
Sh. PE Tadge	SS Gr. II (Lab Attendant)
Sh. MS Kale	SS Gr. II (Messenger)
Sh. RS Kulkarni	SS Gr. II (Lab Attendant)
Sh. SD Waghmare	SS Gr. I (Watchman)
Sh. NH Shaikh	SS Gr. I (Messenger)
Sh. AD Fulsundar	SS Gr. I
Sh. SB Tapkir	SS Gr. I
Sh. SS Gopale	SS Gr. I

Distinguished Guests

1	Prof. Sadanand Shahi, Hindi Department, KHV, Varanasi	29.09.2007
2	Sh. Vijay Kolte, Vice-President, MEAER, Pune	30.11.2007
3	Dr. TP Trivedi, PD (DIPA) & ADG (ARIS), ICAR, New Delhi	01.12.2007
4	Dr. Mangala Rai, Director General, ICAR, New Delhi	13.12.2007
5	Dr. AK Tiwari, Director, GOI, DPD, New Delhi	28.01.2008
	Total number of farmers visited:	**7948**

Dr. Mangala Rai, DG ICAR on a field visit of the NRCOG farm along with the Director and Scientists

Finances

Financial Statement for the year 2007-2008

Head of Accounts	Rupees in Lakhs	
	Budget Allocation	Expenditure
Non-Plan	115.00	110.16
Plan	200.00	200.00
KVK	0.00	0.00
NATP	0.00	0.00
AP-Cess Fund Scheme	*4.25	1.31
Pension & Retirement	20.60	19.82
P-Loans & Advances	8.00	7.58
R-Deposit Scheme	35.45	36.39
Revolving Fund Scheme	8.00	0.01
Total	**391.30**	**375.27**
Revenue Receipts	**15.37**	

(* AP-Cess 3rd Year allocation upto 30.09.2007)

Abbreviations

ALR	Agrifound Light Red
AFW	Agrifound White
AICVIP	All India Co-ordinated Vegetable Improvement Programme
AICRP(VC)	All India Co-ordinated Research Programme (Vegetable Crops)
AVT	Advanced Varietal Trial
MS	Male Sterile
DAT	Days after Transplanting
EMS	Ethyl Methyl Sulphonate
ETL	Economic Threshold Level
FYM	Farm Yard Manure
LCR	Leaf Curling Ratio
LIR	Leaf Injury Ratio
NBPGR	National Bureau of Plant Genetic Resources
NPK	Nitrogen Potassium and Phosphorous
PDI	Percentage Disease Index
SA	Sodium Azide
TSS	Total Soluble Solids

Annexure -1

Meteorological data for the year 2007-08 at NRC for Onion and Garlic, Rajgurunagar

Month	Temperature (°C)		Relative Humidity (%)		Rain fall (mm)	Sunshine hours
	Max.	Min.	Max.	Min.		
April 07	39.1	19.0	57	29	0.0	10.03
May 07	39.0	20.1	58	34	1.2	10.02
June 07	33.0	23.2	91	56	321.2	6.00
July 07	28.1	22.8	83	69	235.8	3.07
August 07	29.5	21.7	82	74	174.8	3.00
September 07	29.0	27.0	85	70	144.0	4.06
October 07	32.0	19.0	78	35	2.0	7.09
November 07	31.0	15.5	72	39	0.0	8.07
December 07	29.0	15.0	79	45	0.0	8.04
January 08	29.4	10.5	79	30	0.0	9.03
February 08	31.0	11.4	63	29	0.0	9.08
March 08	35.1	16.8	65	29	0.0	8.04

List of NRCOG Publications

Technical Bulletins

1. कांदा लागवड
2. कांदा पिकावरील रोग व किडींचे व्यवस्थापन
3. लसूण उत्पादन
4. प्याज की खेती
5. लहसुन उत्पादन
6. Onion Grader
7. प्रतवारी यंत्र
8. प्याज का बीजोत्पादन
9. कांदा व लसूण साठवण
10. कांदा बीजोत्पादन
11. Top and Bottom Ventilated Onion Storage Structure
12. Low Cost Bottom Ventilated Onion Storage Structure
13. प्याज एवं लहसुन भंडारण
14. Intercropping of Onion and Garlic in Sugarcane with modern irrigation systems
15. Cold Storage of Onion and Garlic
16. Diagnosis and Management of Nutrient Deficiency in Onion
17. Integrated pest and disease management in Onion and Garlic
18. *Kharif* Onion Production Technology

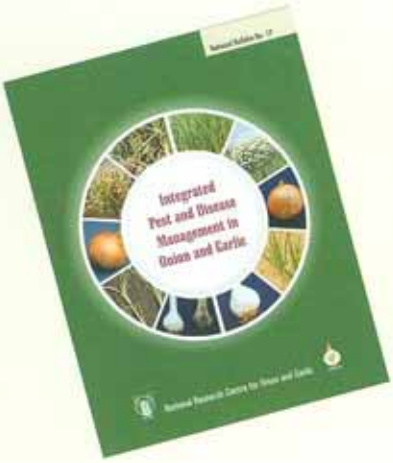
Reports

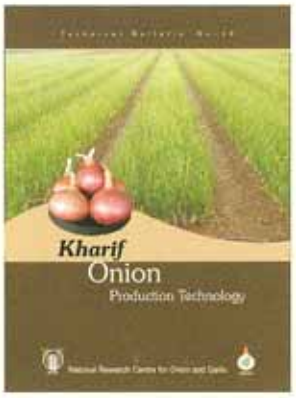
Onion Storage in India - A survey Report

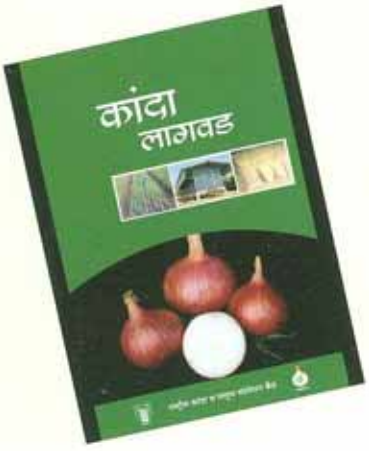
Guidelines

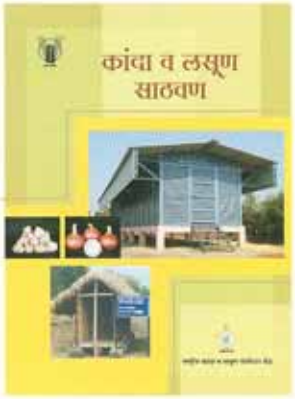
Dus - National Test Guidelines for the Conduct of Test for Distinctness, Uniformity and Stability of Onion (*Allium cepa* L.) and Garlic (*Allium sativum* L.)

Recent Publications









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