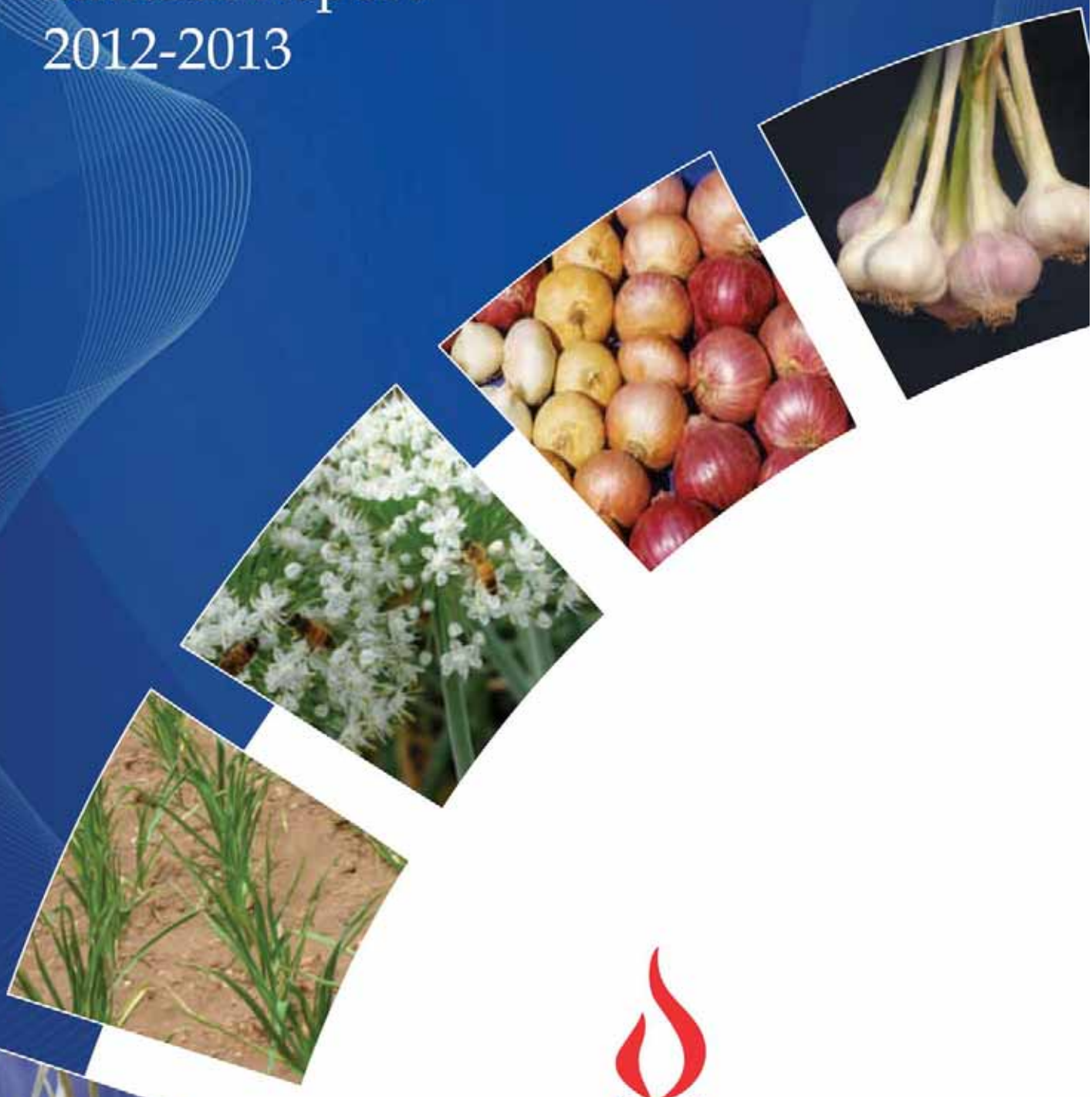
भाकृअनुप
ICAR

Annual Report 2012-2013



DOGR

Directorate of Onion and Garlic Research

(Indian Council of Agricultural Research)
Rajgurunagar, Pune – 410 505, Maharashtra, India

Vision

To improve production, productivity, export and add on value of onion and garlic

Misson

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

Annual Report 2012-13

Directorate of Onion and Garlic Research
(Indian Council of Agricultural Research)
Rajgurunagar, Pune – 410 505, Maharashtra, India

Annual Report 2012-13

Published by
Dr. Jai Gopal
Director

Compiled & Edited by
Dr. S. Anandhan
Dr. A.A. Murkute
Dr. S.J. Gawande
Dr. Jai Gopal

Published
May 2013

Correct Citation
DOGR - Annual Report 2012-13
Directorate of Onion and Garlic Research
Rajgurunagar, Dist. Pune, Maharashtra, India

Phone: 91-2135- 222026, 222697
Fax: 91-2135- 224056
Gram: Onionsearch
E-mail: director@dogr.res.in / aris@dogr.res.in
Website: http://www.dogr.res.in

Designed & Printed by
Anson Advertising & Marketing, Pune
Phone: 91-20- 24213244
Telefax: 91-20- 24210013
Email : ansonorama@gmail.com

Contents

Preface

I feel privileged to present Annual Report of Directorate of Onion and Garlic Research (DOGR) for 2012 – 13. The year was earmarked by formulation of XII plan EFC document and streamlining the R&D aspirations accordingly. The ongoing R&D programmes have contributed significantly in product and technology development and dissemination.

Germplasm collection was strengthened by taking exploration in Sikkim and Darjeeling hills, from where 51 samples of *Allium* were collected. In hybrid development programme of red onion, two F_1 hybrids *viz.*, DOGRhy-1 and DOGRhy-2 were recommended for coordinated trials under All India Network Research Project on Onion and Garlic (AINRPOG). For production of inbreds, haploids were developed through gynogenesis, and were confirmed for haploidy by cytology and flowcytometry. Early maturity of 100 days was recorded in advanced lines of red onion DOGR-1203DR and DOGR-1203LR. Germplasm evaluation during late *kharif* identified WM-510 as non-bolting genotype. Screening for TSS content identified two populations (WHT-6A/M and WHT-5B/M) with high TSS of 18 percent. Efforts to screen for thrips tolerance identified one line W-416 as field resistant. Thirty two genotypes were moderately resistant to thrips. Under garlic development programme, 110 genotypes were evaluated for different traits.

Crop and resource management section is involved in research activities for optimizing resource use for maximization of economic benefits. The nutrient uptake rate of N, P, K and S increases drastically during bulb development phase (40-60 DAP) in onion. Around 70 percent of nutrient uptake occurs during bulb development phase. Garlic also follows similar pattern in which accumulation increases after 75 DAP and most of resources are diverted to bulb till maturity.

In the studies on crop management, application of Oxyflurofen 23.5% EC @ 1.5ml/L before planting and one hand weeding at 40-60 DAP recorded efficient weed control and higher marketable bulb yield. Among the seed drills evaluated for direct sowing, pneumatic seed drill was found better than indigenous method of

direct sowing in terms of yield, low seed rate and saving time. In the studies on organic production of onion and garlic, it was observed that the soil health improved in terms of microbial population (bacterial, fungal and actinomycetes) in organic package.

Effect of vernalisation on seed production revealed that low temperature treatment of bulbs hastened scape initiation at least by a week. In an effort to produce virus free planting material of garlic, *in vitro* bulbils were induced on 6 % sucrose medium and established on soil medium *ex vitro*. The poor germination efficiency of *in vitro* raised bulbils was improved by cold treatment at 4°C for 10 days.

In order to improve storage life of onion, phytochemicals CIPC and $CoCl_2$ were tried as preharvest applications. CIPC @2% at 75 DAT was found to reduce sprouting of *kharif* produce, but was not effective on *rabi* produce. The postharvest application of ethanol was also found to reduce sprouting significantly under storage. Front line demonstrations were carried out for *kharif* production technologies and varieties in farmers' field in three different districts *viz*., Sangli, Latur and Jalna. DOGR varieties namely, Bhima Super, Bhima Raj and Bhima Red performed better than local variety (N-53) at Sangli and Latur. Bhima Super performed better than other two DOGR varieties.

The dissemination of innovative technologies to stakeholders was continued with the organization of several training programmes for the famers and other stake holders. DOGR participated in a number of exhibitions and displayed its technologies and varieties. Field days and farmers visits were also arranged. Two publications from DOGR were released at the inaugural function of 22nd Meeting of ICAR Regional Committee – VII at ICAR RC Goa. Farmers were made aware about 'Protection of Plant Varieties and Farmers' Rights Act' through awareness and training programmes. The scientists were deputed to eight training programmes of their specialization under HRD activities. DOGR actively participated in ICAR sports meet and won silver medal in carom. Last but not least DOGR earned Rs. 49.95 lakhs under revenue generation activity.

I would take this opportunity to express my deep sense of gratitude towards Dr. S. Ayyappan, Secretary DARE, Min. of Agriculture & DG ICAR for his constant encouragement to take strides towards institute mandate. I am grateful to Dr. N.K. Krishna Kumar, DDG (Horticulture) for the guidance and unending support to achieve the expected goals. Thanks are also due to publication committee, all scientific and other staff of DOGR for their valuable inputs to bring out this document.

Jai Gopal

Executive Summary

Directorate of Onion and Garlic Research (DOGR) is a premier Institute under aegis of Indian Council of Agricultural Research (ICAR) bestowed with responsibilities to develop technologies for improving productivity of onion and garlic. Research at the Directorate, targets various issues related to varietal development, crop production, resource management, crop protection and postharvest management. During the year under report (2012-13), ongoing R&D programmes lead to following results, which are summarized discipline wise.

Crop Improvement and Biotechnology

Two F_1 hybrid *viz*., DOGRhy-1 and DOGRhy-2 were introduced into co-ordinated trials under AINPROG. Haploids were developed through gynogenesis and confirmed for haploidy by cytology and flowcytometry. Selected Indian short day onion genotypes were evaluated for bolting and sprouting and contrasting parents were crossed for generation of mapping population. Under red onion breeding programme, two elite lines *viz*., EL-1531 and EL-1414 were identified for cultivation during late *kharif* season. Four elite lines *viz*., EL-1044, EL-1014, EL-654 and red elite composite were found promising during *rabi* season. Five advanced lines *viz*., N-2-4-1DR, red gene pool-2, DOGR-1168, RGO-53, and R-Rb-M-II were found promising for cultivation during *rabi* season. Early maturity of 100 days was recorded in advanced lines DOGR-1203DR and DOGR-1203LR. Thirty one genotypes evaluated for organic onion production, and three genotypes were found suitable for organic production.

Fifty one samples of *Allium* species were collected from Sikkim and Darjeeling Hills. Nearly 1200 accessions of onion and 650 accessions of garlic and 12 wild species were maintained at DOGR. Seventeen red onion accessions were evaluated during *late kharif*, 128 accessions including 94 exotic accessions during *rabi* and 164 accessions including 10 multiplier and 8 rose types during *kharif* along with checks. During late *kharif* accession 1395 produced the higher yield 34.26 t/ha than check Phule Samarth (32.07 t/ha). Accessions 1507, 1509 and 1508 were found superior over check ALR in *rabi* season. Accessions 1437-BF, 1344 and 1330 were found superior over check Bhima Super in *kharif*. Eighty five white onion germplasm lines were evaluated during *rabi*. Genotype WM-156 recorded the highest marketable yield (40.33 t/ha). Accession W-225 recorded the highest marketable yield (21.81 t/ha) in *kharif* season. Genotype W-344 recorded the least weight loss after three months of storage. During *rabi*, two elite lines *viz*., W-429/EL-2, and W-419/EL-4 recorded the highest marketable yield. While screening for TSS contents, two populations (WHT-6A/M and WHT-5B/M) recorded high TSS i.e. 18%. Among yellow onion germplasm, Y-074 recorded the highest marketable yield (34.13 t/ha). Thirty-nine white onion germplasm accessions were screened against thrips under field conditions. Accession W-416 showed field resistance to thrips.

In pursuit of locating sources of resistance against *Collitotrichum gleosporoides*, which cause anthracnose/twister disease of onion, 15 genotypes were screened during *kharif* seasons of 2010,

2011 and 2012. Bhima Raj showed resistance to anthracnose in all the three years. Variability among garlic germplasm was observed for yield contributing traits like average bulb weight, bulb polar diameter, bulb equatorial diameter. For efficient conservation of garlic propagules under slow growth conditions, different media components like sucrose and sorbital were evaluated. Significant reduction in growth parameters like shoot length, root length and no of leaves were observed on medium with 4% sorbitol.

Crop Production

Experiments were conducted for studying nutrient uptake pattern, weed management and organic production of onion and garlic. Dry matter accumulation pattern in onion bulb crop indicated that the accumulation in leaves stabilized after 60 days of planting, but, dry matter increases at greater rate in bulbs. This showed that major resources were diverted for bulb enlargement. The nutrient uptake rate of N, P, K and S increased drastically during bulb development phase (40-60 DAP). Garlic also followed similar pattern *i.e.* dry matter accumulation increased after 75 DAP and most of the resources diverted to bulb till the maturity. Maximum nutrient accumulation occurred during 45-90 DAP. In an interesting observation, application of FYM was found to increase the absorption of phosphorus by the onion crop.

Studies on organic production of onion and garlic, revealed that inorganic package performed better than any organic package. Among the organic packages (FYM, poultry manure, vermicompost, neem cake and their combination), poultry manure package recorded relatively higher yield in both crops than other packages. But, the quality of bulbs in terms of biochemical constituents was better in organic packages than inorganic packages. Similarly, organoleptic attributes like colour, texture, flavor, taste and preference of fresh salad onion were found to be influenced by manure package and was better for FYM and poultry manure package than other organic packages. Soil health in terms of microbial population (bacterial, fungal and actinomycetes) increased in organic package.

Application of Oxyflurofen 23.5% EC @ 1.5ml/L before planting followed by one hand weeding at 40-60 DAP efficiently controlled weed infestation and increased marketable bulb yield. Application of phytochemicals like salicyclic acid and humic acid were found to improve crop growth and yield in onion. Transplanting is one of the labour intensive operations in onion crop and direct seeding is opted as choice in critical periods. Among the seed drills evaluated for direct sowing, pneumatic seed drill was found better than other indigenous drills for direct sowing in terms of yield, low seed rate and time saving.

Crop Protection

Disease management trials revealed that the spray schedule involving spray of Mancozeb (0.25%) + Methomyl (0.8g/L) at 30 DAT, Tricyclazole (0.1%) + Carbosulphan (2ml/L) at 45 DAT and Hexaconazole (0.1%) + Profenophos (1ml/L) at 60 DAT was effective for the management of *Stemphylium* Blight and Purple blotch. Through seasonal incidence studies it was observed that peak incidence of Anthracnose occurs during 15th August to 15th September. To develop diagnostics, RT-PCR based detection protocol was standardized for the detection of GCLV by using primers flanking its coat protein (CP) gene. Similarly, N gene of IYSV has been characterized for recombinant antigen production for the preparation of indigenous ELISA kits.

Two peaks of thrips population were observed in the seasonal dynamics studies on thrips. First one

appeared in the month of August and the second in the month of February. The highest population of thrips was recorded in the month of February.

Seed Technology

Investigations on effect of vernalisation on seed production revealed that low temperature treatment of bulbs hastened scape initiation at least by a week. Biomass accumulation in cold treated plants was lower than control and seed yield improved. In an effort to produce virus free planting material for garlic, *in vitro* bulbils were induced on 6 % sucrose medium. Bulbils were established on soil medium and developed into complete plant. Germination efficiency of *in vitro* bulbils improved by cold treatment at 4°C for 10 days.

Postharvest Technology

In order to improve storage life of onion, phytochemicals CIPC and $CoCl_2$ were used. Application of CIPC @ 2% at 75 DAT was found to reduce sprouting of *kharif* produce, but was not effective on *rabi* produce. $CoCl_2$ was effective in arresting sprouting in *rabi* produce onion. Postharvest application of ethanol and ethephon (2%) was also found effective in reducing postharvest losses in onion.

Extension

Front line demonstrations were carried out for *kharif* production technologies in farmers field in three different districts of Maharashtra *viz*., Sangli, Latur and Jalna. DOGR varieties namely, Bhima Super, Bhima Raj and Bhima Red performed better than local variety (N-53) during demonstrations. Bhima Super performed better than other two DOGR varieties.

The dissemination of innovative technologies to stakeholders was continued with the organization of several training programmes for the farmers at several locations. Two technical publications of DOGR were released at the inaugural function of 22nd meeting of ICAR Regional Committee – VII at ICAR RC Goa. The radio talks and popular articles on production technologies of onion and garlic including postharvest management is a routine activity of the directorate. In a maiden attempt the farmers were made aware about 'Protection Plant of Varieties and Farmers' Rights Act' through awareness and training programmes. DOGR participated in four agricultural exhibitions organized by government and private agencies to demonstrate the innovative technologies and improved varieties of onion and garlic.

Miscellaneous

In human resource development programmes, concerned scientists were deputed to eight training programmes related to their specialization/ duty requirements. Many dignitaries including Dr. Gurbachan Singh, Chairman ASRB visited directorate and appreciated the working ambience. In a new initiative 'Foundation Day' celebration has been started from this year and conducted on June 16, 2012. Mr. Dilip Mohite Patil, MLA (Khed) presided over function and Dr.K.E.Lawande, Vice-Chancellor (BSKKV, Dapoli) delivered Foundation day lecture. The Hindi Saptah was celebrated during September 14 – 20, 2012. Several competitions including essay writing and quiz were organized on this occasion to motivate the office staff. Also, a Vigilance Awareness week was celebrated during October 29 to November 2, 2012 to curb corruption. DOGR actively participated in ICAR sports meet and won silver medal in carom. Last but not least, out of the allocated budget of Rs. 720.27 lakh during the reporting year around 99% budget has been utilized and DOGR earned Rs. 49.95 lakh under revenue generation activity.

Introduction

The Directorate

Realizing the importance of onion and garlic in the country, Indian Council of Agricultural Research (ICAR) established National Research Centre for Onion and Garlic in VIII Plan at Nasik in 1994. Later, the Centre was shifted to Rajgurunagar on 16th June 1998. Due to expansion of R&D activities of onion and garlic, the centre was rechristened and upgraded to Directorate of Onion and Garlic Research (DOGR) in December 2008. Besides the R&D at main Institute, DOGR also has All India Network Project on Onion and Garlic with 12 participating centres and 16 voluntary centres across the country.

Location and weather

The Head Quarter of Directorate located at Rajgurunagar, is about 45 km from Pune, Maharashtra on Pune –Nashik Highway. It is 18.32 °N and 73.51 °E at 553.8 m above m.s.l. with a temperature range of 5.5 °C to 42.0 °C and having annual average rainfall of 669 mm.

Infrastructure

The centre has 55 acres of research farm with perennial irrigation facilities at Rajgurunagar, 25 acres at Kalus and 10 acres at Manjari. The centre has research laboratories for biotechnology, soil science, plant protection, seed technology and post harvest technology with modern state of the art equipments. The library at the centre has extensive collection of books, journals, e-sources on *Alliums*. The internet and e-mail connectivity has been strengthened for easy literature access. The centre has its own website: http://dogr.res.in, which provides rapid updates and all relevant information on onion and garlic and administrative matters of DOGR.

Vision:

To improve production, productivity, export and add on value of onion and garlic.

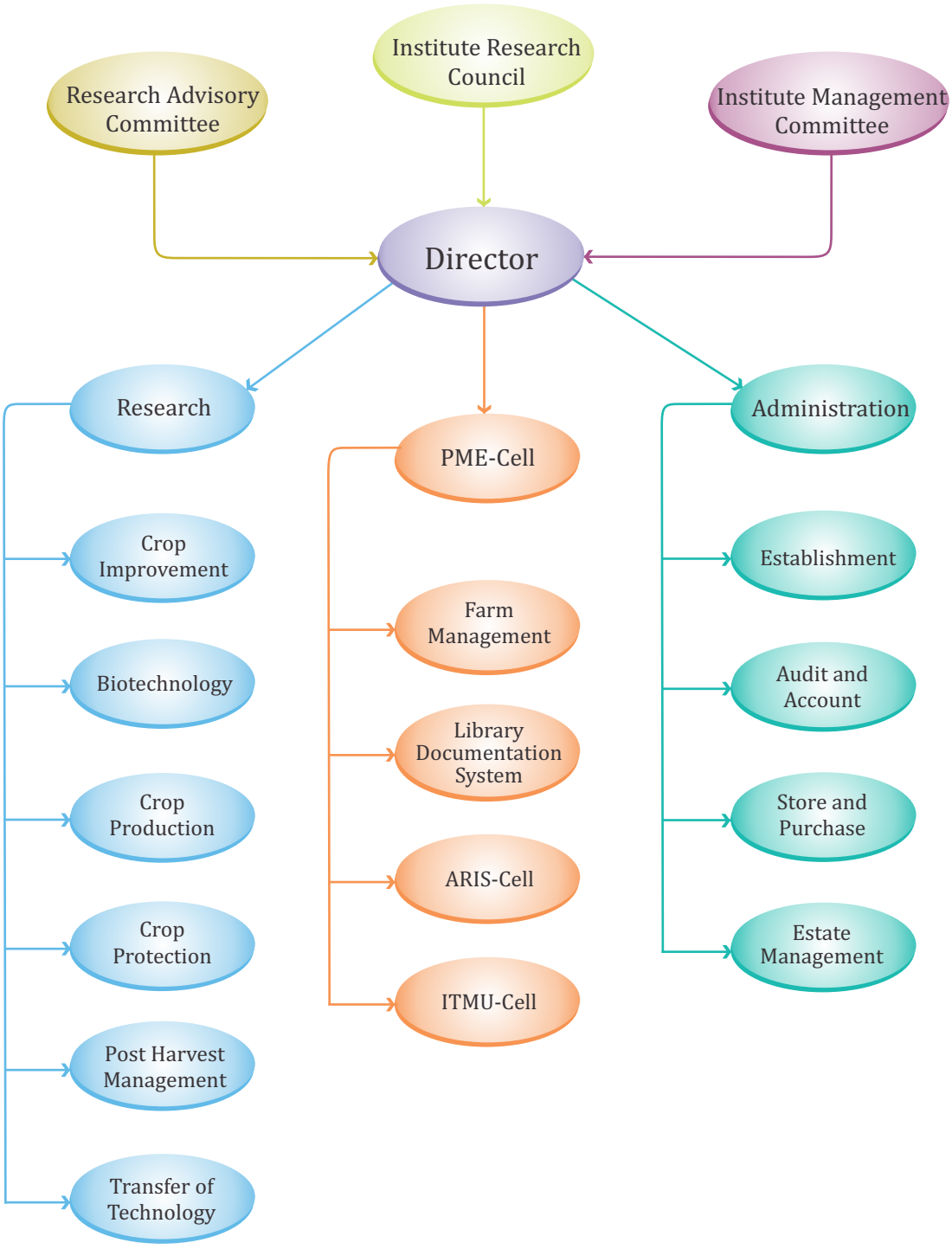
Mission:

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.

Mandate:

- To act as a repository of genetic resources and scientific information of onion and garlic
- To undertake basic and applied research for enhancing production and productivity of onion and garlic
- To undertake strategic research for technology development and production of quality seed of onion and garlic
- To promote utilisation and development of value added products through processing and post harvest management practices
- To disseminate technology, provide advisory and consultancy services and promote entrepreneurship
- To develop linkages with national, international and private organisations in network mode for collaborative research programmes

Organogram


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

Research Achievements

Crop Improvement

Crop improvement section of this institute targets at developing new improved varieties of onion and garlic for increasing productivity. Both conventional breeding approaches and biotechnological tools are used for developing new varieties with desired traits. Our attempts are also directed towards collection, conservation and evaluation of genetic resources. Germplasm is used in breeding programmes to evolve new improved varieties. The programmes comprising different projects have been formulated to achieve the said goal.

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

Exploration and collection of new germplasm

In order to enrich germplasm resource available at the directorate, exploration for collection of onion and garlic germplasm was undertaken during September 10-21, 2012 in collaboration with NBPGR RS, Bhowali. A total of 51 *Allium* samples were collected from Sikkim and Darjeeling hills of West Bengal (Table 1.1). Wide range of variation was observed for colour, size, shape and number of bulblets/cloves (2-5) (Fig. 1.1 & 1.2). In case of onion, majority of the accessions possessed globe or flat globe bulbs, which were dark red

Table 1.1: Germplasm collections made from Sikkim and Darjeeling (WB)

S. No.	Crop	No. of Accessions
1	Onion (*Allium cepa*)	4
2	Garlic (*Allium sativum*)	21
3	Leek (*A. ampeloprasum*)	3
4	Shallot (*A. ascalonicum*)	11
5	*Allium tuberosum*	3
6	*Allium hookerii*	7
7	*Allium* spp. (unknown)	2

Fig. 1.1: Variability in onion germplasm

or light red. High diversity was noted in bulb weight (10.1-101.3 g), followed by equatorial diameter (2.64-6.16 cm) and polar diameter (2.52-5.31 cm). In case of shallot, light red and dark red were the more common. Bulb weight had high diversity (1.9-16.5 g), followed by bulblet weight (2.3-4.3 g), polar diameter (2.18-3.07 cm) and equatorial diameter (1.34-1.90 cm). Promising accessions of onion were NG-3144 (101.3 g, high bulb weight) and of shallot were NG-3157 (16.5 g) and NG-3142 (15.6 g). These collections hold potential for possible utilization in breeding programmes.

Fig. 1.2: Variability in garlic germplasm

Evaluation of red onion germplasm

ACC.1395

Fig. 1.3: Promising Acc. 1395 during late *kharif*

To characterise onion germplasm for various economically important traits, seventeen red onion accessions were evaluated during late *kharif*, 128 accessions including 94 exotic accessions during *rabi* and 164 accessions including 10 multiplier and 8 rose types during *kharif* along with checks. During late *kharif*, only Acc. 1395 produced higher yield (34.26 t/ha; Fig. 1.3) with the 44.62% A grade bulbs, 75.51% marketable yield and 2.47% doubles than check Phule Samarth (32.07 t/ha). Minimum bolting percentage was recorded in Acc. 1351 (nil) followed by Acc. 1398 (4.94%) and Acc. 1324 (7.08%). Bulb centerness ranged from 1.00 (7 accessions) to 1.23 (Acc. 1251) and average marketable bulb weight ranged from 68.03 (Acc. 1304) to 104.17 g (Acc. 1360). Minimum days to harvest recorded in Acc. 1350 (128 days). Minimum bulb weight loss after four months of storage was recorded in Acc. 1395 (25.4%) followed by 1398 (29.7%).

During *rabi*, Acc. 1507, 1509 and 1508 produced more than 27.0 t/ha marketable yield and found superior over check ALR (25.98 t/ha) (Table 1.2). These accessions also recorded >90% marketable yield, >50 g average bulb weight, <5% doubles and no bolters. Among exotic germplasm, the highest marketable yield was recorded in EC-717035 (23.89 t/ha) followed by EC-717046 and EC-717055 (18.89 t/ha). All the accessions were free from doubles and bolters except EC-716987, EC-716995 and EC-717015. Minimum bulb weight loss after four months of storage was recorded in EC-717012 (23.1%) followed by EC-717002 (30.2%) and EC-717001 (32.4%).

During *kharif*, Acc. 1437-BF (28.33 t/ha), 1344 (26.67 t/ha) and 1330 (25.00 t/ha) were found superior over check Bhima Super (Table 1.3). These accessions also recorded >80% marketable yield, >55 g average bulb weight, <10% doubles and no bolters. More than 14% TSS was recorded in Acc. 1395, 1399, 1407, 1471 and 1561. Bulb centerness ranged from 1.0 to 2.0 and average marketable bulb weight ranged from 33.3 to 87.5 g. Forty-five accessions were early in maturity and harvested 85 days after planting.

Table 1.2: Five best performing accessions of *rabi* 2011-12

S. No	Accession No	TY t/ha	MY t/ha	TSS (%)	Double (%)	Bolters (%)	Center	MBW (g)	DTH	E:P
1	1508	29.57	27.26	11.28	3.82	0.00	1.33	55.82	117.00	1.14
2	1507	29.06	27.78	10.95	1.63	0.00	1.27	54.34	116.00	1.14
3	1160	28.95	26.57	11.84	0.00	0.00	1.13	44.12	124.00	1.35
4	1509	28.29	27.52	11.11	0.00	0.00	1.20	50.95	116.33	1.14
5	ALR(C)	26.79	25.98	11.00	0.36	0.00	1.27	58.12	120.67	1.18

MY: Marketable yield; TY: Total yield; MBW: Marketable bulb weight; DTH: Days to harvest; E:P: Bulb equatorial and polar ratio

Table 1.3: Five best performing accessions of *kharif* 2012

S. No	Accession No	TY t/ha	MY t/ha	TSS (%)	Double (%)	Bolters (%)	Center	MBW (g)	DTH	E:P
1	1437(BF)	33.52	28.33	12.99	7.77	0.00	1.00	69.58	90.00	1.20
2	1344	31.67	26.67	9.32	3.85	0.00	1.40	67.31	86.00	1.19
3	Bhima Super (C)	30.32	24.13	12.00	10.91	0.00	1.40	66.41	91.00	1.06
4	1566	28.89	24.00	10.56	8.26	0.00	1.60	71.21	87.00	1.11
5	1330	26.67	25.00	10.80	6.25	0.00	1.40	57.69	91.00	1.16

MY: Marketable yield; TY: Total yield; MBW: Marketable bulb weight; DTH: Days to harvest; E:P: Bulb equatorial and polar ratio

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

Evaluation of red onion elite lines

In order to breed red onion varieties for yield and quality, five new elite lines were evaluated during late *kharif*, whereas 13 elite lines were evaluated during *rabi* and 5 elite lines during *kharif* along with checks. During late *kharif*, EL-531 (53.33 t/ha) and EL-1414 (37.78 t/ha) were found better than check Bhima Shakti (30.43 t/ha) for marketable yield (Fig. 1.4) with 42.9% and 24.2% superiority over check, respectively. Bulb centerness was from 1.00 to 1.27 and average marketable bulb weight ranged from 73.4 to 105.0 g.

During *rabi*, four elite lines *viz.*, EL-1044, EL-1014, EL-654 and Red Elite Composite produced >25.00 t/ha marketable yield and showed superiority over check Bhima Kiran (20.74 t/ha) (Fig. 1.4). These lines also

recorded >95% marketable yield, >55 g average bulb weight, >25% A grade bulbs and were free from doubles and bolters. Bulb centerness ranged from 1.00 to 1.27 and average marketable bulb weight was from 56.3 to 65.5 g.

EL-531 EL-1044

Fig. 1.4: Promising selections EL-531 and EL-1044

During *kharif*, none of the lines was found better than check for marketable yield though, EL-1043 (22.41t/ha) appeared promising. Maximum average marketable bulb weight was in EL-1168 (68.3 g) and all the lines matured early and were harvested 85 days after planting.

Evaluation of red onion advance breeding lines

Eighteen advance breeding lines were evaluated during late *kharif*, 16 lines were evaluated during *rabi* and 8 lines during *kharif* along with checks. During late *kharif*, DOGR-1043 (42.02 t/ha), DOGR-1044 (40.62 t/ha) and LK-07-C1 (DR-2) (39.85 t/ha) were found better than check Bhima Shakti (36.19 t/ha) for marketable yield. Centerness ranged from 1.00 to 1.27 whereas TSS ranged from 10.85 to 11.84%. Maximum average marketable bulb weight was recorded in LK-07-C1 (DR-1) (114.6 g) followed by LK-07-C1 (DR-2) (104.1 g) and R-LK-M-II (100.5 g). The minimum bulb weight loss after four months of storage was recorded in DOGR-571 (22.2%) followed by DOGR-546 (25.1%) and DOGR-654 (25.3%).

During *rabi*, five lines *viz.*, N-2-4-1 DR, Red Genepool-2, DOGR-1168, RGO-53 and R-Rb-M-II produced >30.00 t/ha marketable yield and showed superiority over check Bhima Kiran (21.45 t/ha) (Fig. 1.5). These lines also recorded >90% marketable yield, >60 g average bulb weight, >25% A grade bulbs and <5% doubles and bolters. Minimum days to harvesting were recorded in genotype DOGR-1203-DR and DOGR-1203-LR (96 days) followed by DOGR-1133 (112 days) and R-Rb-M-I (113 days). The minimum bulb weight loss after four months of storage was recorded in DOGR-1168 (35.1%) followed by DOGR-1133 (37.4%).

Fig. 1.5: Bulbs of N-2-4-1 (DR) with N-2-4-1 (LR)

Based on marketable yield, R-Kh-M-I (32.64 t/ha), R-Kh-M-II (31.25 t/ha) and C4-KM-4 (30.58 t/ha) were found promising during *kharif* season. These lines also recorded >80% marketable yield, >60 g average bulb weight, >30% A grade bulbs and <1% doubles and bolters.

DOGR-546-DR and DOGR-571-LR introduced in AINRPOG trial

Two lines (DOGR-546-DR and DOGR-571-LR) have been recommended for AINRPOG varietal trial. DOGR-546-DR (Fig. 1.6) is suitable for *rabi* season. Its bulbs are flat-globe and dark red. It is free from doubles and bolters. The average bulb weight was 64.7 g with thin neck. On the basis of two year data (Table 1.4), this line produced 37.34 t/ha marketable bulbs yield which is 18.3% higher than check N-2-4-1 (31.57

t/ha). It has very good bulb storage for four months. DOGR-571-LR (Fig 1.6) onion line is suitable for *rabi* season and its bulbs are red and globe in shape. It is free from doubles and bolters. The average bulb weight was 67.4 g with thin neck. This line is early in maturity and suitable for harvesting in four months. Storage of bulb is very good (Table 1.4b). On the basis of two year data (Table 1.4a), this line produced 37.10 t/ha marketable bulbs yield which is 17.5% higher than check N-2-4-1 (31.57 t/ha).

DOGR-546-DR DOGR-571-LR

Fig. 1.6: Promising lines introduced in Network trial

Table 1.4a: Marketable yield of new entries and their superiority over check N-2-4-1

Breeding Line/ Variety	Marketable yield (t/ha)			Marketable yield increase over check N-2-4-1(%)
	Rabi 2008-09	*Rabi* 2009-10	Mean	
DOGR-546-DR	41.67	33.00	37.34	18.3%
DOGR-571-LR	38.67	35.53	37.10	17.5%
N-2-4-1 (C)	34.89	28.25	31.57	-
Bhima Kiran (C)	-	29.21	29.21	

Table 1.4b. Other important characteristics of new entries

Season & year	Breeding Line/ Variety	Marketable yield (%)	Days to harvest (days)	Weight loss after 4 months' storage (%)
Rabi 2008-09	DOGR-546-DR	98.9	108	27.3
	DOGR-571-LR	96.3	108	24.6
	N-2-4-1 (C)	93.7	108	39.4
Rabi 2009-10	DOGR-546-DR	97.1	112	28.3
	DOGR-571-LR	96.4	109	-
	N-2-4-1 (C)	94.0	112	32.5
	Bhima Kiran (C)	95.1	112	30.0

Performance of populations developed from N-2-4-1, Bhima Kiran and Bhima Shakti

Thirty-seven selfed populations of N-2-4-1, 70 selfed populations of Bhima Kiran and 93 selfed populations of Bhima Shakti were evaluated. Three populations *viz.*, N-Pop-04, N-Pop-06 and N-Pop-07 recorded >30.00 t/ha marketable yield compared to 22.38 t/ha in check N-2-4-1. N-Pop-07 was also the best storer and recorded 18.80% total weight loss after four months of storage. Fifteen populations of Bhima Kiran produced >25.00 t/ha marketable yield as compared to 22.48 t/ha in check Bhima Kiran. Minimum bulb weight loss after four months of storage was recorded in BK-Pop-14 (15.4%) followed by BK-Pop-07 (16.0%)

and BK-Pop-39 (19.4%). Six populations of Bhima Shakti *viz.*, BS-Pop-47, BS-Pop-25, BS-Pop-64, BS-Pop-78, BS-Pop-91 and BS-Pop-94 produced >35.00 t/ha marketable yield compared to 26.32 t/ha in check Bhima Shakti. Minimum bulb weight loss after four months of storage was recorded in BS-Pop-17 (15.4%) followed by BS-Pop-18 (15.8%) and BS-Pop-26 (16.6%) compared to 38.87% in check Bhima Shakti.

Assessment of onion advance lines/varieties for bolting behavior

Twelve advance lines/ varieties of onion were screened for bolting tolerance during late *kharif* at five dates of planting at 15 days interval. Data compiled on the basis of mean of five planting dates showed that Bhima Shakti, DOGR-1168 and DOGR-595 had <5% bolting and these genotypes produced >35.0 t/ha marketable yield. These lines also recorded >90% marketable yield, >70 g average bulb weight, >35% A grade bulbs and <5% doubles. On the basis of two years data, the highest marketable yield was recorded in DOGR-1168 (38.84 t/ha) followed by DOGR-595 (37.02 t/ha) with the minimum bolting percentage (<5%). Both lines also recorded >85% marketable yield, >90 g average bulb weight, >40% A grade bulbs and <10% doubles. It was concluded that DOGR-1168 and DOGR-595 are bolting tolerant onion lines and highly suitable for late *kharif* and *rabi* seasons (Fig. 1.7 & 1.8).

Fig. 1.7: Bolting tolerant lines for *late kharif* and *rabi* seasons

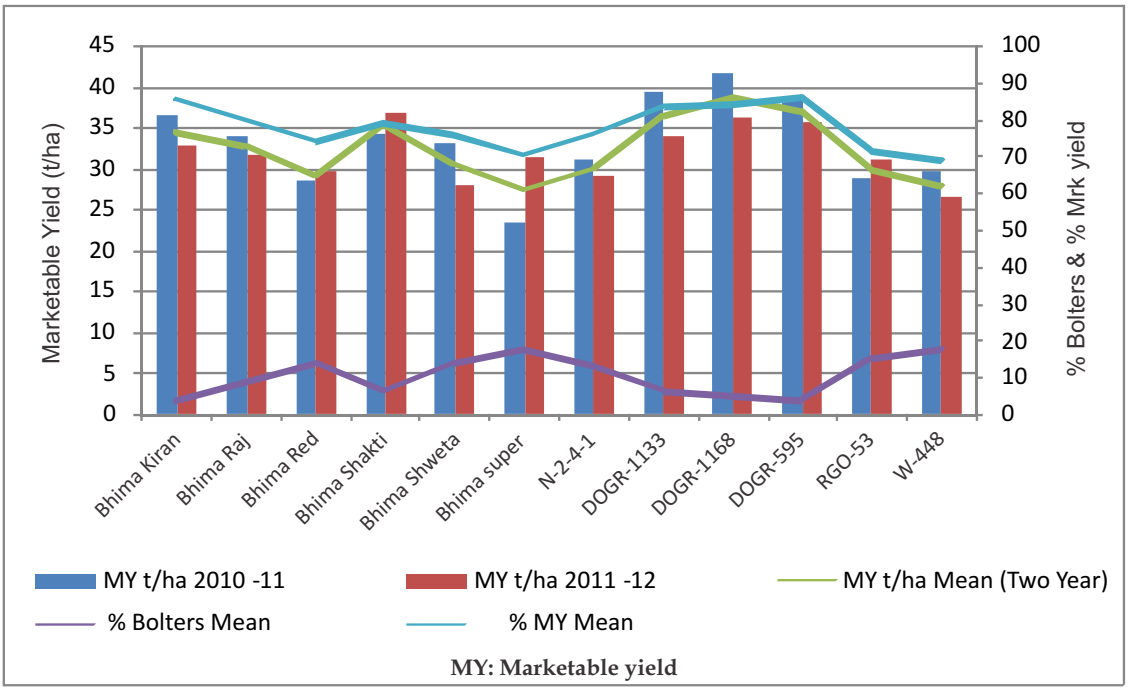


Fig. 1.8: Screening of onion advance lines/ varieties for bolting tolerance

Screening of onion advance lines/varieties for organic farming

To assess suitability of cultivars for organic farming, thirty-one advance lines/ varieties of onion were screened under organic farming during late *kharif* at Kalus Farm of DOGR. The differences in varietal performance were observed under organic and inorganic conditions in respect of bulb yield and quality parameters. Five lines *viz.*; DOGR-595, EL-1044, DOGR-1168, EL-1043 and Bhima Shakti performed well

under organic trial and produced >45.0 t/ha marketable yield during late *kharif*, but it was statistically at par with inorganic trial. These lines recorded >75% marketable yield, >95 g average bulb weight, <10% doubles and <15% bolters. Minimum bulb weight loss after five months of storage was recorded in DOGR-1133 (16.05%) followed by EL-610 (19.6%) and EL-571 (21.4%).

On the basis of two years data (Table 1.5), maximum marketable yield was recorded in DOGR-1168 (47.59 t/ha) followed by EL-1044 (45.44 t/ha) and DOGR-595 (45.35) and these performed better in organic condition. The performance of these lines under inorganic trial were comparatively poor and recorded 42.51 t/ha, 40.55 t/ha and 43.49 t/ha marketable yield, respectively. These lines also recorded >85% marketable yield, >95 g average bulb weight, <6% doubles and <10% bolters. It was concluded that DOGR-1168, EL-1044 and DOGR-595 are highly suitable for organic farming (Fig. 1.9).

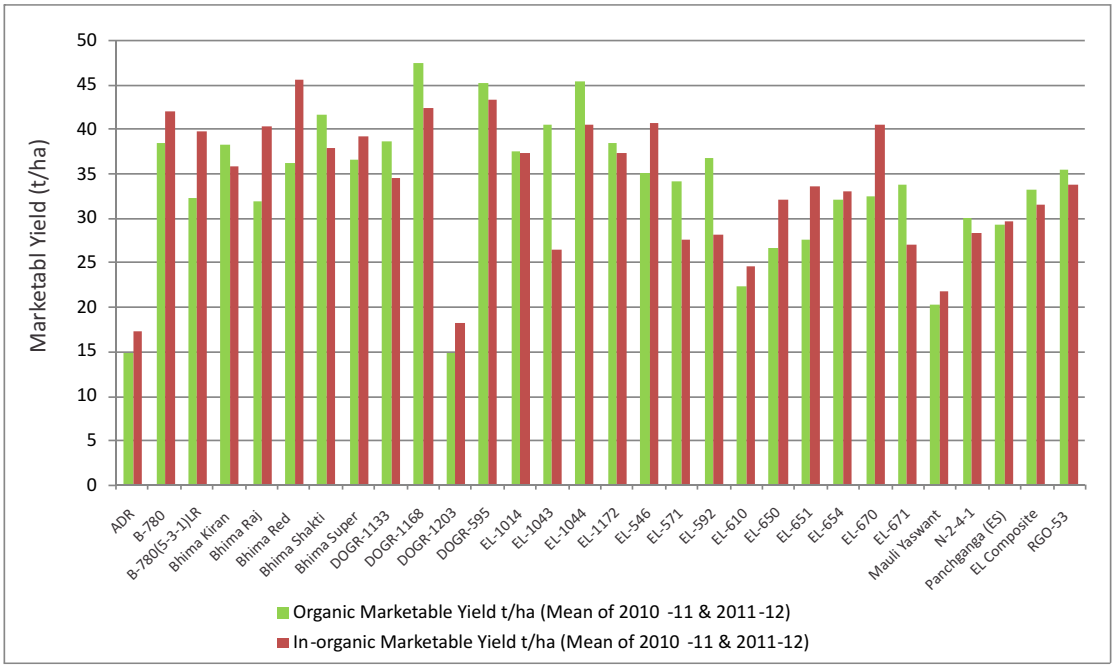


Fig. 1.9: Performance of onion genotypes under organic and inorganic farming

Table 1.5: Best performing onion advance lines/ varieties under organic farming

S. No.	Entries	%Double			% Bolters			Marketable Yield t/ha		
		2010-11	2011-12	Mean	2010-11	2011-12	Mean	2010-11	2011-12	Mean
1	DOGR-1168	4.21	2.08	3.15	1.92	11.30	6.61	45.33	49.84	47.59
2	EL-1044	11.53	0.00	5.77	4.61	13.49	9.05	40.33	50.56	45.44
3	DOGR-595	2.76	2.23	2.49	3.66	10.29	6.98	39.58	51.11	45.35
4	Bhima Shakti	7.43	6.03	6.73	4.22	17.69	10.96	37.57	45.71	41.64
5	EL-1043	1.84	8.17	5.01	3.14	5.67	4.40	34.72	46.39	40.55
6	DOGR-1133	7.61	3.16	5.38	4.47	18.06	11.27	38.24	39.21	38.73
7	EL-1172	5.31	1.48	3.40	2.53	17.00	9.77	34.21	43.02	38.61
8	B-780	4.46	0.45	2.46	2.39	17.90	10.15	39.77	37.30	38.54
9	Bhima Kiran	4.76	0.74	2.75	7.76	13.67	10.72	36.46	40.40	38.43
10	EL-1014	8.02	5.56	6.79	4.68	5.56	5.12	32.56	42.67	37.62

Project 1.3: Heterosis breeding in red onion

Evaluation of red onion F_1 hybrids developed through male sterile lines

Thirty-three F_1 hybrids along with their parents were evaluated during late *kharif* with check Bhima Shakti. Four F_1 hybrids showed >20% marketable yield superiority over check Bhima Shakti (31.62 t/ha). These F_1 hybrids except one, also recorded >90% marketable yield, >80 g average bulb weight, and <5% doubles and bolters. Centerness ranged from 1.00 to 1.40 whereas TSS ranged from 11.12 to 12.43%. Three F_1 hybrids were good storer and recorded <30% total weight loss after four months of storage.

During *rabi*, 60 F_1 hybrids along with their parents were evaluated with standard check Bhima Kiran. Standard heterosis up to 47.12% was recorded for marketable yield. Six F_1 hybrids produced >30.00 t/ha marketable yield as compared to 25.30 t/ha in check Bhima Kiran (Table 1.6). Bulb centerness ranged from 1.00 to 1.33 and average marketable bulb weight ranged from 38.7 g to 60.1 g. Fifty-two F_1 hybrids were found free from doubles and bolters, and two F_1 hybrids were early in maturity and harvested within 115 days after planting. Five F_1 hybrids were good storer and recorded <30% total bulb weight loss after four months of storage.

Table 1.6: Ten best performing F_1 hybrids during *rabi* 2011-12

S. No.	F1 hybrids	Double (%)	Bolters (%)	MY (t/ha)	Heterosis over check (%)
1	DOGR Hy-50	0.00	0.61	37.22	47.12
2	DOGR Hy-2	0.00	0.00	36.15	42.90
3	DOGR Hy-5	0.00	0.00	35.30	39.52
4	DOGR Hy-7	0.00	0.00	34.62	36.82
5	DOGR Hy-8	2.34	0.00	33.59	32.77
6	DOGR Hy-21	0.00	0.00	30.26	19.59
7	DOGR Hy-1	0.70	0.00	29.66	17.23
8	DOGR Hy-3	0.00	0.00	29.10	15.03
9	DOGR Hy-54	0.00	0.00	28.77	13.70
10	DOGR Hy-16	0.29	0.00	28.21	11.48
	Bhima Kiran (c)	**0.00**	**0.00**	**25.30**	**-**

During *kharif*, 58 F_1 hybrids along with their parents were evaluated with check Arka Lalima. Standard heterosis up to 41.53% was recorded for marketable yield. Ten F_1 hybrids performed better during *kharif* and showed >20% marketable yield superiority over check Arka Lalima (20.61 t/ha) with uniform and attractive dark red bulbs (Fig. 1.10). Seven F_1 hybrids were found free from doubles and bolters, and three F_1 hybrids were early in maturity and harvested within 80 days after planting.

DOGR Hy-3 | DOGR Hy-7 | Arka Lalima

Fig. 1.10: Promising DOGR Hy-3 (for *kharif*) and DOGR Hy-7 (for *rabi*) along with check Arka Lalima

Eighteen crosses made between DOGR-1203 and selected 18 elite lines were evaluated during *rabi* season. Crosses with DOGR-1044 (38.33 t/ha) and RGO-53 (35.00 t/ha) were found promising for achieving uniform neck-fall and earliness (94 days). One F_1 hybrid recorded 100% marketable yield (44.44 t/ha) during *rabi* as compared to 96.30% marketable yield (17.78 t/ha) in check Bhima Kiran. Further, 60 F_1 hybrids of red onion were developed by crossing 5 MS lines with selected 12 elite lines as pollinators and evaluation of these hybrids during *rabi* 2012-13 is in progress.

DOGR Hy-1 and DOGR Hy-2 introduced in AINRPOG trial

Two F_1 hybrids (DOGR Hy-1 and DOGR Hy-2) have been recommended for AINRPOG hybrid trial. DOGR Hy-1 (Fig. 1.11) is suitable for *rabi* season and its bulbs are light red and flat-globe in shape. It is free from doubles and bolters. The average bulb weight was 68.2 g with thin neck. This hybrid is early in maturity and harvested within four months. On the basis of two year data (Table 1.7a & 1.7b), this hybrid produced 41.30 t/ha marketable bulbs yield which is 42.84% higher than check Bhima Kiran (28.91 t/ha). DOGR Hy-2 (Fig. 1.11) is also suitable for *rabi* season and its bulbs are dark red and globe in shape. It is free from double bulbs and bolters. The average bulb weight was 64.5 g with thin neck. This hybrid is early in maturity and harvested within four months. Storage of bulb is very good. Based on mean of two years data (Table 1.7a & 1.7b), this hybrid produced 34.96 t/ha marketable bulbs yield which is 20.91% higher than check Bhima Kiran.

DOGR Hy-1 | DOGR Hy-2

Fig. 1.11: Promising hybrids introduced in Network trial

Table 1.7a: Marketable yield of new F1 hybrids and its superiority over check Bhima Kiran

Hybrid/ Variety	Marketable yield (q/ha)			Heterosis over check Bhima Kiran(%)
	Rabi 2009-10	*Rabi* 2010-11	Mean	
DOGR Hy-1	44.52	38.07	41.30	42.84%
DOGR Hy-2	27.69	42.22	34.96	20.91%
Bhima Kiran (c)	27.14	30.68	28.91	-

Table 1.7b: Other important characteristics of new F_1 hybrids

Season & year (days)	Hybrid / Variety	Marketable yield (%)	A grade bulbs (%)	Bolters (%)	Av. Marketable Bulb weight (g)	Days to harvesting
Rabi 2009-10	DOGR Hy-1	98.4	50.6	0.0	70.6	104
	DOGR Hy-2	80.6	26.9	0.0	56.3	99
	Bhima Kiran (C)	90.3	18.3	0.0	52.3	105
Rabi 2010-11	DOGR Hy-1	95.3	42.7	0.0	65.8	102
	DOGR Hy-2	97.4	41.8	0.0	72.6	101
	Bhima Kiran (C)	90.3	32.9	0.0	64.0	102

Development of new male sterile lines and inbreds in onion

Purification and multiplication of male sterile lines were continued with the selected bulbs. Three MS lines were crossed with each of three selected elite lines to transfer male sterility in improved varietal backgrounds as per procedure suggested by Pike 1986 (Fig. 1.12). About 100 plants of each MS lines were selected at random and crossed with selected male parent. Simultaneously, half of the umbels of selected plants of male parent in each cross were selfed for its B line development. About 50% selected male sterile plants produced F_1 seeds along with self seed of male plants. F_1 progenies with 100% male-sterile plants indicate which selections are B lines. Seed of the selfed selection from each test cross were saved so that once the B lines are identified, they can be used in backcross programme to develop A line.

Fig. 1.12: Development of male sterile lines, inbred lines and hybrid seed production in onion

Development of 48 new inbred lines (I_1) from single bulb of selected lines and advancement of 16 inbred lines (I_2) is in progress (Fig. 1.12). Advancement of selected bulbs of F_2 hybrids is also in progress.

Programme 2: Development of Onion (White and yellow) Varieties for Processing, Export and Resistant to Biotic and Abiotic Stresses

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

Evaluation of white onion germplasm

Six germplasm accessions along with check Bhima Shubhra were evaluated for different traits during late *kharif*. Bhima Shubhra recorded the highest (54.56%) 'A' grade bulbs (AGB) and marketable yield (35.52 t/ha). It also had the lowest doubles (6.5%) followed by check Phule Safed (7.11%) and W-444 (16.88%). Accession WM-510 was completely free of bolters compared to 11.75% bolters in variety Bhima Shubhra. In multiplier type onion, the highest yield was recorded in WM-514 (25.21 t/ha) whereas in WM-410 it was 17.38 t/ha. TSS was higher in accessions W-526 (16.68%) and WM-514 (14.12%) compared to check Bhima Shubhra (12.10%).

During *rabi* season, eighty five white germplasm lines with four checks were evaluated. Observations were recorded for twenty six characters. Percentage of "A" grade bulbs were significantly higher in four lines which ranged from 60.59 to 76.42% compared to 45.95% in check Bhima Shweta. Marketable yield ranged from 9.05 t/ha (W-543) to 40.33 t/ha (W-156). Accession W-156 (40.33 t/ha) was significantly superior to check Bhima Shweta (34.62 t/ha) for marketable yield, whereas nineteen lines (29.60 to 37.22 t/ha) were at par with check Bhima Shweta. Total yield was higher in four lines (42.86 to 48.06 t/ha) than check Bhima Shweta (37.85 t/ha). TSS ranged from 10.48% to 16.96%. In fifty two lines TSS was higher than check Bhima Shweta (12.44%) and nine lines were significantly superior to check, whereas TSS was between 13.72 to

Table 2.1: Range for some of the important characters in late *kharif* germplasm

Characters	Max.	Min.	Mean
%AGB	54.57	4.70	35.09
%Double	22.22	0.00	14.60
% Bolters	28.63	0.00	11.93
%MY	97.37	37.74	67.98
MY t/ha	35.71	8.67	24.07
(%)TSS	16.68	12.09	13.06

AGB: A grade bulbs; MY: Marketable Yield

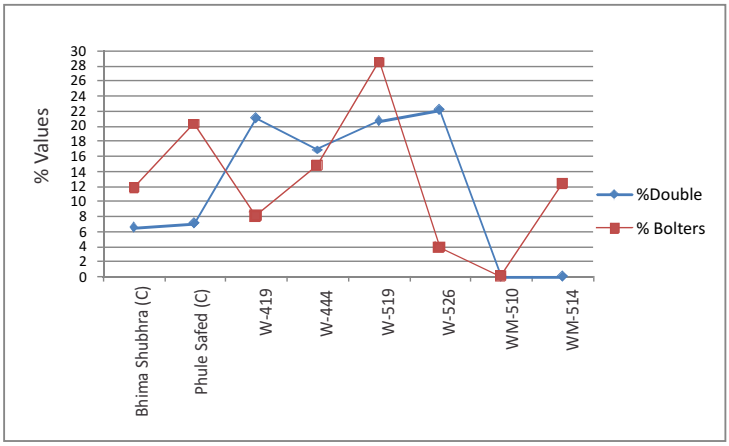


Fig 2.1: Doubles and bolters in germplasm during late *kharif*

14.36%. WM-514, a multiplier type, recorded the highest TSS (16.96%). Seventy six germplasm accessions were free of bolters. Twenty nine accessions had no double bulbs while check had 5.40% doubles.

Fifteen germplasm accessions along with two checks were evaluated during *kharif*. Bhima Shubhra recorded the highest (27.83%) 'A' grade bulbs followed by W-229 (25.32%) and W-225 (25%). No double bulbs were recorded in four lines including check. All fifteen germplasm and check were completely free of bolters. Line W-225 recorded the highest marketable (21.81 t/ha) and total yield (28.60 t/ha) as compared to check Bhima Shubhra (19.05 t/ha and 23.97 t/ha, respectively). Multiplier type line WM-485 yielded 10 t/ha. WM-485 (13.42%) and W-229 (12.10%) were superior for TSS, while Bhima Shubhra recorded 11.97%.

Table 2.2: Range for some of the important characters in *rabi* & *kharif* germplasm

	Max.	Min.	Mean	Max.	Min.	Mean
%AGB	76.42	0.00	34.02	27.83	0.00	10.69
%Double	44.44	0.00	6.72	11.11	0.00	1.91
% Bolters	12.78	0.00	0.46	0.00	0.00	0.00
%MY	100.00	46.67	87.05	79.38	18.87	49.86
MY t/ha	40.33	9.05	26.12	21.81	2.22	9.22
TY t/ha	48.06	16.19	29.96	28.60	9.69	17.06
%TSS	16.96	10.48	12.80	13.42	9.93	11.37

%AGB: % A Grade Bulbs; MY: Marketable Yield; TY:Total Yield; %TSS: % Total Soluble Solids

Performance of white onion lines under organic cultivation

Eight varieties were evaluated during late *kharif* season for organic cultivation. Bhima Shweta (35.03%) recorded the highest 'A' grade bulb and Agrifound White recorded the lowest (5.07%). Minimum double bulbs were observed in Arka Pitamber (0.39%) followed by White G.P. Composite (0.89%) and the highest were in Agrifound White (14.92%). Overall double bulbs were high (11.69%) in inorganic trial, whereas it was 3.68% in organic trial. But percentage of bolters was 43.27% in organic trial which was higher as compared with inorganic trial (29.38%). Marketable yield ranged between 5.16 to 32.78 t/ha in organic cultivation, whereas it was between 5.13 to 34.21 t/ha in inorganic cultivation. Overall average marketable yield was less in organic trial compared with inorganic one. Bhima Shubhra performed better in both

organic and inorganic cultivation with 32.78 and 34.21 t/ha, respectively. There was 16.95 % increase in marketable yield of Arka Pitamber in organic trial over inorganic one, which was followed by in White GP Composite with 3.93% and Bhima Shweta with 2.17%. In rest of the varieties marketable yield was less in organic trial than the inorganic trial. But in case of total yield, six lines recorded higher yield in organic cultivation with 3.09 to 22.08% increase over inorganically produced varieties. TSS ranged between 13 to 14.33 % under organic condition whereas in inorganic it was 12.93 to 14.93%.

Table 2.3: Comparative performance of white onion lines under organic and inorganic trials

Character	Organic Trial	Inorganic Trial
% Av. Doubles	3.68%	11.69%
%Av. Bolters	43.27%	29.38%
MY t/ha	5.16 to 32.78	5.13 to 34.21
MY t/ha Bhima Shubra	32.78	34.21
Overall average MYwas less in organic trial compared with in-organic one.		
% increase in MY over inorganic trial		
A. Pitambar	16.95%	
W Gp Comp.	3.93%	
Bhima Shweta	2.17%	
Rest of the varieties	MY less than inorganic trial	
TY t/ha (% increase over inorganic)	6 lines 3.09 to 22.08%	
%TSS	13 to 14.33%	12.93 to 14.93

MY: Marketable Yield; TY: Total Yield

Evaluation of white onion germplasm for storage

Harvested bulbs of six genotypes produced during late *kharif* were stored for three months in ventilated storage structure. Total weight loss ranged from 24.78 to 36.97%. Accessions W-444 and W-419 recorded 24.78% and 28.15% total weight loss, respectively, whereas in check Bhima Shweta and Phule Safed it was 23.81% and 37.67%, respectively.

Eighty five lines of germplasm produced during *rabi* were evaluated in storage for three months. Line W-344 showed the lowest (32.37%) weight loss. Total weight loss ranged from 32.37 to 97.31%. Accessions W-077 and W-462 recorded less than 50% weight loss. Check variety Bhima Shweta recorded 46.65% weight loss, whereas Phule Safed had recorded 42.04% and in Bhima Shakti and Bhima Kiran 30.16 and 33.97% weight loss, respectively.

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

Performance of white advanced lines

Twenty six advanced lines were evaluated during *rabi* season. Fourteen lines recorded higher 'A' grade bulbs (39.19 to 59.18%) than check Bhima Shweta (38.69%). Entry W-197 AD recorded the highest (59.18%) of 'A' grade bulbs. Five lines along with Bhima Shweta recorded no doubles. Twenty one lines along with check were completely free of bolters. Marketable yield ranged from 17.62 to 40.95 t/ha. Two lines recorded

significantly higher marketable yield than check Bhima Shweta (32.85 t/ha), while twelve lines were at par with check Bhima Shweta. TSS ranged from 11.44% in W-085 AD to 13.46 % (W-402 AD).Twenty lines recorded higher TSS than check Bhima Shweta (11.86%). Seven entries were found to be earlier maturing (114 DAT) compared to check Bhima Shweta (121 DAT).

Thirty four advance lines were evaluated during *kharif* season. Four advanced lines recorded the highest (25.90 to 33.33%) 'A' grade bulbs compared to check Bhima Shubhra (23.63%). Twenty five lines recorded zero percent double bulbs as compared to Bhima Shubhra (0.50%). All lines and checks were free from bolters. Bhima Shubhra recorded the highest marketable yield (21.92 t/ha), which was at par with W-302 AD (17.78 t/ha) and W-306 AD (17.22 t/ha). TSS ranged between 8.15 to 13.26%. Fourteen lines were having higher TSS than check Bhima Shubhra (11.82%).

Advanced line w-448 for *rabi*

Advanced line w-009 for *kharif*

Table 2.4 : Performance of top five advanced lines during *rabi* season

Advanced lines	% AGB	% Double	% Bolters	% MY	MY t/ ha	TY t/ ha	(%) TSS
W-448 BR-6	37.4	0.0	1.8	95.6	41.0	42.8	12.1
W-302 AD	53.3	0.0	0.0	96.5	37.1	38.5	11.8
W.G.P.Composite	44.3	0.8	0.0	97.7	35.2	36.1	11.8
W-186 AD	31.7	9.4	0.0	89.0	34.4	38.6	12.3
W-367 AD	31.3	1.4	0.0	93.9	33.1	35.2	13.4
Bhima Shweta	38.7	0.0	0.0	99.0	32.9	33.2	11.9

MY: Marketable Yield; TY: Total Yield

Performance of white massing and elite lines

Four massing and five elite lines along with check Bhima Shubhra were evaluated during late *kharif* season. W-397/M-3 recorded the highest (61.67%) 'A' grade bulbs compared to check Bhima Shubhra (53.94%). Line W-444/EL-4 recorded zero percent double bulbs and W-397/M-3 gave 2.20% double bulbs compared to 2.45% in the check Bhima Shubhra. Three lines showed less bolters as compared to Bhima Shubhra (7.33%). Bhima Shubhra gave the highest marketable yield (31.33 t/ha) followed by W-340/M-4 (27 t/ha) and W-419/EL-4 (26.67 t/ha). TSS ranged between 11.48 to 14.90%. Three lines recorded higher TSS (14.14 to 14.90%) than Bhima Shubhra (13.95%).

Seeds of seven lines were produced from the bulb obtained and stored in late *kharif* and were evaluated during late *kharif* along with respective varieties where the seed were produced from the bulb harvested during *rabi* or *kharif*. Bolters in Bhima Shubhra-LG-107-2, (4.06%) and Phule Suwarna-LG-107-2 (12.74%) were less as compared to respective variety Bhima Shubhra (7.33%) and Phule Suwarna (21.21%). Marketable yield ranged between 22.83 t/ha to 31.67 t/ha in LG populations. Bhima Shweta-LG-107-2

recorded higher marketable yield (31.67 t/ha) than Bhima Shweta (27.17 t/ha). Three LG groups recorded higher yield than check Bhima Shweta. Bolters were reduced in LG populations of Bhima Shubhra, Phule Suwarna and White GP Composite by 5 to 44.61% as compared to their respective check varieties.

During *Rabi* season, eight elite lines were evaluated along with four checks. W-396/EL-4 recorded the highest 'A' grade bulbs (47.55%) compared to check Bhima Shweta (38.69%). Four lines had no double bulbs and six lines recorded no bolters. Marketable yield ranged from 19.23 t/ha to 35.05 t/ha. Entries W-429/EL-2 and W-419/EL-4 recorded the highest marketable yield of 35.05 and 34.05 t/ha, respectively over check Bhima Shweta (32.85 t/ha). TSS ranged from 11.26% (W-417/EL-4) to 13.18% (W-393/EL-2).

Twenty massing lines along with four checks were evaluated during *rabi*. W-177/M-3 recorded the highest percent 'A' grade bulbs (73.68%) while Bhima Shweta recorded 38.69%. Twelve lines and check Bhima Shweta had no double bulbs. All twenty lines were completely free of bolters. Three lines gave higher marketable yield but at par compared to check Bhima Shweta (32.85 t/ha). Highest marketable yield was recorded for W-177/M-3 (38.11 t/ha). Fourteen lines were superior for TSS than Bhima Shweta (11.86%). W-195/M-4 recorded the highest TSS (13.28%). Three lines were found to be early in maturity (114 DAT) in comparison to check (121 DAT).

Table 2.5: Top ten massing lines for total soluble solids and their marketable yield and % marketable bulbs in massing lines during *rabi*.

Massing lines	%Total Soluble Solids	Marketable Yield t/ha	% Marketable bulbs
W-195/M-4	13.28	31.44	97.01
W-453/M-3	13.15	27.62	93.55
W-340/M-4	13.04	32.73	97.83
W-104/M-4	12.54	29.44	92.31
W-066/M-3	12.32	27.30	96.54
W-103/M-4	12.32	22.38	92.36
W-436/M-4	12.26	29.87	86.25
W-104/M-3	12.16	29.44	88.24
W-177/M-3	12.08	38.11	100.00
W-418/M-2	12.04	32.86	95.30
Bhima Shweta	11.86	32.86	98.99

Two massing and four elite lines along with two checks were evaluated during *kharif* 2011. Marketable yield ranged between 8.57 to 21.67 t/ha. Marketable yield was higher in W-420/EL-4 (21.67 t/ha) but at par compared to check Bhima Shubhra (19.05 t/ha). Five lines and check Bhima Shubhra had no doubles. All the lines including check were completely free of bolters. TSS ranged from 10.44% in W-028/M-4 to 11.97 in Bhima Shubhra. The highest "A" grade bulbs were observed in line W-408/EL-6 (30.75%) and W-420/EL-4 (29.17%). All lines matured in 95 days after transplanting.

White onion high-TSS lines

During *rabi* season seventeen lines along with four checks were evaluated for yield and TSS. One entry HT-GR-03A/M-4CC recorded no double bulbs. Marketable yield ranged between 8.81 t/ha to 32.86 t/ha. One

entry WHT-20/M (30 t/ha) was at par with check Bhima Shweta (32.86 t/ha) for marketable yield. TSS value ranged from 11.61% (HT-Genepool/M-2) to 18.52% (WHT-6A/M). Thirteen entries were significantly superior over check Bhima Shweta (11.86%) for TSS. Seven entries matured earlier (114 DAT) than check (121 DAT). To evaluate the performance of TSS in 6th generation, TSS were recorded from all the bulbs harvested and stored during *rabi*. In progenies of WHT-6A/M population TSS was the highest with 18.63% followed by HT-GR-2A/M-4 with 17.62% and WHT-5B/M with 18.19%, where 96.29%, 92.10% and 90% bulbs, respectively had more than 15% TSS.

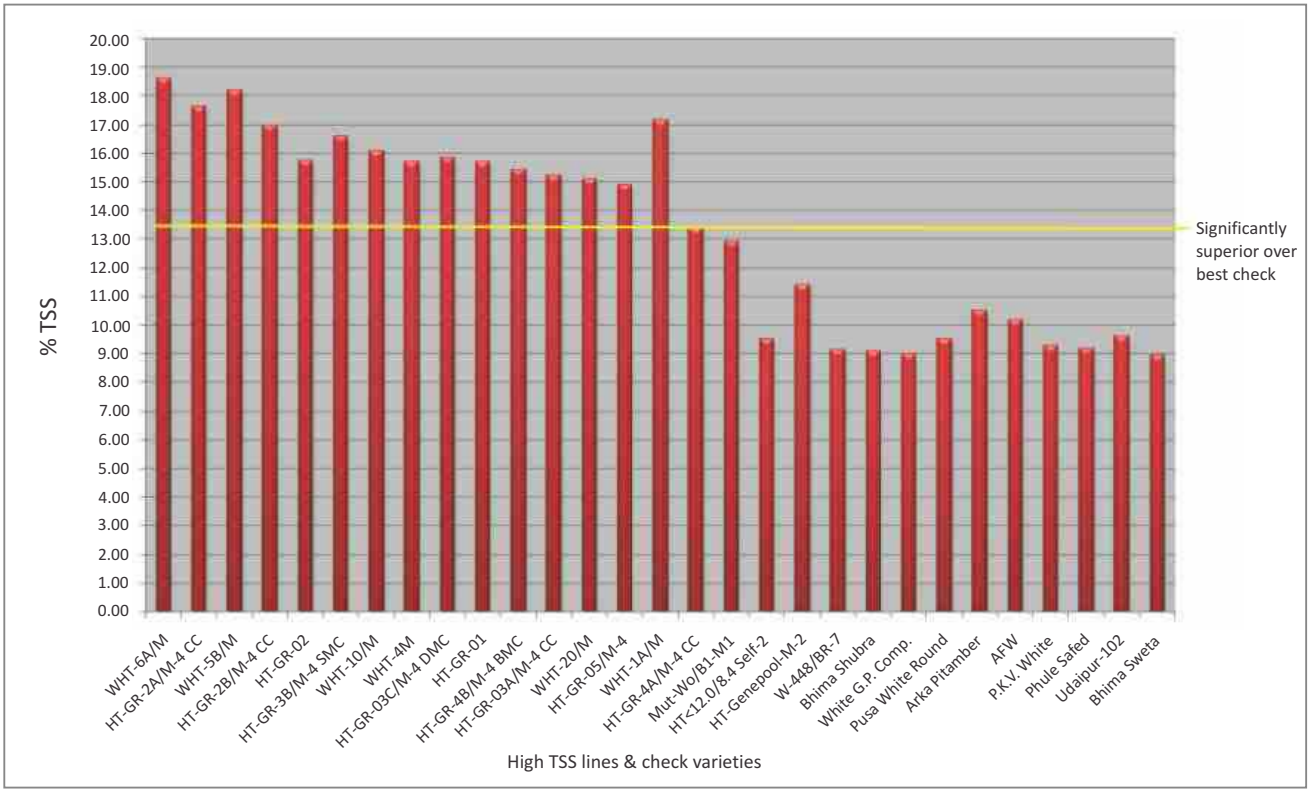


Fig 2.2: Performance of high TSS lines in sixth generation

Table 2.6: Populations, mean %TSS and % of bulbs above 15% & 18% TSS in high TSS lines

Varieties / Lines	Mean Percent TSS	% of bulbs with TSS		
		More than 18%	between 15-18%	More than 15%
WHT-6A/M	18.63	56.79	39.51	96.30
HT-GR-2A/M-4 CC	17.63	44.74	47.37	92.11
WHT-5B/M	18.20	48.00	42.00	90.00
HT-GR-2B/M-4 CC	16.94	32.56	51.94	84.50
HT-GR-02	15.72	16.13	58.06	74.19
HT-GR-3B/M-4 SMC	16.59	31.82	36.36	68.18
WHT-10/M	16.05	25.97	41.56	67.53
WHT-4M	15.69	9.38	56.25	65.63
HT-GR-03C/M-4 DMC	15.81	20.56	42.06	62.62
HT-GR-01	15.69	14.58	47.92	62.50

Continued on next pg.....

Continued from last pg.....

Varieties / Lines	Mean Percent TSS	% of bulbs with TSS		
		More than 18%	between 15-18%	More than 15%
HT-GR-4B/M-4 BMC	15.42	11.02	51.18	62.20
HT-GR-03A/M-4 CC	15.21	4.35	52.17	56.52
WHT-20/M	15.08	14.04	42.11	56.14
HT-GR-05/M-4	14.89	8.60	36.56	45.16
WHT-1A/M	17.15	12.73	18.18	30.91
HT-GR-4A/M-4 CC	13.38	0.00	25.00	25.00
Mut-Wo/B1-M1	12.91	0.00	20.00	20.00
HT<12.0/8.4 Self-2	9.48	0.00	0.00	0.00
HT-Genepool-M-2	11.41	0.00	0.00	0.00
W-448/BR-7	9.11	0.00	0.00	0.00
Bhima Shubra	9.07	0.00	0.00	0.00
White G.P. Comp.	8.98	0.00	0.00	0.00
Pusa White Round	9.49	0.00	0.00	0.00
Arka Pitamber	10.47	0.00	0.00	0.00
AFW	10.17	0.00	0.00	0.00
P.K.V. White	9.25	0.00	0.00	0.00
Phule Safed	9.19	0.00	0.00	0.00
Udaipur-102	9.59	0.00	0.00	0.00
Bhima Shweta	8.95	0.00	0.00	0.00

Evaluation of populations from the crosses made using white and yellow exotic lines

Populations from fifty nine crosses made by hybridizing white and yellow exotic lines with indigenous onion lines were evaluated during *rabi* in F_2 generation. None of the populations had bolters, whereas forty lines had no double bulbs. Marketable yield ranged between 13.81 t/ha to 40.55 t/ha, whereas check Bhima Shweta and Arka Pitamber recorded 27.62 and 25.98 t/ha, respectively. Populations from thirteen crosses performed significantly superior to check Bhima Shweta for marketable yield (32.85 to 40.55 t/ha) and fifteen populations were superior for total yield with 33.24 to 43.89 t/ha against check Bhima Shweta (28.09 t/ha). TSS ranged between 7.0 to 12% in these populations. Bulbs from cross N-2-4-1 x Reforma in F_2 generation recorded the highest 12% TSS.

These populations were studied for storage losses during *rabi*. Eight crosses showed less than 60% weight loss after three months of storage with the lowest loss by weight recorded in Reforma x White Elite Composite F2M1 (44.11%). Losses in 28 lines were more than 75%. Red check Bhima Shakti recorded 53.93% total weight loss followed by Phule Suwarna (56.42%) and Bhima Shweta (56.84%).

Performance of *rabi* onion white advance, elite, massing and high TSS lines in storage

Out of twenty six advanced lines, eight lines showed less than 45% weight loss (32.79 to 43.78%) after three months of storage. Among eight white elite lines, five lines viz., W-408/EL-4 (36.09%), W-402/EL-5

(39.39%), W-396/EL-3 (42.85%), W-444/EL-4 (43.47%), W-429/EL-5 (43.35%) showed less than 50% weight loss. Among twenty massing lines, entry W-147/M-2 had the least (26.78%) weight loss after three months of storage. In seventeen high TSS lines, total weight loss ranged between 28.14 (HT-GR-03A/M-4CC) to 52.83% (Mut W0B1M1) and three lines had total weight losses up to 30%, while check Bhima Shweta showed 41.7% weight loss, Bhima Shakti 19.77% and Bhima Kiran 24.79% losses. Total weight loss after four months of storage ranged from 40.98 to 96.73% in all of these lines. Losses were less than 50% in WHT-1A/M, W-147/M-2, WHT-10B/M and WHT-5B/M, whereas it was 35.29%, 47.33% and 68.72% in checks Bhima Shakti, Bhima Kiran and Bhima Shweta, respectively.

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

Evaluation of yellow onion germplasm

During *rabi* season, ten accessions were evaluated along with check Arka Pitamber and Phule Suvarna. Marketable yield ranged between 27.18 to 34.13 t/ha. Five lines gave significantly higher yield (32.38 to 34.13 t/ha), than Arka Pitambar (24.51 t/ha) and Phule Suvarna (26.57 t/ha). Y-074 recorded the highest (34.13 t/ha) marketable yield. Eight lines had no double bulbs while all lines were free of bolters. TSS in these lines ranged from 11.56% (Y-003) to 13.48% (Y-055). Line Y-009 recorded the lowest total weight loss of 38.33% compared to check Arka Pitambar (42.86%) after three months of storage.

Project 2.4: Development of yellow onion variety suitable for export

Evaluation of yellow massing lines

Five yellow massing lines were evaluated along with two checks during *rabi* season. Two lines Yellow Genepool (SC) (40.24 t/ha) and Y-073/M-1 (34.44 t/ha) were significantly superior to check Phule Suvarna (26.57 t/ha) and Arka Pitamber (24.51 t/ha). Check Phule Suvarna recorded the highest TSS (13.33%) while Y-073/M-1 (11.86%) had the lowest TSS. No double bulbs were observed in four lines.

Storage losses were also studied in these lines. Y-062/M-3 and check Arka Pitamber recorded 41.63 and 42.86% total loss by weight after three months of storage, whereas in rest of the lines losses were more than 50%.

Project 2.5: Heterosis breeding in white onion.

Evaluation of white onion F_1 hybrids

Twelve crosses were made using white advanced lines and white onion male sterile line and developed F_1 hybrids. These F_1 hybrids were evaluated during *rabi* season. Marketable yield in hybrids ranged between 25.71 t/ha to 42.62 t/ha, whereas in parents it ranged between 20.63 to 33.81 t/ha. One F_1 hybrid recorded 58.27% A grade bulbs, 99.36% marketable bulbs, 42.62 t/ha marketable yield, 42.90 t/ha total yield with no bolters and no doubles. Heterosis in these hybrids ranged between -18.3 to 29.14%. Heterobeltosis over the top parent (33.81 and 34.95 t/ha) was recorded in one of the crosses with 26.06 and 29.14% superiority and 42.62 and 42.9 t/ha for marketable and total yield, respectively. Heterosis for storability was improved in nine hybrid combinations (7.88 to 25.26%) over their respective better parent.

White F_1 Hybrids	Yield t/ha	% Heterosis
WHY-1	27.62	-18.31
WHY-2	33.10	13.94
WHY-3	34.95	17.99
WHY-4	31.19	15.52
WHY-5	31.19	3.97
WHY-6	42.90	29.15
WHY-7	31.24	-3.81
WHY-8	31.67	8.83
WHY-9	31.33	-5.33
WHY-10	35.71	2.17
WHY-11	31.05	-8.16
WHY-12	26.62	14.31

Programme 3: Improvement of Garlic through Conventional and Biotechnological Approaches

Project 3.1: Collection, evaluation and maintenance of garlic (*Allium sativum* L.) germplasm

Evaluation:

A total of 110 genotypes along with two checks (G41 and Godavari) were characterized by using data on nine horticultural traits viz., average bulb weight, average clove weight, bulb polar diameter, equatorial diameter, clove polar diameter, clove equatorial diameter, biological yield loss and net yield. Only four traits viz., average bulb weight, bulb polar diameter, bulb equatorial diameter and yield varied significantly among the genotypes. Performance of 10 top accessions for various characters is shown in figure 3.1.

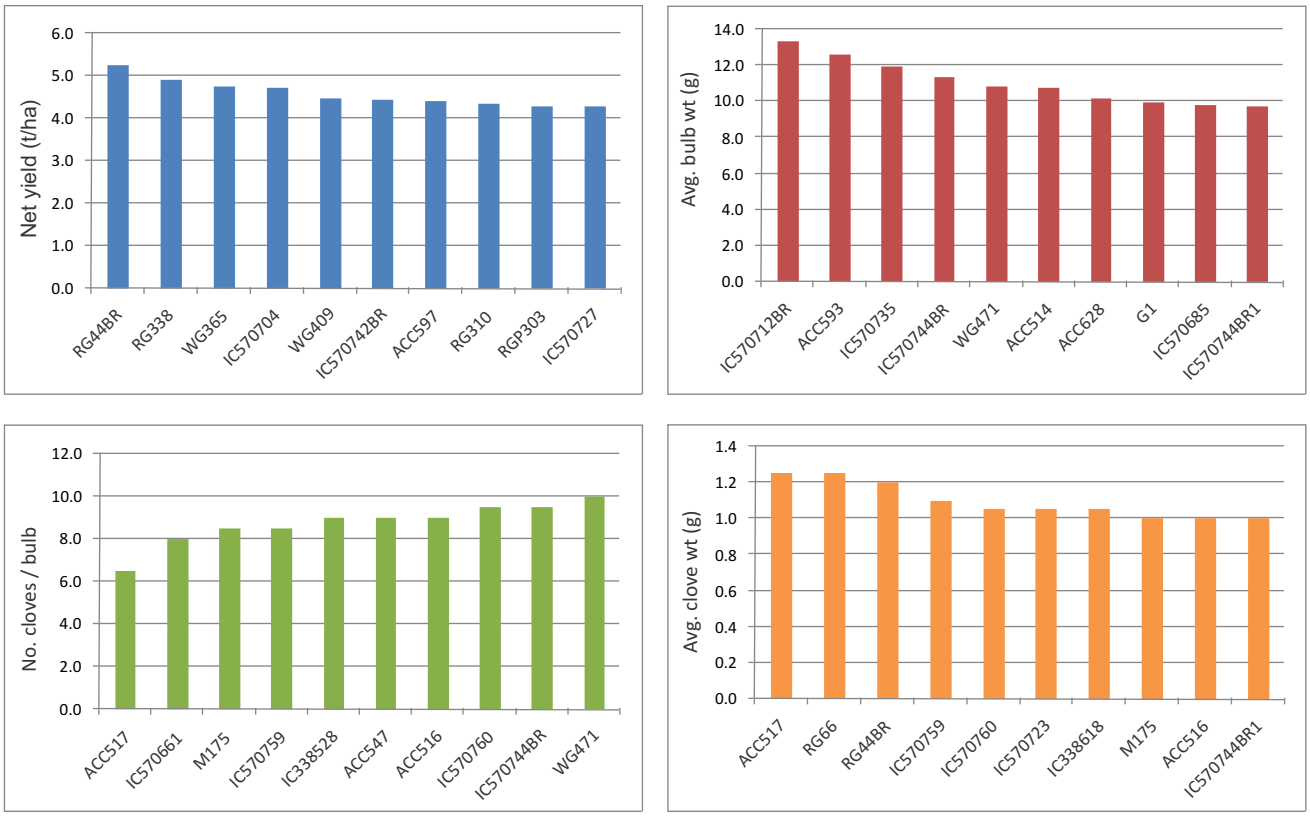


Fig. 3.1: Performance of top 10 garlic accessions for various characters

Maintenance:

More than 600 genotypes were maintained by multiplying them under the field conditions. A set of 625 garlic accessions were sent to Junagadh Agricultural University, Junagadh to maintain duplicate gene bank in case of any calamities. Besides this, a part of 200 lines which were sent earlier for maintenance at JAU, Junagadh were received for evaluation at DOGR.

An experiment on standardisation of *in vitro* conservation protocol in garlic has been initiated using two commercial varieties viz., Bhima Omkar and G41. Meristem tip from garlic cloves were used as explant. After 10-15 days of meristem elongation, the explants were shifted to varying concentrations of sucrose (1-2%) and sorbitol (1-4%). Observations on number of leaves (NOL), number of roots (NOR), root length (RL) and shoot length (SL) were taken after 1 and 2 months of culturing. It was observed that sorbitol @ 4% was instrumental in checking the plantlet growth in Bhima Omkar (Fig.3.2A &B).

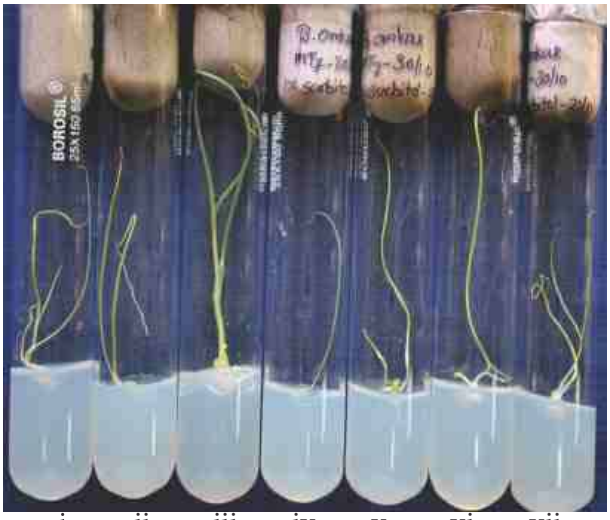


Fig 3.2A: *In vitro* conservation of garlic cv. Bhima Omkar i) control ii) Sucrose 1% iii) Sucrose 2% iv) Sorbitol 1% v) Sorbitol 2% vi) Sorbitol 3% vii) Sorbitol 4%

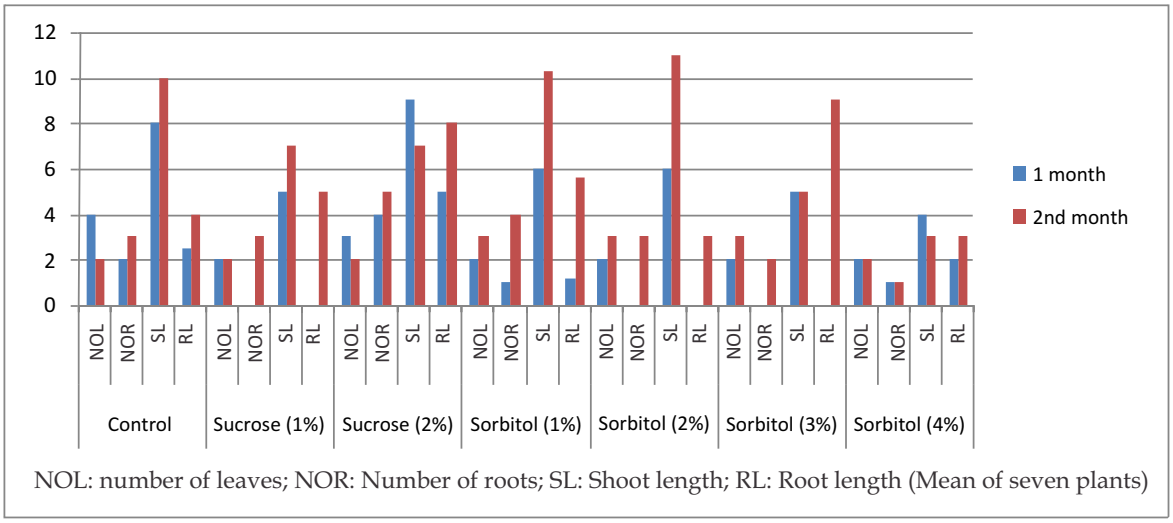


Fig 3.2 B: Effect of various treatments on *in vitro* conservation ability of garlic cv. Bhima Omkar

In case of cultivar G41, it was observed that sucrose @1% was effective in checking the growth and there was no root development and shoot length was also very short (Fig.3.3). It was concluded that there was genotypic variation in response to *in vitro* conservation in garlic.

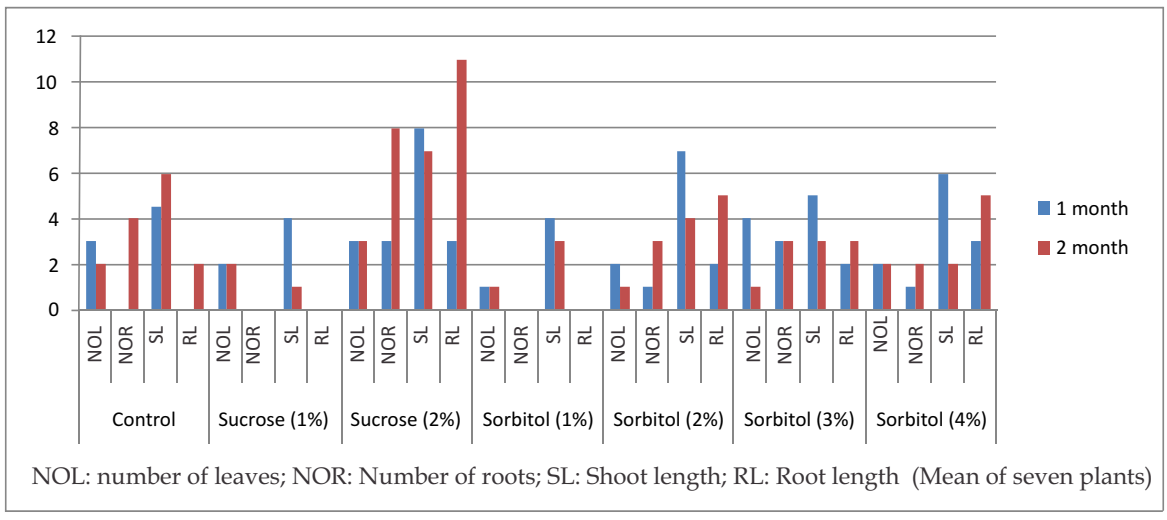


Fig 3.3: Effect of various treatments on *in vitro* conservation ability of garlic cv. G41

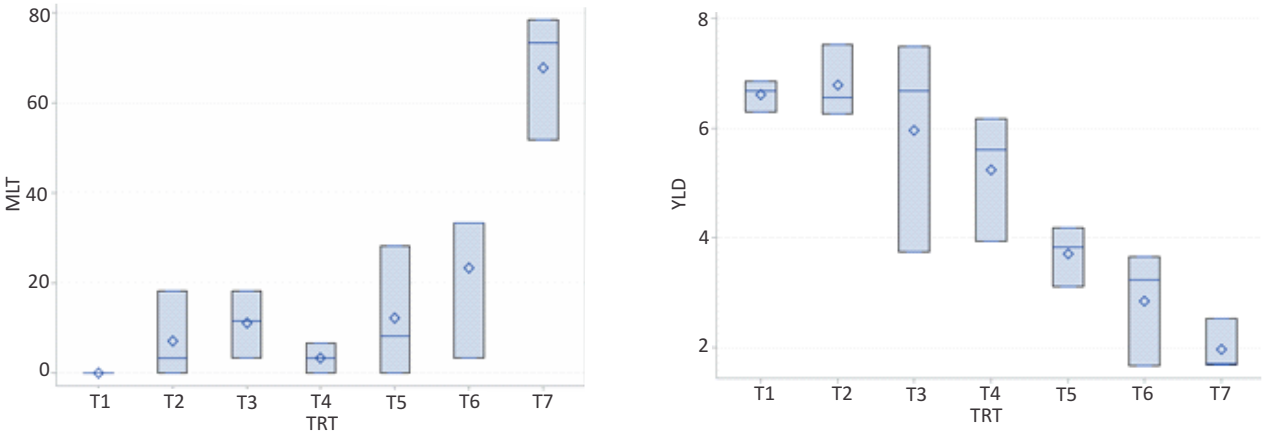
Project 3.2: Development of high yielding garlic varieties suitable for different production areas through clonal selection

Forty eight elite lines (M7) obtained through mutagenesis of base material of variety G41 were analysed along with the mother plant. Data were recorded on nine horticultural traits viz., average bulb weight, average clove weight, bulb polar diameter, equatorial diameter, clove polar diameter, clove equatorial diameter, biological yield loss and net yield. It was found that number of cloves, bulb polar diameter and clove equatorial diameter differed significantly alongwith the mother plant G41 and some lines performed better than G41 in terms of yield but differences were not significant (Table 3.1).

Table 3.1: Performance of elite lines of garlic obtained through mutagenesis

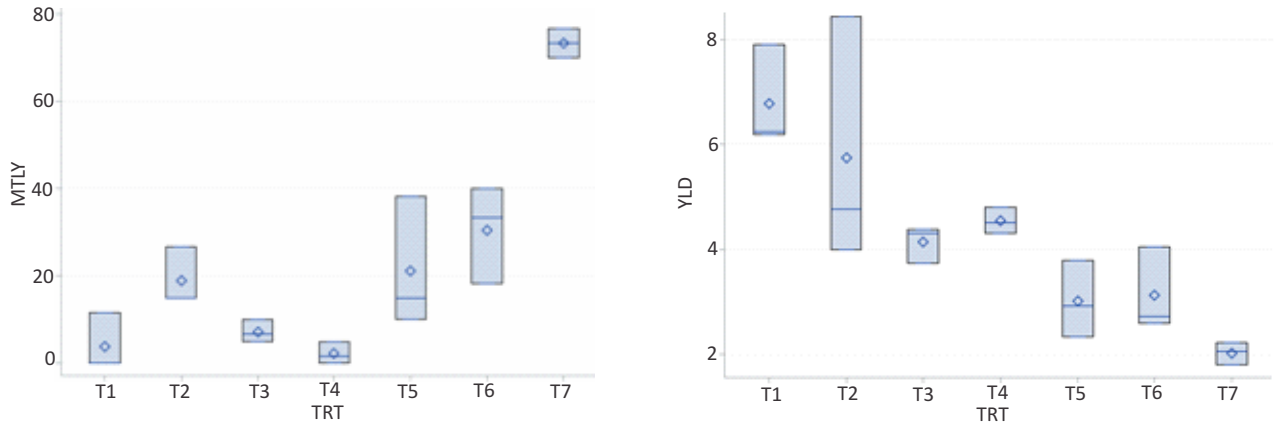
Variable	Mean	G41 (Check)	Min.	Max.	Std Error	CV (%)	Pr>F
Average bulb weight (g)	9.43	11.2	3.50	16.8	0.23	25.5	0.0932
Average clove weight (g)	0.80	0.87	0.40	1.4	0.01	15.4	0.0558
Number of cloves/bulb	16.19	18.33	6.00	28.0	0.36	21.2	0.0131
Bulb polar diameter (cm)	2.55	2.72	2.03	3.11	0.02	8.1	0.0392
Bulb equatorial diameter (cm)	2.85	3.11	2.20	3.62	0.03	10.8	0.4562
Clove polar diameter (cm)	1.85	1.84	1.48	2.35	0.01	9.6	0.2804
Clove quatorial diameter (cm)	0.79	0.84	0.52	1.22	0.01	10.67	<.0001
Biological yield loss (%)	12.89	22.90	4.14	47.81	0.48	48.9	0.7861
Yield (t/ha)	2.23	2.66	0.48	4.36	0.06	27.3	0.2559

In order to create variability, cloves of three garlic varieties viz., Phule Baswant, Godavari and Chinese garlic were subjected to gamma radiation @ 1Gy, 2.5 Gy , 5 Gy , 7.5 Gy, 10 Gy and 15 Gy concentrations and the M0 plants were studied for plant height, number of leaves, leaf length, leaf width, pseudostem diameter, collar diameter, mortality percent and yield. It was observed that yield reduced and mortality increased significantly at 15Gy irradiation (Fig.3.4 &3.5).



Treatments T1=Control; T2=1Gy; T3=2.5 Gy; T4=5 Gy; T5=7.5 Gy; T6=10 Gy; T7= 15 Gy

Fig 3.4: Distribution of mortality and Yield in Phule Baswant

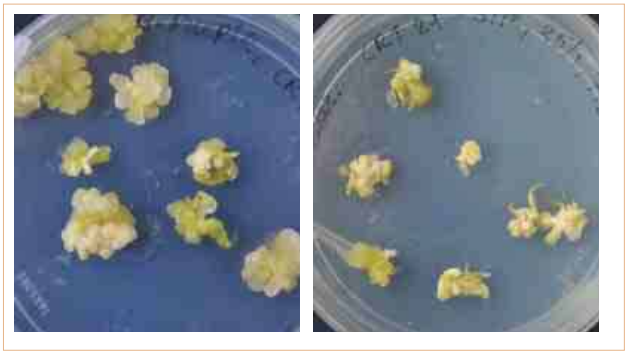


Treatments T1=Control; T2=1Gy; T3=2.5 Gy; T4=5 Gy; T5=7.5 Gy; T6=10 Gy; T7= 15 Gy

Fig 3.5: Distribution of mortality and Yield in Godavari

Project 3.3: Studies on somaclonal variations in garlic (*Allium sativum* L.)

Creation of variability for development of new variety is difficult in garlic being non-flowering (sterile) in nature. Induction of variation under *in vitro* culture condition is known in many crops. In order to induce somaclonal variation in garlic, root tip of garlic genotypes Bhima Omkar, Bhima Purple, G408 and G378 were inoculated on B5 medium containing different concentrations of 2,4-D and BA. Genotypic differences in response to various media were observed, though callus formation was noted in all the varieties from root tips. After first and second subculture callus regeneration or formation of more gigantic roots were observed (Fig. 3.6).



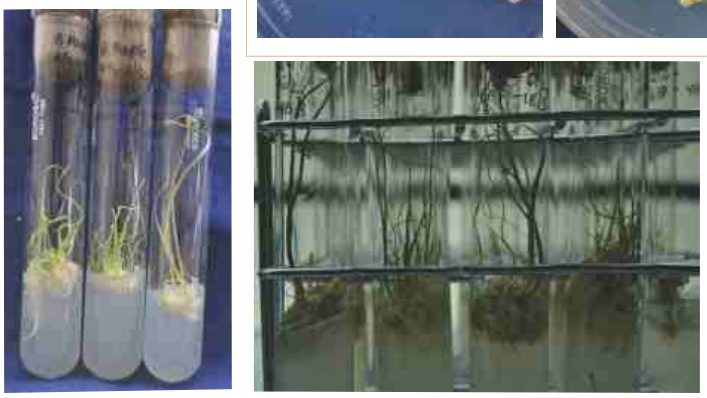


Fig 3.6: Various stages of callus culture, regeneration and shoot formation in garlic

Programme 4: Biotechnological Approaches for Improvement of Onion (*Allium cepa*. L)

Project 4.1: Induction of haploid in onion (*Allium cepa* L.)

Induction of gynogenic haploids

Due to the high inbreeding depression shown by the onion crop, conventional breeding through selfing for production of inbreds is tedious and time consuming. Under such circumstances the help of non-conventional methods like production of haploids through anther/ovule/ovary/microspore culture can be tried. Haploid induction in onion was achieved (Table 4.1) through gynogenesis from flower bud culture.

Different varieties and lines were tried on the gynogenic media during *rabi* season 2011-12. Gynogenic potential varied between varieties. In general gynogenic potential was low (below five percent) when compared to reported potential in long day varieties. Present status of gynogenic plants in culture is given below (Table 4.1). Regenerants were cultured on basal media (with 3% sucrose) for proper establishment. Plantlets established on solid media had thin roots which are difficult to process for cytological analysis. Established plantlets were cultured on liquid basal media (Fig.4.1) and root growth was found normal and good for cytological analysis. Around 30 plants were processed for cytology and obtained good preparation in 15 samples. Around 12 samples were found haploid (Fig. 4.2A) and 3 mixoploids. Two of the plants confirmed by cytology (BK- 19 and BK-54) were analysed by flowcytometry (Fig. 4.2 B) and confirmed as haploids.

Table 4.1: Success in the production of gynogenic plants

Variety	Number of explants	No of regenerants	Gynogenesis (%)	Mortality	Regenerants available
Bhima Kiran	2300	65	2.8	11	54
Bhima Red	2000	38	1.9	6	32
Bhima Shweta	3800	34	0.9	4	30
Bhima Shakti	1250	26	2.1	15	11
Bhima Super	1000	35	3.5	32	3
N-2-4-1	500	15	3.0	12	3

Fig. 4.1: Gynogenic plants cultured on paper support in liquid medium

A.

B.

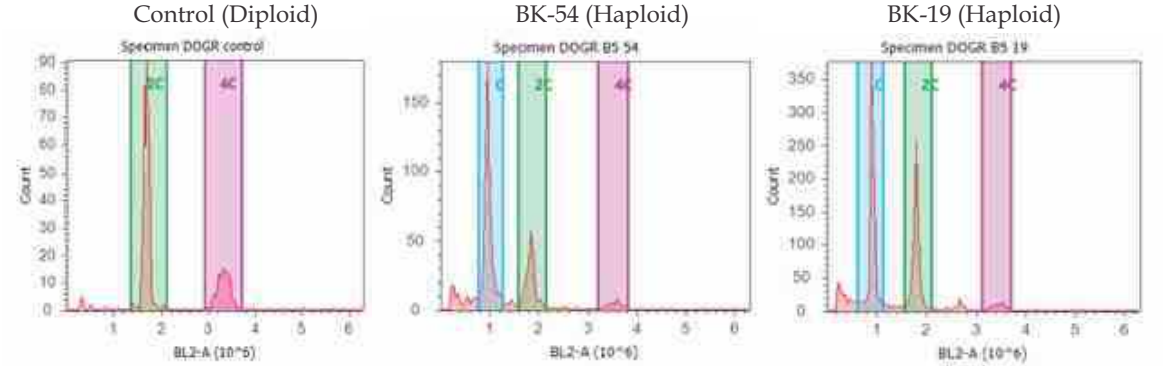


Fig. 4.2: A. Cytology of Haploid B. Ploidy analysis of gynogenic plants by flowcytometry,

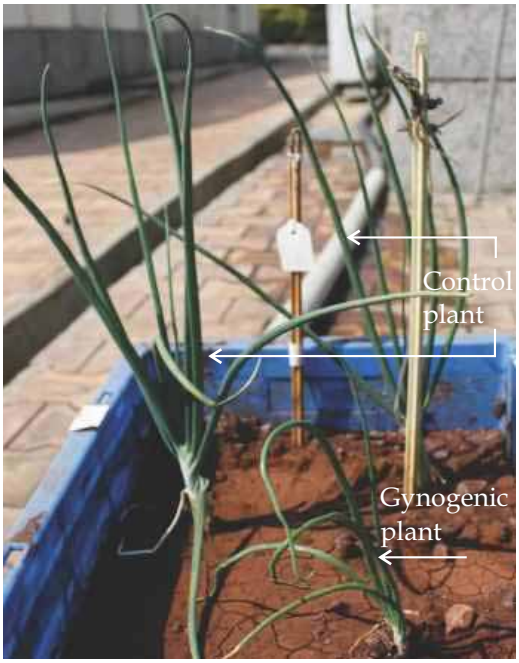


Fig. 4.3: Hardened gynogenic plant

Project 4.3: DNA profiling of onion lines using molecular markers

There are many types of molecular markers reported for onion. In this study, available SSR markers were evaluated for diversity and varietal identification. In addition, development of new marker i.e. retro-transposon based insertional polymorphism (RBIP) was also tried.

Evaluation of genetic diversity among the genotypes

Onion being a cross pollinated plant, establishing varietal identity becomes difficult. Markers for onion were compiled based on available resources from public domain. About 50 markers which were already located on chromosomes were selected for screening diversity in parental population which can also be used in mapping desired traits. Eleven SSR markers were evaluated on 27 varieties. Cluster analysis identified two major clusters (I and II; see figure 4.4) among the commonly cultivated onion varieties in India. Early Grano and AgriFound Rose (AFR) were found genetically at distance from these two clusters.

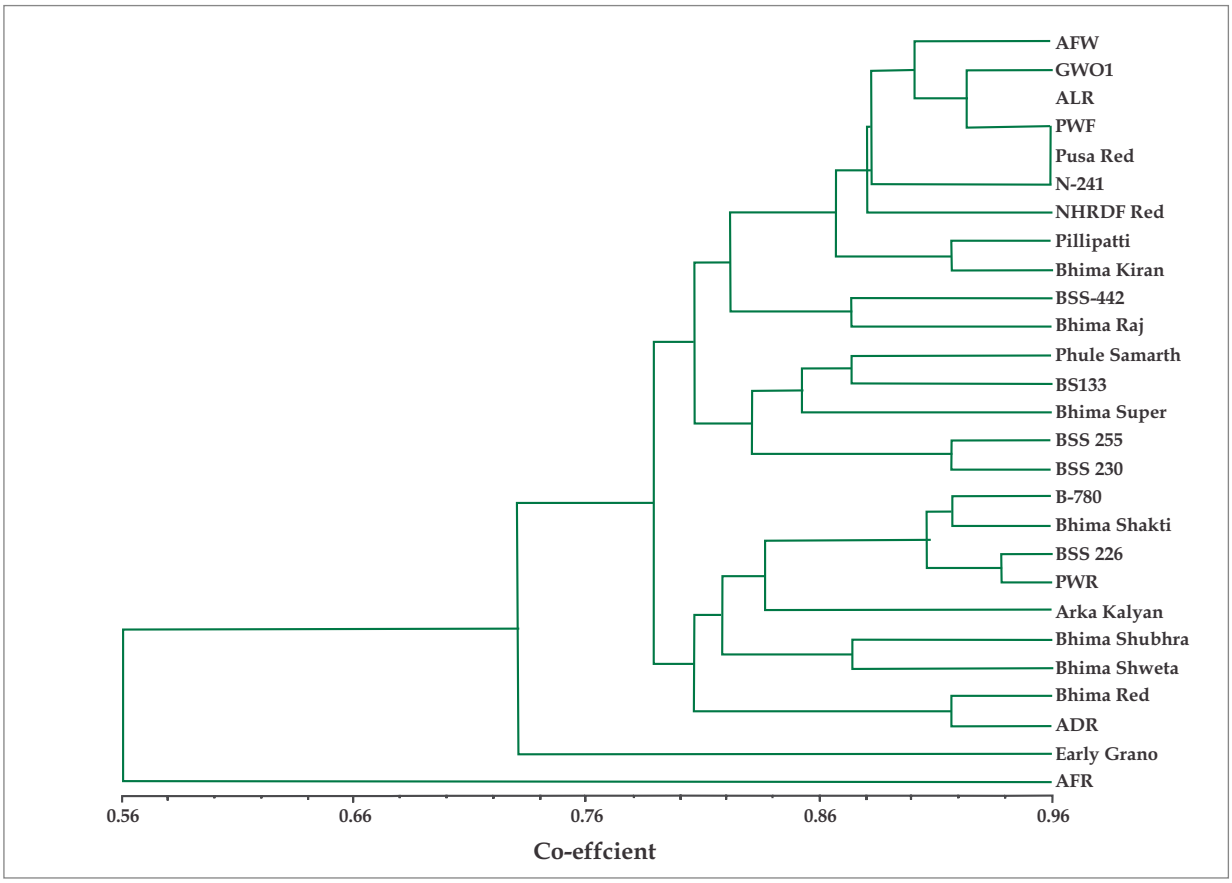


Fig. 4.4: Phylogenetic analysis based on dissimilarity obtained from SSR data

Retroposon Based Insertion Polymorphism (RBIP)

RBIP was attempted for developing a Real-Time based detection method for varietal discrimination. In order to develop the method, ends of retro-transposon copia-1 was cloned and characterized. Sequence analysis identified long terminal repeats (LTRs) and primers were designed based on LTR sequence. Sequence Specific Amplification Polymorphism was detected using LTR specific primers and adapter specific primer. Similarly, inter-transposon polymorphism (IRAP) was evaluated by primers located on LTR alone (Fig.4.5).

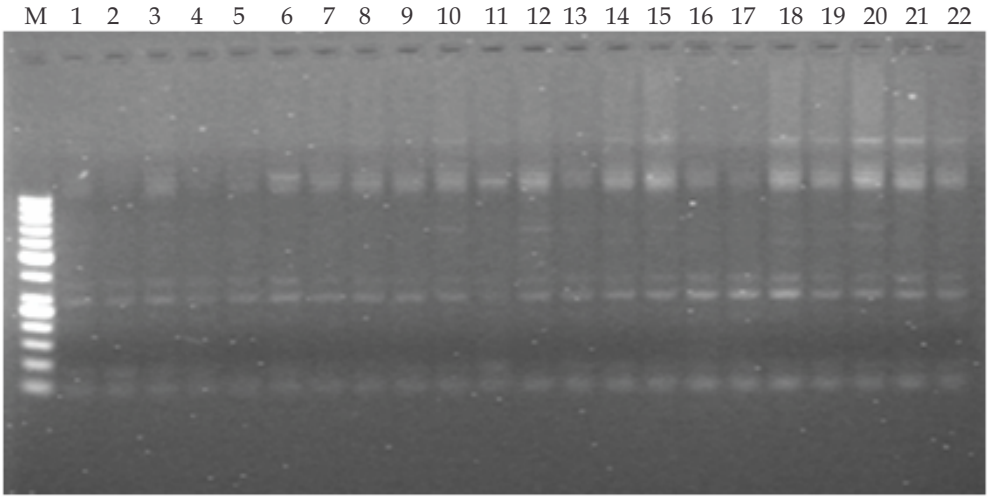


Fig. 4.5: Inter-Retro-transposon Amplification Polymorphism (IRAP)

Lane no	Description	7	Phule Samarth	15	N241
M	Marker	8	Pillipatti local	16	ADR
1	Pusa Red	9	PWR	17	AF Rose
2	Phule Swarna	10	Bhima Shubhra	18	AFW
3	GWO-1	11	Bhima Kiran	19	Garwa
4	PWF	12	Bhima Raj	20	BSS-226
5	Pusa Madhwi	13	Bhima Shweta	21	Onion Co 5
6	Early Grano	14	Bhima Shakti	22	Arka Kalyan

Screening for male sterile cytoplasm in different genotypes

Male sterility in onion is governed by cytoplasmic factors. Two types cytoplasmic sterility is observed in onion i.e. S and T type. Cytoplasmic factor can be identified by molecular markers. Screening of natural population can identify the naturally occurring male sterile cytoplasm which can be exploited for generation of male sterile lines adapted to local condition. Mitochondrial rearrangements at sites near to *orf501* and *5'-cob* gene is usually associated

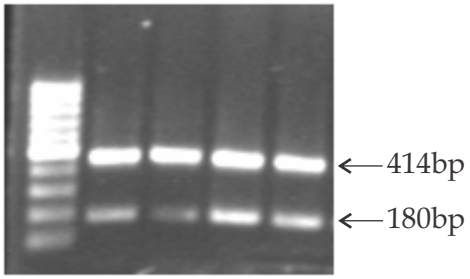


Fig. 4.6: Amplification for 5'-cob specific primers

with male sterility in onion. Amplification of 473bp fragment using *orf501* primers indicates fertility/sterility status of cytoplasm. Amplification of two fragments (414, 180bp) from *5'-cob* specific primers confirmed the S type CMS cytoplasm (Fig 4.6). Thirty genotypes were evaluated for *orf501* and *5'-cob* specific primers and four genotypes showed presence of mitochondrial rearrangement for S type cytoplasm and three for T type cytoplasm.

Marker assisted selection for bolting

Bolting (induction of inflorescence stalk) is a major problem in bulb onion crop in late *kharif*. Bolting leads to poor bulb formation and bulb resources are diverted for flower and seed production. Thus, there is reduction in marketable bulb yield. Late *kharif* / early *rabi* crop is affected by bolting problem due altered photo-thermo regime under which crop is grown. As bolting is regulated by interplay of factors related to crop development and environmental cues, field management may be achieved through improved genotypes. In an effort to map the bolting, variation for bolting was studied in twelve genotypes during late *kharif*. Bolting percentage ranged from 5 to 88.9 percent. It was the highest in AgriFound Rose in which bolting started very early from 50 DAT and continued till the 110 DAT. Bolting was very less (around 6 percent) in Bhima Kiran, Bhima Red and Pusa White Round. Variation within variety was also observed and varieties AgriFound White (AFW), Arka Kalyan and AgriFound Rose showed high variation in percent and time of bolting. The genotypes were clustered into three groups using Duncans Multiple Range Test (DMRT; Fig 4.7). AgriFound Rose alone was classified in high bolting group, AFW and Arka Kalyan in medium bolting group and rest of genotypes in low bolting group. For developing mapping population crosses were made between Bhima Kiran X AFR, AFW x Bhima Shakti.

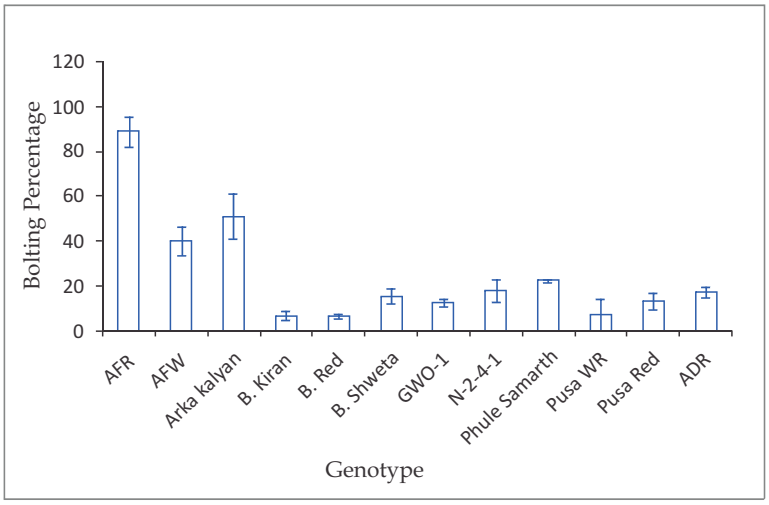


Fig. 4.7: Variation in bolting behavior of onion genotypes

Marker assisted selection for sprouting behavior

Onion is stored mostly under natural environment in traditional structures. Exposure to natural environment leads to losses in storage due to sprouting, physiological weight loss and microbial rot. The physiological weight loss and rot can be managed to an extent by clean storage practices and cold storage. But the loss due to sprouting i.e. resumption of bud growth is the main issue in long term storage. Development of markers

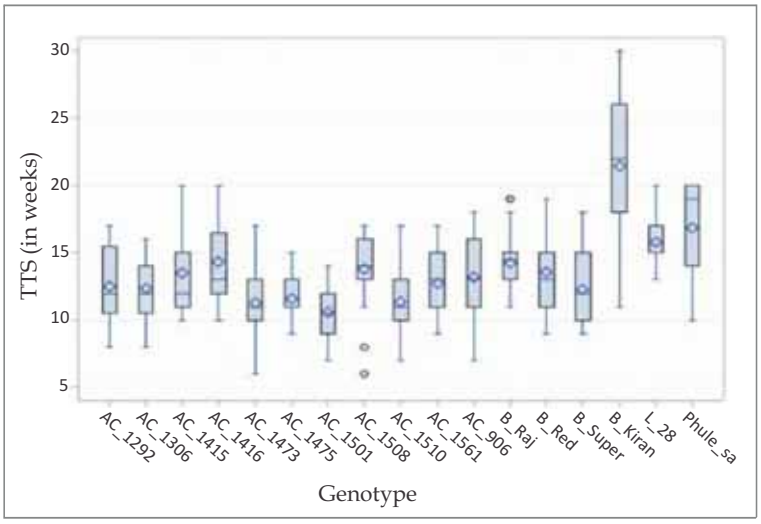


Fig.4.8: Variation in time to sprouting (TTS) in onion genotypes

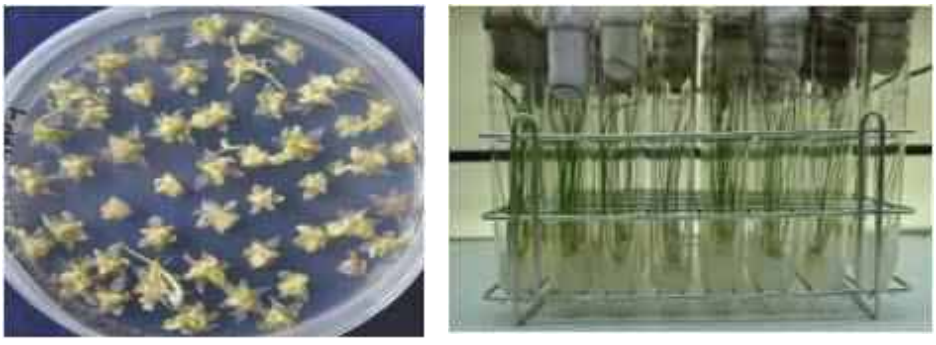
linked to sprouting trait might help in breeding for selection of desired trait. In order to identify parental lines for developing mapping populations, variability for sprouting traits was studied. *Rabi* produce of forty genotypes were evaluated under natural condition. Sprouting percentage ranged from 5 to 90 percent among genotypes after five months of storage. Highest sprouting was observed in accession 1415 and least in accession 625. Average time to sprouting (TTS) ranged from 10 to 22 weeks. Early sprouting was observed in accession 1501 and also in *kharif* varieties Bhima Red, Bhima Raj and Bhima Super. Though average TTS is late in Bhima Kiran (22 weeks), but the sprouting was dispersed (Fig 4.8) from 11 weeks to 30 weeks implying higher variation for sprouting behavior within variety.

Bhima Kiran and Bhima Shakti were selected for late sprouting and Bhima Super, Bhima Shubhra and Bhima Red were selected for early sprouting. Intervarietal crossings were initiated and three combinations of crosses were made till now (Bhima Kiran x Bhima Shubbra, Bhima Red x Bhima Kiran, Bhima Shakti x Bhima Super).

Programme 5: Collection, Characterisation and Screening of Wild Species for *Allium* Improvement

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

A. tuberosum is a tetraploid species which has been found to be resistant to a number of insect pests affecting cultivated onion. Crossing of *A. tubersoum* with *A. cepa* lead to embryo abortion and no seed formation. Our aim was to develop haploid plants through *in vitro* gynogenesis in *A. tubersoum*. In this respect, nine mediums (H1-H9) having varying concentrations of 2,4-D, NAA and BA were tried and approximately 3500 flower buds were inoculated in these media. Out of nine media, it was found that H4 medium performed best in terms of direct plant regeneration through *in vitro* gynogenesis and some of buds were polyembryonic although all the buds lead to direct plant formation (Fig.5.1). The problem in *A. tuberosum* is that it is an apomictic plant, hence getting plants through *in vitro* gynogenesis do not confirm their haploidy. Hence, an effort is being made to cytologically analyse the plants for their haploid behaviour which can then be used for further crossing programme.



A B

Fig. 5.1: A, Direct regeneration of plants through flower buds; B, *In vitro* multiple shoot formation of plants obtained through *in vitro* gynogenesis

A new project on "Marker assisted selection in onion" has been initiated to identify the sources of resistance to major diseases viz., Purple blotch and Anthracnose and develop a mapping population to tag the genes of interest. In this direction, nine onion varieties viz., Bhima Subhra, Bhima Shakti, B 780, Bhima Raj, Bhima Shweta, Bhima Kiran, Arka Bindu, Arka Niketan and Bhima Super were artificially inoculated with *Colletotrichum gleosporoides* under polyhouse conditions. Experimental material was 5 plants per replication and there were three replications. After spray, observations were recorded two times. Bhima Kiran (21.3%) and Bhima Shweta (22%) recorded very less infection as compared to Bhima Shakti, Arka Bindu and Bhima Super (46-50%) which recorded the maximum infection (Fig. 5.2).

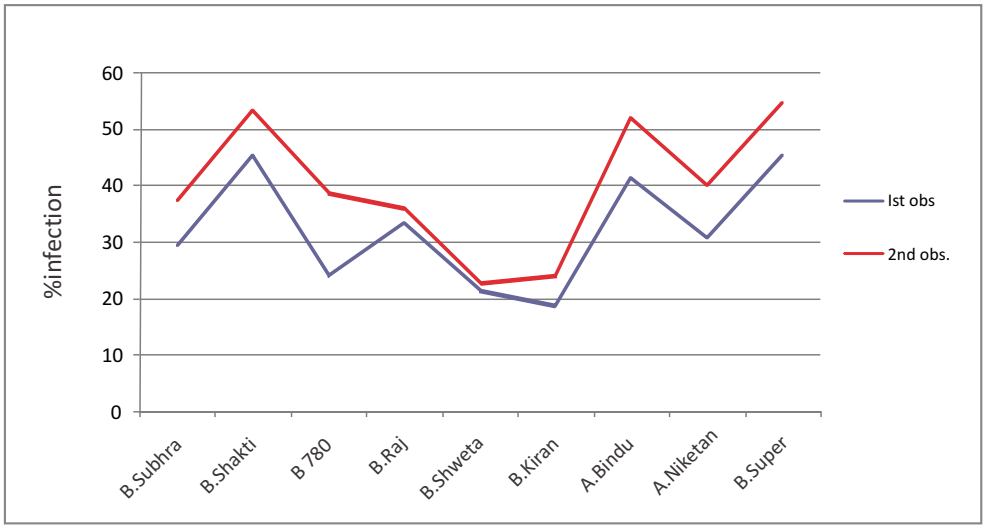


Fig. 5.2: Evaluation of onion varieties for anthracnose resistance

Crop Production

Plant growth and development is limited by many environmental factors, including nutrition. Plant nutrition depends mainly on crop requirement, yield potential, cropping season, soil fertility and decaying organic matter. In addition to this, the information about rate of nutrient uptake and stage at which the crop absorbs maximum nutrients are essential to devise the fertilizer application programme for higher nutrient use efficiency and productivity. Keeping this in view, the present experiments were carried out to study the effect of fertilizer levels on biomass accumulation and nutrient uptake pattern of onion bulb crop and garlic at different growth stages at DOGR, Rajgurunagar.

Programme 6: Integrated Nutrient Management for Onion and Garlic

Biomass accumulation and nutrient uptake pattern of onion

The field experiment was carried out to study the biomass accumulation and nutrient uptake pattern of onion bulb crop at different growth stages during *rabi* season. The experiment was undertaken with five treatments namely control, 50 % RDF, 50 % RDF+10 t FYM/ha, 100 % RDF, 100 % RDF+10 t FYM/ha. The crop was raised with standard package of practices of DOGR. The plant samples were collected 30 days after transplanting (DAT) with 15 days intervals. The collected samples were washed and dried in hot air oven at 60^{0}C after separating leaves from bulbs until reaching constant weight. After drying, the samples were ground and passed through 2 mm sieve and stored for nutrient analysis. Total N, P, K and S in plant samples were analysed using standard procedures. The results showed that different levels of fertilizer application significantly influenced the biomass accumulation (Fig. 6.1). The highest biomass accumulation was recorded with application of 100 % RDF+20 t FYM/ha while the lowest was in control. In general, the biomass accumulation in leaves increased up to 60 DAT and started declining thereafter. Unlike in leaves, biomass accumulation in bulbs increased up to maturity. However, the rate of biomass accumulation was low up to 60 DAT and increased thereafter. This increase in biomass in bulbs was higher and coincided with the bulb development and enlargement stages.

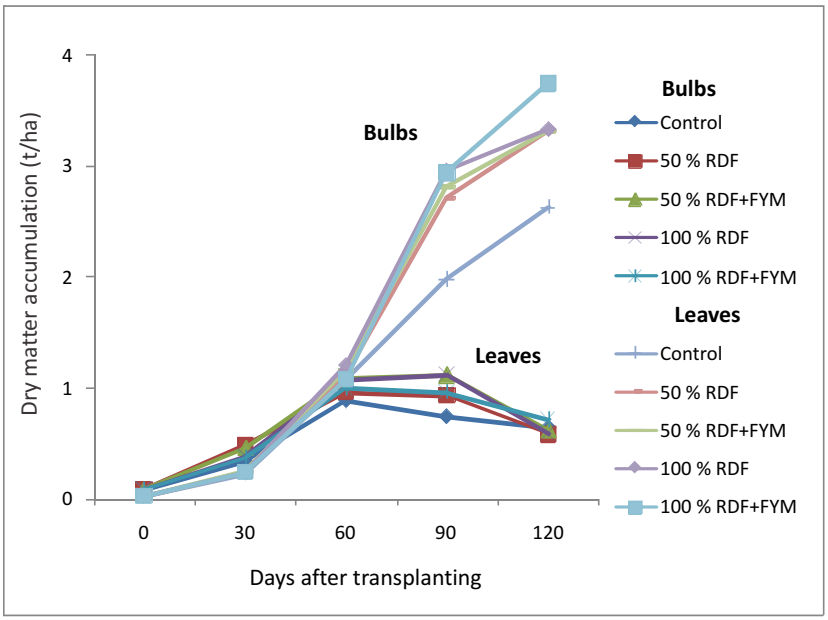


Fig. 6.1: Dry matter accumulation pattern of onion cv. Bhima Kiran

Total N uptake

The pattern of N uptake in relation to fertilizer application indicated that the period of increased absorption was between transplanting to bulb development stages in all the treatments (Fig. 6.2). N absorption rate was higher from 45 to 60 DAT for all the treatments. Total nutrient uptake was significantly higher in treatment - 100% RDF+20 t FYM/ha followed by 100% RDF/ha and 50% RDF+10t FYM/ha over 50% RDF/ha and control. About 20-25 % N was absorbed during the initial growth period *i.e.* from transplanting to 30 DAT and the remaining 70-75 % of the required N was removed during 30 to 60 DAT. Only about 3-5 % of N was removed during the crop maturity.

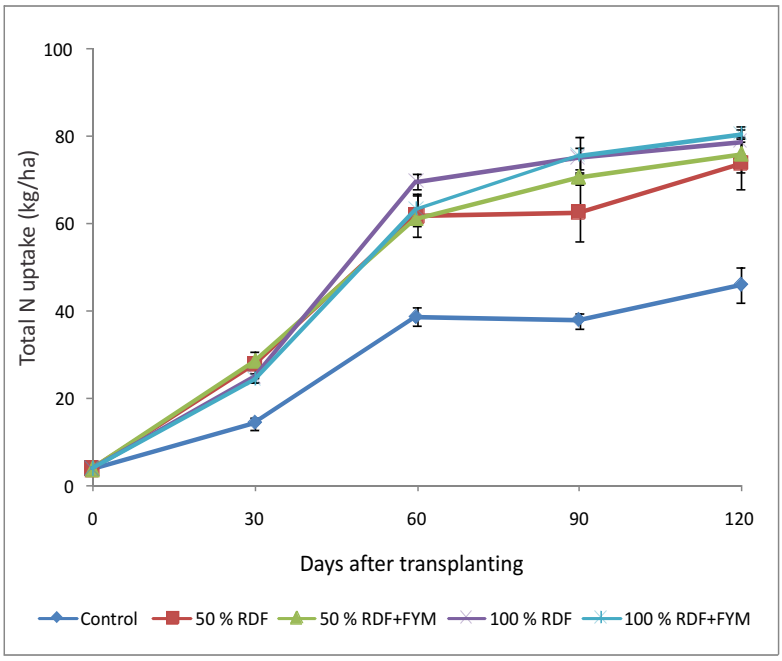


Fig. 6.2: Total N uptake at different growth stages

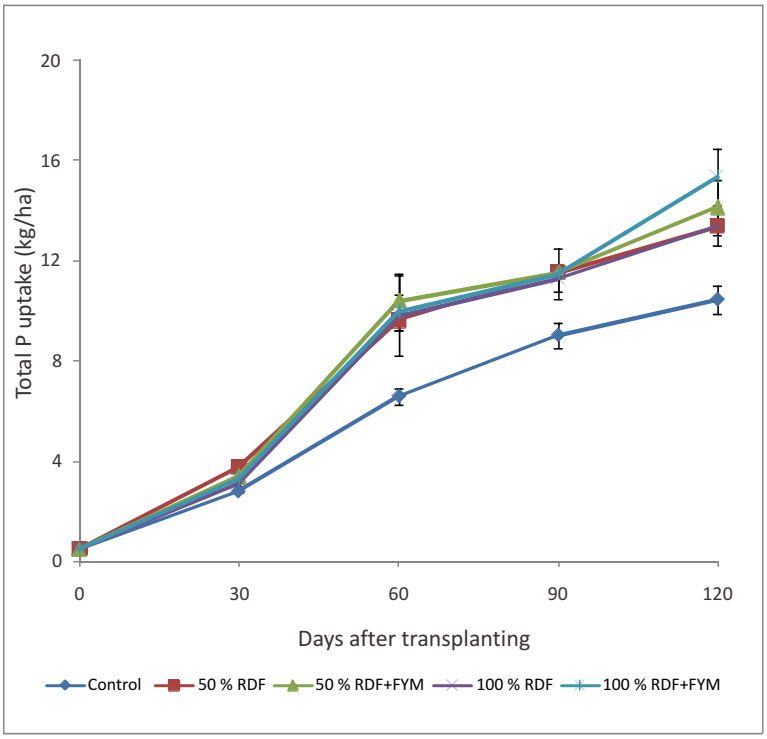


Fig. 6.3: Total P uptake at different growth stages

Total P uptake

The P uptake pattern varied significantly with fertilizer levels. The highest P uptake was recorded in plots with 100% RDF+20 t FYM/ha followed by 50% RDF+10 t FYM/ha whereas the lowest was recorded in control plots (Fig. 6.3). The increase in P uptake in FYM treatments was due to the release of organic acids during decomposition and chelating effect of organic acids on P. The period of increased P absorption was observed during transplanting to bulb development stages in all the treatments (Fig. 6.3). P absorption rate was higher from 45 to 60 DAT for all the treatments. This trend was similar for all the fertilizer levels studied. About 10-15% P was absorbed from transplanting to 30 DAT and the remaining 70-75 % and 5-10 % of the required P was removed during bulb development and enlargement, and crop maturity stages, respectively.

Total K uptake

Total K uptake at harvest of onion bulbs varied between 48.9 kg/ha in control and 68.7 kg/ha in 100 % RDF + 20 t FYM/ha (Fig 6.4). Total K uptake in 100 % RDF + 20 t FYM/ha was at par with 100 % RDF which were significantly higher than 50 % RDF + 10 t FYM/ha, 50 % RDF and control. The K uptake by plants increased with increasing fertilizer levels. The K uptake rate was the highest during 45-60 DAT and declined thereafter. About 90 % of required K was removed during the vegetative phase *i.e.* up to 60 DAT and only 10 % of total K uptake was recorded during later part of the growth period.

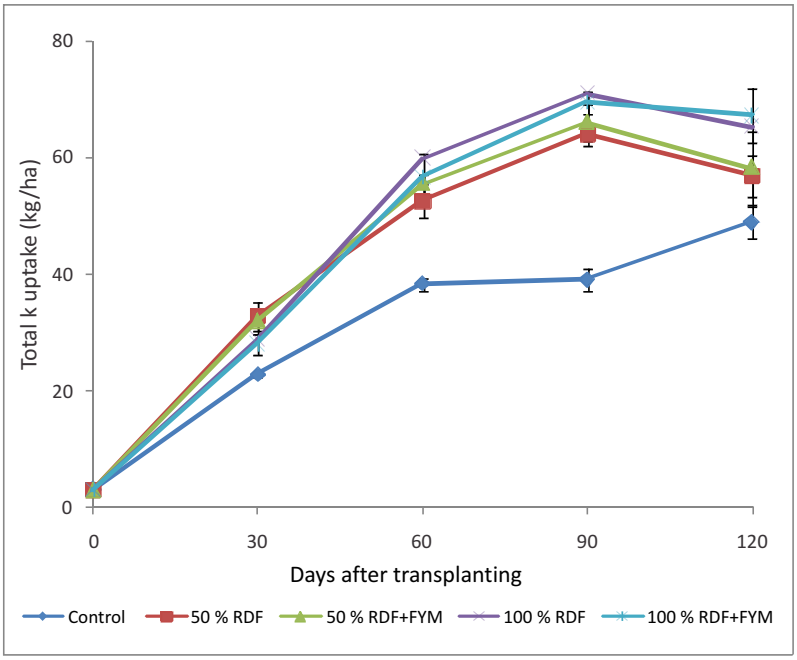


Fig 6.4: Total K uptake at different growth stages

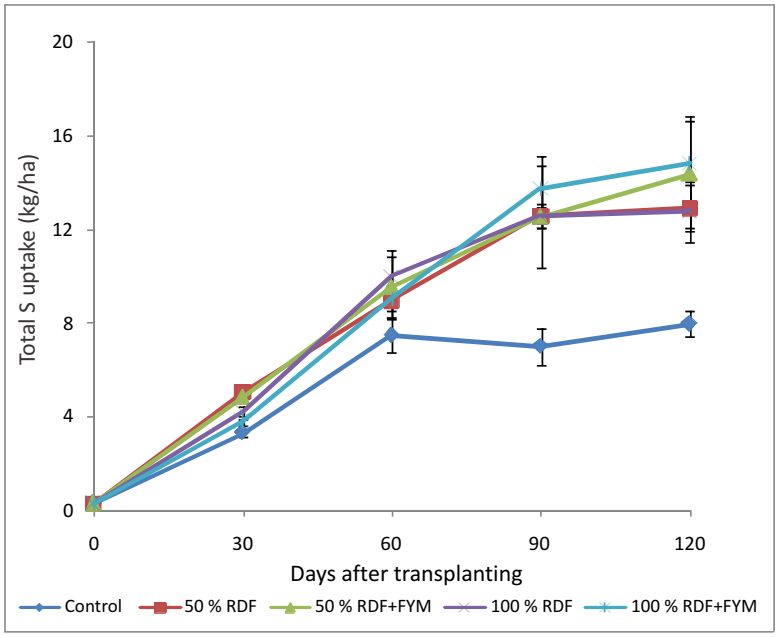


Fig 6.5: Total S uptake at different growth stages

Total S uptake

The total S uptake increased with increasing fertilizer levels. The S uptake in the fertilizer treatments was significantly higher over the control plots (Fig. 6.5). Highest S uptake was recorded with application of 100 % RDF + 20 t FYM/ha and the lowest was observed in control plots. The S absorption rate was low till 45 DAT and the highest S absorption rate was found at 45-60 DAT and declined thereafter. About 80% of the required S was removed up to 60 DAT and the remaining 20% of S during 60 DAT to harvest

The results of the present study indicated that the onion crop removed about 95-97 % of the required nutrients during active vegetative growth stages i.*e.* from transplanting to 60 DAT. But, as per current fertilizer recommendation, 1/3 of N and full of recommended P, K and S are applied as basal at the time of transplanting and remaining 2/3 N is applied in two equal splits as topdressing at 4 and 6 weeks after emergence. Basal application of fertilizer does not synchronize with the period of maximum nutrient requirement of onion, since less than 25 % of total uptake of N, P, K and S occurs within 4 weeks after emergence. Normally, three irrigations are given from fertilizer application at time of transplanting to 10 DAT for good establishment of onion seedling. Root systems of the seedling at the time establishment will be about 5-10 cm only and if large amount of irrigation water is applied in the root zone, applied nutrients

will dissolve in water and carried beyond the root zone by percolating water, which may not be available to onion plants. Therefore, quantity and time of fertilizer application should match with crop requirement to enhance the efficiency of applied fertilizer nutrients and crop yield.

Nutrient uptake and dry matter accumulation in garlic

Field study was carried out to study dry biomass accumulation and nutrient uptake pattern of garlic during *rabi* season. The experiment comprised of five fertilizer treatments including control. Full dose of required P, K, and S were applied as basal dosage whereas one third of N was applied as basal dosage and the remaining 2/3 of N was applied as top dressing at 30 and 45 DAP. The standard package of practices was followed to grow garlic crop. Plant samples were collected at 15 days intervals starting from 30 DAP to harvest. Collected samples were washed, dried in hot air oven at 60^{0}C and processed after recording dry weight. The processed samples were used for different nutrient analysis. The nutrient uptake was calculated by multiplying nutrient concentration and dry weight and expressed in kg/ha. However, the dry biomass accumulation was expressed in t/ha. The results of the study showed that the dry matter accumulation in the tops increased up to 75 days from planting and then leveled off and declined after 90 days of planting (Fig. 6.6). The dry matter accumulation in the garlic bulbs progressed slowly up to 75 days from planting. Increased there after 75 days from planting to harvest. No significant difference was observed for dry matter accumulation between the fertilizer treatments. All the fertilizer treatments recorded significantly higher dry matter accumulation over the control.

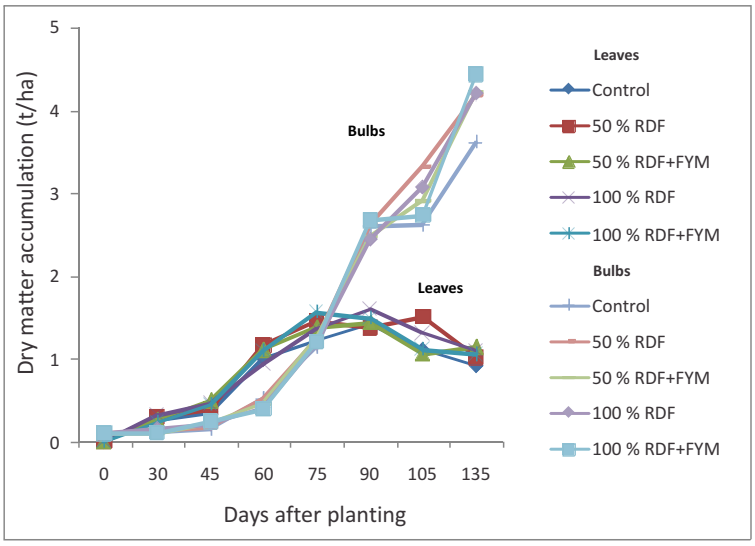


Fig. 6.6: Dry biomass accumulation pattern in Garlic

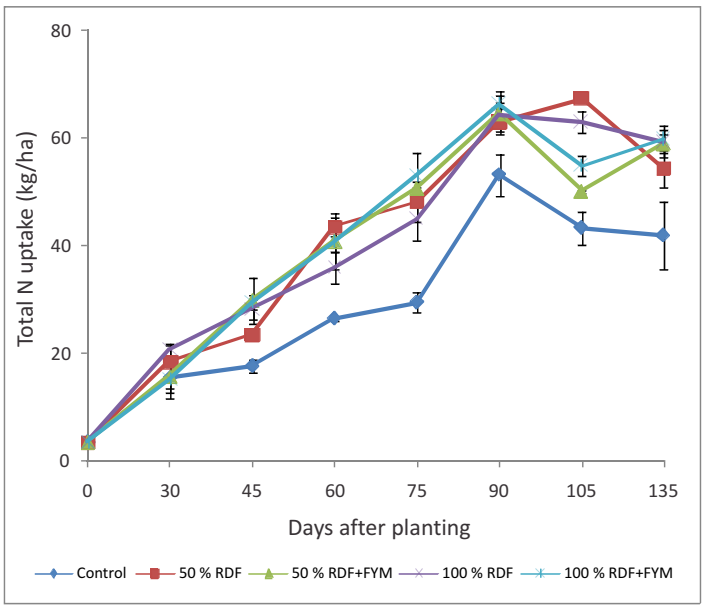


Fig. 6.7: Total N uptake pattern of garlic

Total N Uptake pattern

Nitrogen uptake in fertilizer applied treatments was significantly higher over the control whereas there was no significant difference between the fertilizer levels (Fig. 6.7). The total N uptake increased up to 90 days from transplanting. However, the increase was slow during the initial growth phase and rapid uptake was observed from 45-90 days from planting. About 60-70 % of the total N was absorbed during this period. The N uptake recorded after 90 DAP was slightly lower than the quantity recorded at 90 DAP. The decrease in N uptake was due to drying and loss of old and matured leaves.

Total P uptake pattern

The data indicated that there was no significant difference between the treatments for P uptake (Fig. 6.8). Like N, P uptake pattern also increased up to 90 DAP and leveled off after 90 days. The uptake rate increased gradually and reached maximum between 60-90 DAP and decreased after 90 days. Almost 95 % of the required P was removed up to 90 DAP.

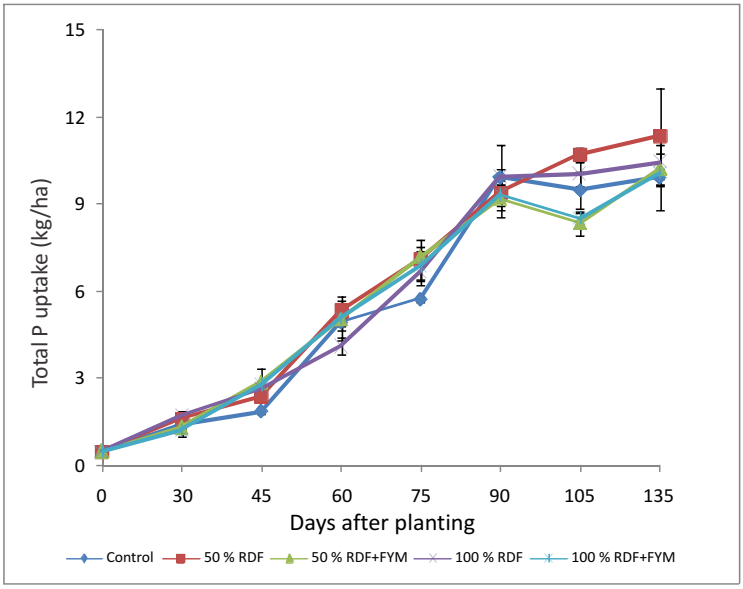


Fig. 6.8: Total P uptake pattern

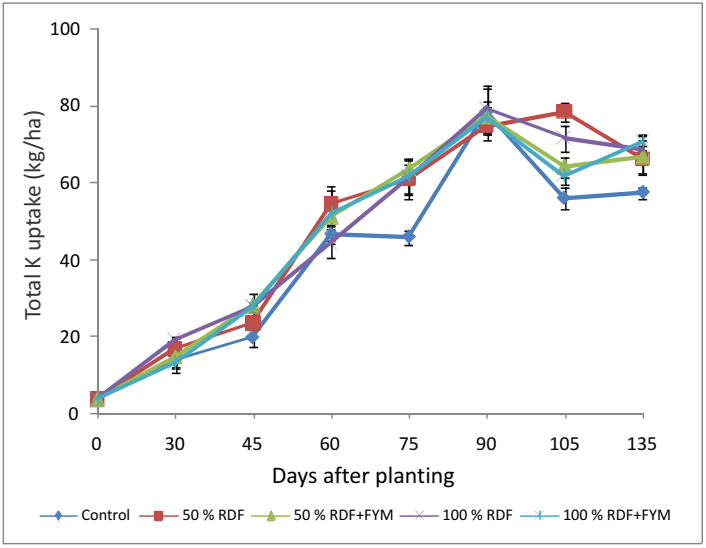


Fig. 6.9: Total K uptake pattern

Total K uptake pattern

Changes in K uptake over time followed the same pattern of total N uptake pattern (Fig. 6.9). There was no significant difference between the treatments for total K uptake. The K uptake was slow during the initial growth phase up to 30 days from planting and much more rapid uptake was observed from 45-90 DAP and decreased thereafter. Over 80 % of the total K was removed during the active growth phase *i.e.* from 45-90 DAP. The K concentration in plants tends to decline with crop stages, as occur in other crops.

Total S uptake pattern

Total S uptake was not significantly influenced by the fertilizer levels (Fig. 6.10). The total S uptake also increased up to 90 DAT and leveled off there after. The uptake rate increased gradually up to 75 days and reached maximum between 75-90 DAT and declined after 90 days from planting. About 80-90 % of the required S was removed up to 90 days from planting.

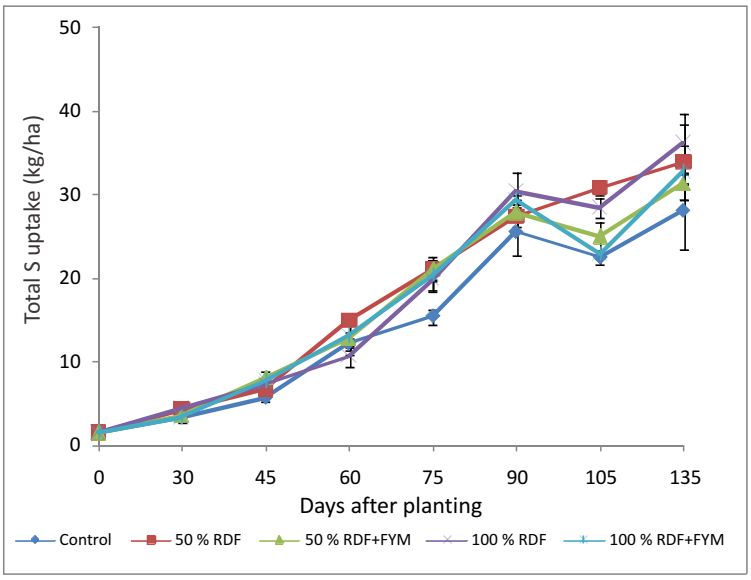


Fig. 6.10: Total S uptake pattern

The uptake pattern of N, P, K and S of garlic showed that the garlic crop removed about 95-97 % of the required nutrients during active vegetative growth stages i.e. from planting to 90 DAP. Therefore, required N, P, K and S should be applied before 90 days from planting. Application of fertilizer nutrients after 90 days may not have any impact on garlic bulb yield.

Programme 7: Enhancement of Production of Onion and Garlic through Agronomic Innovations

Project 7.4 Studies on organic production of onion and garlic

Effect of soil application of various organic manures on growth, yield, quality and storage life of onion and garlic

Organic farming is a holistic production management system which promotes and enhances agro ecosystem health, including biodiversity, biological cycles and soil biological activity. It is one of the ways to sustain the productivity of crops in long run without affecting the soil health and environment. Keeping this in view, an experiment was conducted in onion and garlic at DOGR during *rabi* season to study the influence of combined effect of various organic inputs (organic manures, organic growth stimulants, biofertilizers and biopesticides) on growth, yield, quality, post harvest storage life and soil fertility status of both the crops in comparison with inorganic farming.

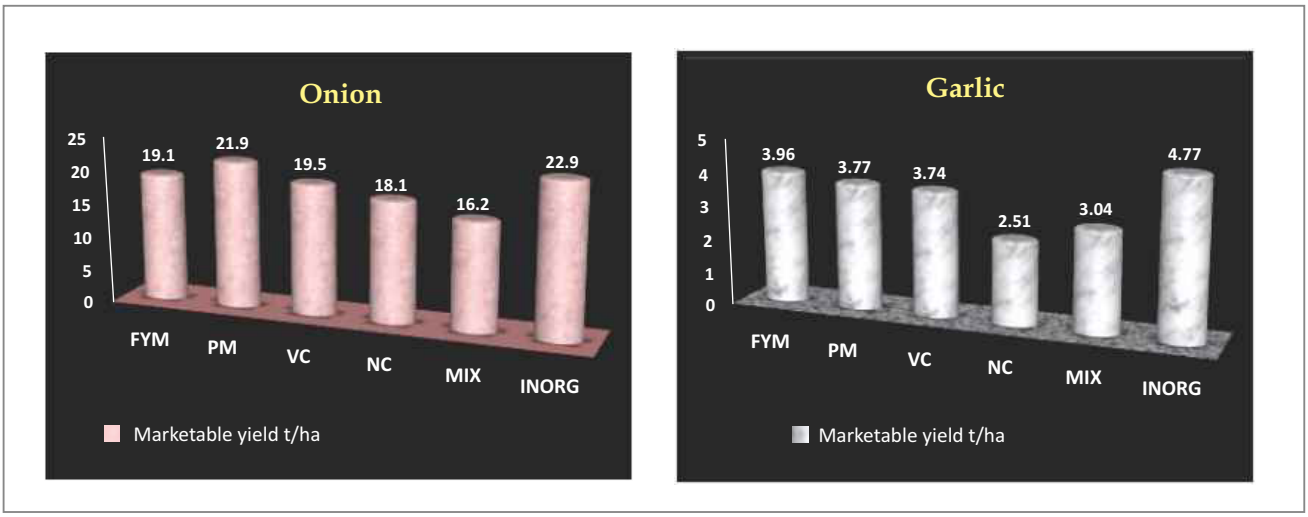


Fig. 7.1: Effect of soil application of various organic manures on yield of onion and garlic

The results from the present experiment revealed that inorganic treatment consisting of 100 per cent recommended dose of NPK fertilizers along with chemical plant protection measures recorded the highest marketable bulb of 26.9 t/ha in onion and 4.77t/ha in garlic. In case of organic farming practices, among the various organic manures (FYM, Poultry manure, Vermicompost, Neem cake and their combinations) applied. Poultry manure package recorded relatively higher yield (21.9 t/ha in onion and 3.97 t/ha in garlic) than other organic manures evaluated in both the crops (Fig 7.1). However, almost 17 –48 % lesser marketable yield was recorded in organic farming system depending upon the treatments in comparison with inorganic production system of both the crops.

It was observed from the quality aspects that organically nourished bulbs recorded better quality in terms of biochemical constituents of bulbs than inorganic package. However, there was no significant difference between various kinds of applied organic manures.

With regards to post harvest storage life of onion and garlic, it was noticed that physiological loss in weight (PLW), sprouting and rotting losses were highly influenced by different applied organic manures and other organic inputs application. Overall, the maximum total storage losses of bulbs were noticed in inorganic farming in both crops after 150 days of storage (Fig 7.2). However, there was no significant difference between treatments. Among the various organic and inorganic cultivation practices, soil available N, P, K and S content (kg/ha) were on higher side in inorganic fertilizers applied plot than organic manures applied plots in both the crops.

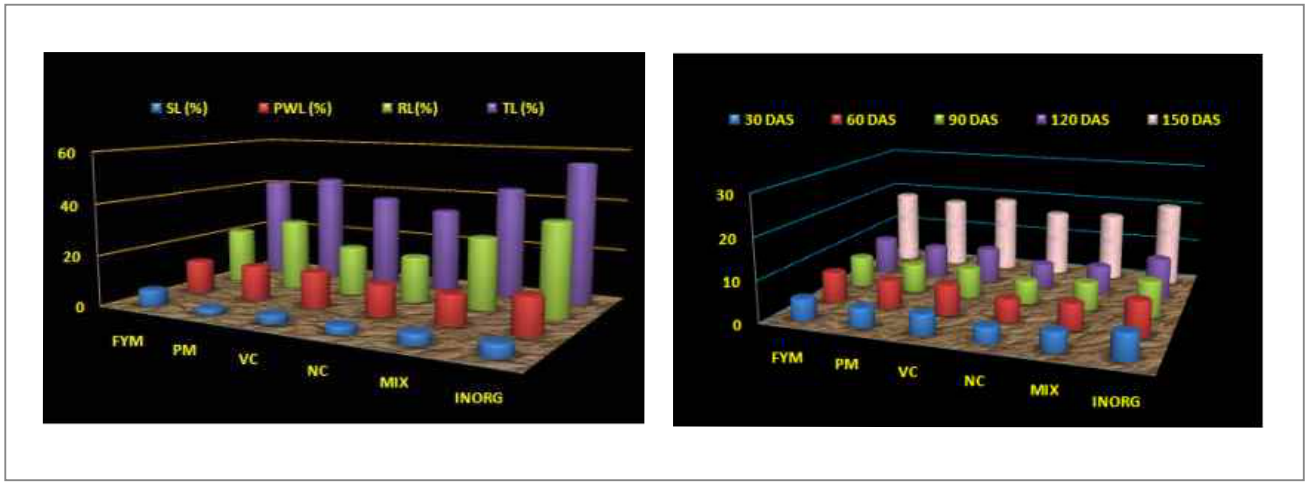


Fig. 7.2: Effect of soil application of various organic manures on post storage life of onion and garlic

The influence of organic sources of nutrients on the soil biological properties was studied through the assessment of soil microbial population. It was noticed that soil bacteria, fungal and actinomycetes population were higher in soil nourished with organic manures and other organic inputs as compared to inorganic fertilizers applied plot. Higher population of soil microbes under organic treatments acted as an index of soil fertility because it serves as temporary sink of nutrients flux. The soil microbial load was low in 100 per cent inorganic NPK fertilizer treatments which might be due to the inhibitory nature of chemical fertilizers on the growth and development of soil microbes. The organoleptic attributes, such as colour, flavor, texture, taste and over all acceptability of fresh salad onion were influenced by different manures based organic package, particularly, FYM and poultry manure package had higher scores than other organic manures applied as well as inorganic fertilizers. With regards to pest and disease incidence, there were no significant difference observed between organic and in organic production systems of both the crops.

Project 7.5 Weed management in onion and garlic

Chemical weed management in *rabi* onion

Weed infestation is one of the limiting factors in quality bulb production in onion as onion exhibits greater susceptibility to weed competition than most of other vegetable crops. It is mainly due to slow initial growth and inherent characteristics of onion bulbs such as short stature, non branching habit, sparse foliage, shallow root systems coupled with frequent irrigation and fertilizers application. Hence, an experiment was conducted at DOGR to study suitable weedicides for effective control of weeds in *rabi* onion production in comparison with manual weeding.

Table 7.1: Pooled data for marketable yield

Treatment	Marketable Yield (t/ha)			
	2009-10	2010-11	2011-12	Pooled Mean
T1	42.6	30.7	33.9	35.7
T2	32.7	24.2	33.4	30.1
T3	40.8	27.1	34.9	34.3
T4	42.2	25.7	36.3	34.7
T5	41.0	23.4	33.7	32.7
T6	38.7	29.9	30.5	33.0
T7	43.5	36.1	37.1	38.9
T8	16.6	3.67	10.8	10.4

Based on the three year results, it was concluded that among the various weedicides evaluated, application of Oxyflurofen 23.5% EC @1.5ml/L before planting and one hand weeding at 55 days after transplanting recorded higher marketable bulb yield of 38.9 t/ha (Table 7.1) coupled with good weed control efficiency (81.4 %) and B:C ratio (2.78) (Fig. 7.3).

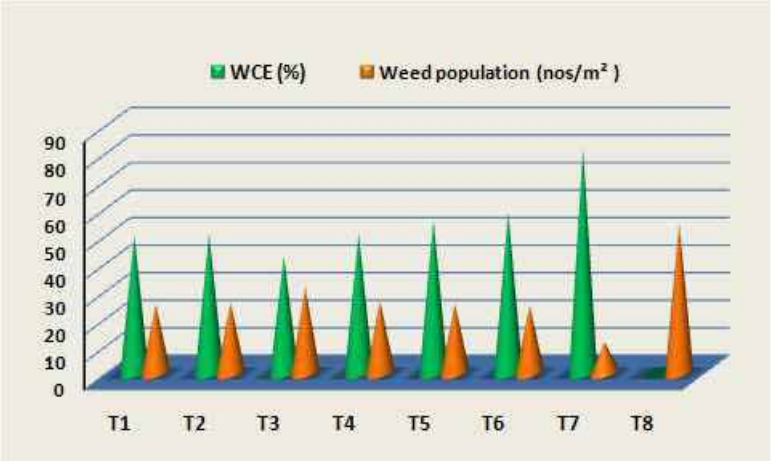


Fig. 7.3: Effect of chemical weed management on weed control efficiency (WCE) and weed population in onion.

T_1 - Oxyflurofen 23.5%EC application before planting and second application at 30 DAT

T_2 - Oxyflurofen 23.5%EC application before planting + Quizalofop Ethyl 5% EC application at 30 DAT

T_3 - Combined spray of Oxyflurofen 23.5%EC and Quizalofop Ethyl 5.0%EC at the time of planting and second application at 30 DAT

T_4 - Pendimethalin30.0%EC application before planting and second application 30 DAT

T_5 - Pendimethalin30.0%EC application before planting + and Quizalofop Ethyl 5% EC application at 30 DAT

T_6 - Combined spray of Pendimethalin30.0%EC + Quizalofop Ethyl 5% EC at the time of planting and second application at 30 DAT

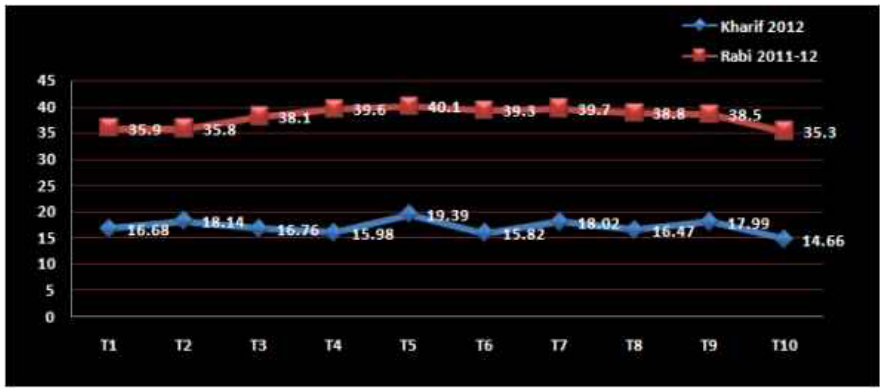
T_7 - DOGR Recommended practices (Oxyflurofen23.5%EC application before planting + one hand weeding at 40-60 DAT)

T_8 - Weedy check

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

Effect of foliar application of salicylic acid on growth, yield, quality and storage life of onion.

Salicylic acid (SA) is a common plant produced phenolic compound which acts as signal molecule during biotic and abiotic stresses and also has growth promoting effect. To study the plant growth promoting effect of salicylic acid on onion growth, yield and quality, an experiment was conducted at DOGR during *kharif* as well as *rabi* season. Salicylic acid was sprayed at nursery, main field and on both in both the seasons.



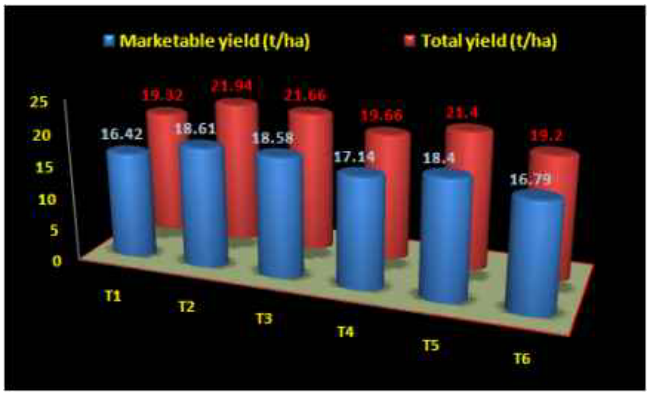
T1: Nursery Spray 20 + 40 DAS, T2: T1+20 DAP, T3: T1+20 & 40 DAP, T4: Nursery Spray 30 DAS+20 DAP, T5: T4+40 DAP, T6: T4+40 DAP + 60 DAP, T7: Main field - 20 & 40 DAP, T8: T7 + 60 DAP, T9: T7 + 60 + 80 DAP, T10: Control.

Fig. 7.4: Effect of foliar application of salicylic acid on marketable bulb yield (t/ha) of onion

The results revealed that irrespective of season and treatments, foliar application of salicylic acid improved the yield and yield contributing characters of onion in both the seasons compared to control. Among the various treatment combinations, foliar application of salicylic acid @250mg/L at 30 days after sowing followed by 20 and 40 days after transplanting recorded higher marketable bulb yield in Bhima Super (19.4 t/ha) during *kharif* season and Bhima Kiran (40.1t/ha) in case of *rabi* as compared to control (14.9 and 35.3 t/ha). However, there were no significant differences observed in bulb biochemical constituents and post harvest storage life of onion.

Effect of humic acid application on growth, yield, quality and storage life of *kharif* onion.

Humic acid is a unique soil conditioner, a naturally occurring organic substance consisting primarily of humic acid and minor levels of minerals. It acts as a bio-catalyzer and bio-stimulator and enhances soil fertility status by way of stimulating development of soil microflora population, improves soil structure, increases cation exchange and water retention capacity and increases availability of soil nutrients to the plants. An experiment was conducted at DOGR, Rajgurunagar to study the effect of humic acid on plant growth, yield and soil nutrient availability and uptake. Humic acid was applied to the plants by three methods *viz.;* soil application, foliar sprays and drip fertigation.



T1: Humic acid foliar spray at 15, 30, & 45 DAP

T2: Humic acid fertigation at 15, 30, & 45 DAP

T3: Humic acid through granules – Basal application

T4: Humic acid foliar spray at 15, 30, & 45 DAP + Humic acid through granules – Basal application

T5: Humic acid fertigation at 15, 30, & 45 DAP + Humic acid through granules – Basal application

T6: Control

Fig. 7.5: Effect of humic acid application on yield of *kharif* onion.

Among the various treatments, drip fertigation of humic acid @ 0.75 - 1.25 kg/ha improved the growth and yield components of onion var Bhima Super during *kharif* season. Overall, higher marketable bulb (18.6t/ha) yield was recorded in drip fertigation of humic acid at 15, 30 and 45 days after transplanting (Fig 7.5). However, no significant difference was observed among treatments.

Project: Mechanization in onion and garlic

Direct seeding in onion

The onion seed drill developed locally and tested at DOGR reveals that indigenous manually operated seed drills do not help in labour saving and also precision particularly depth of sowing and proper spacing are not satisfactory. To overcome these problems, CIAE, Bhopal has imported the pneumatic seed drill machine from Italy. This versatile and multipurpose machine can be fitted with as many seeding units as needed to meet the specific requirements of the farmers and equipped with everything necessary to handle all the different types of vegetable seed. With this background, direct sowing experiment was conducted at DOGR, Rajgurunagar during the *kharif* as well as *rabi* seasons with the varieties Bhima Super and Bhima Kiran. To study the effect different direct sowing methods in onion production, imported pneumatic seed drill has been compared with local seed drill and manual sowing (broadcasting) along with farmers transplanting method.

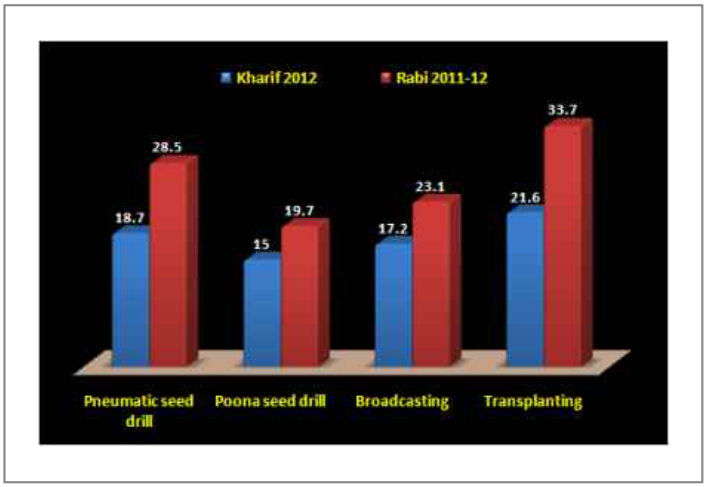


Fig. 7.6: Effect of direct seeding methods on marketable yield of onion

Among various direct sowing methods, bigger bulbs, more percent of A grade bulbs and less number of double bulbs were observed in method using pneumatic seed drill. However, transplanting method of onion production recorded the highest marketable yield followed by pneumatic seed drill and these registered relatively higher marketable bulb yield than other methods of sowing(Fig 7.6). Reduction in bulb yield in pneumatic seed drilled plots may be due lower population and crop stand at initial stage. However, low seed rate, easy sowing, saving in time and early maturity of onion were observed in pneumatic seed drill machine. The lowest marketable yield was observed in Poona seed drill followed by manual sowing (broadcasting) method.


Pneumatic seed drill


Broadcasting


Poona seed drill

Fig. 7.7: Different methods of direct seed sowing in onion

Crop Protection

Insect pest and diseases have significant impact on yield of onion and garlic. The main aim of crop protection section is to evolve strategies for eco-friendly management of these yield limiting pests and diseases. To achieve this endeavor, our efforts are focused on exploration of sources of resistance, work out seasonal dynamics of pest and diseases, development of IPM/IDM modules and development of diagnostics for viral pathogens.

Programme 9: Integrated Pest Management in Onion and Garlic

The main purpose of this experiment is to monitor the population of thrips round the year. During the year, two peaks of thrips population were observed, first appeared in the month of August and second in the month of February. Highest population of thrips was recorded in the month of February. Average nymph population was 90 thrips/plant. Thrips population started declining from the month of March. There were considerable variation in the marketable yields. In *rabi*, planting on 1-December recorded the highest yield (40.97 t/ha) despite of recording high number of thrips population.

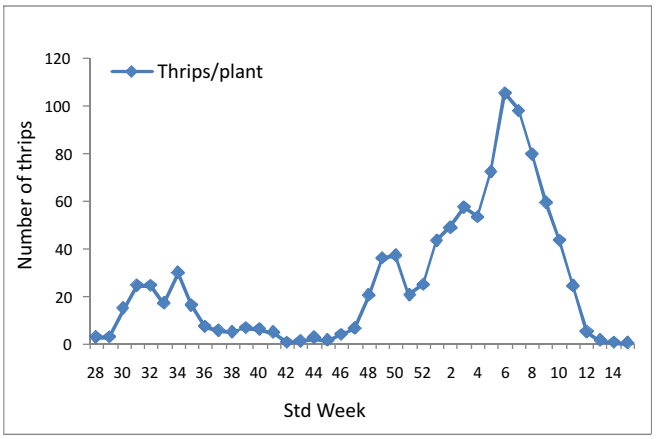


Fig. 9.1: Seasonal incidence of onion thrips at Rajgurunagar

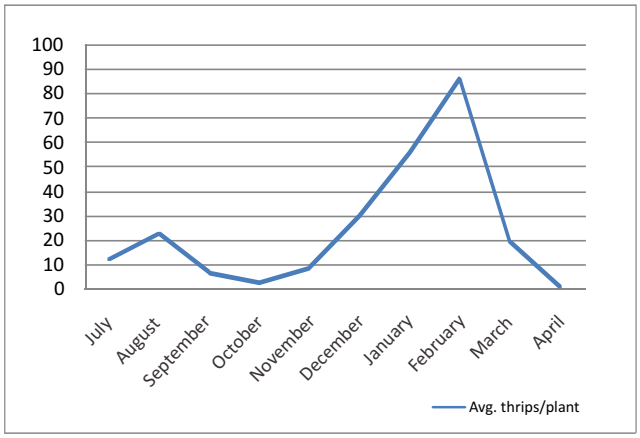


Fig. 9.2: Month wise incidence of onion thrips at Rajgurunagar

Screening of white onion germplasm against thrips under field condition during *rabi*

Thirty-nine white onion germplasm lines were screened against thrips under field conditions. Line W-416 showed field tolerance to thrips. Remaining 32 lines were moderately resistant and 6 lines were susceptible.

Table 9.1: Scoring of thrips on white germplasm during *rabi*

No of thrips / plant	Rating	Germplasm line
Up to1	Highly resistant	Nil
1.1-2	Resistant (1 line)	W-416(1.00)
2.1-3.0	Moderately resistant (32 lines)	W-081(1.35),W-097(1.35),W-138(2.00),W-146(1.80),W-147(1.25), W-151(1.30),W-153(1.20),W-182(1.10),W-199(1.50),W-217(2.00), W-226(1.45)W-227(1.85),W-236(1.40), W-253(1.60),W-329(1.40), W-356(1.55),W-399(1.50),W-410(1.85), W-428(1.25),W-429(1.80), W-104(1.65),W-149(1.85),W-150(1.70),W-176(1.60),W-210(1.90), W-237(1.90), W-244(1.90),W-255(1.45),W-282(1.70),W-400(1.35), W-438(1.40),N-2-4-1(1.05)
3.1-4.0	Susceptible (6 lines)	W-221(2.40), W-249(2.10), W-267(2.40),W-290(2.40), W-102(2.30), W-224(2.35)
4.1-5.0	Highly susceptible	Nil

Screening of wild germplasm of onion under controlled conditions

To locate the resistance sources against thrips in onion, selections from *A. fistulosum*, *A. ampeloprasum* and cultivated varieties N-2-4-1 and Bhima super were screened against thrips (*Thrips tabaci)* under polyhouse conditions. Accessions of wild germplasm *A. ampeloprasum* showed resistance *i.e.,* no thrips with no leaf damage rating. Whereas, *A.fistulosum* accessions showed a maximum of 15 thrips/plant with 2.17 leaf damage rating. The highest thrips, 35.67/plant with 7.58 leaf damage rating was observed in cultivated check line N-2-4-1 followed by Bhima Super with 19.06 thrips/plant with 4.43 leaf damage rating.

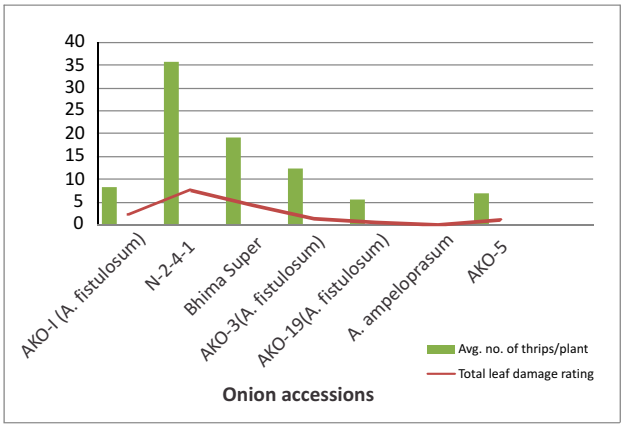


Fig. 9.3: Incidence of *Thrips tabaci* on onion germplasm

Programme 10: Geospatical Pathogenic and Molecular Characterisation of Fungal Diseases in Onion and Garlic- Detection, Management and Risk Analysis

Management of *Colletotrichum gloeosporioides* causing Anthracnose in onion

In order to control *Colletotrichum gloeosporioides*, a combination of soil, seed and foliar spray schedule was followed for control of Anthracnose during *Kharif*. The soil treatments were Metam sodium 14ml/sq m. Basamid 50g/ sqm and Suzone 14ml/sqm, seed treatments were Thiram 5g/kg, Benomyl, 5g/kg and

Captan 5g/kg and spray schedule included 5 contact fungicides: Benomyl 50%, Mancozeb 75%, Fluopyram+ Tebuconazole, Natio 75 WP, Anthracol 70 WP. These were tested in two agronomic practices viz. flat and raised bed planting. Observations were recorded on 10 plants in each replication at 15 days interval till 75 days after transplanting. Seed treatment with Thiram @ 5g/kg of seed, nursery soil treatment with fumigation of Suzone (Na_2CS_4)@ 14ml/sqm in raised bed with foliar spray of Fluopyram+ Tebuconazole @ 2ml/L could achieve 65% control over 90 and 80% of disease incidence in check with DM-45, respectively.

Assessment of indigenous Garlic germplasm for resistance to fungal diseases:

An indigenous garlic genotype Ranibennur local collected from Ranibennur area of Karnataka, was screened for resistance to fungal disease during *rabi* and *kharif* seasons of 2011-12 and 2012-13. This genotype was found moderately susceptible to fungal diseases viz. *Stemphylium* blight and Purple blotch. Genotype was found to mature early in 95 days during both *rabi* and *kharif* seasons.

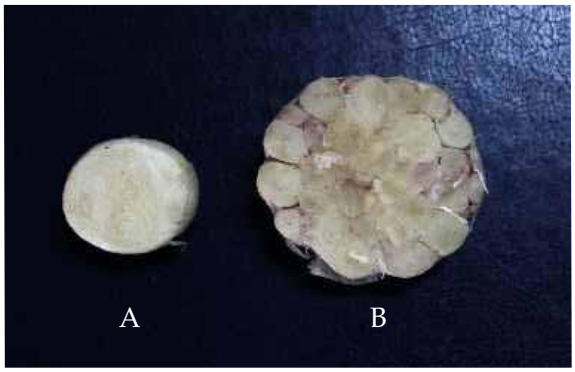


Fig. 10.1: Cross section garlic germplasm Ranibennur (B) local indicating early maturity compared to check variety G-41 (A)

Fig. 10.2: Early maturing garlic germplasm Ranibennur local (B) along with check variety G-41 (A)

Experiment for alternate hosts

A cropping experiment on fixed sick plot for pink root disease to find non hosts as alternate crop was initiated at Rajgurunagar during *Kharif* 2009. The components of *Kharif* cropping sequence were T-1 Soybean, T-2 Groundnut, T-3 Mungbean, T-4 Bajra, T-5 Cabbage, T-6 Sorghum and T-7 Radish. The plants were pulled out at 10 days old seedling stage to flowering stage for assessing pink root infestation. The infection was assessed using 1-10 scale. The control showed 86-93% infection. Soybean (56.6) and Wheat (97.0) showed higher percent of infection compared to Bajra (33.3). Radish and cabbage did not show any infection. The roots were assayed on water agar incorporated with wheat straw for expression of pink coloration. None of the samples from radish and cabbage yielded any positive reaction at any stage of crop growth. Three years data revealed that there is significant decrease in soil potential when cruciferous non hosts are grown.

Spray scheduling for management of onion foliar diseases

In order to arrest the possible development of resistance to foliar fungal pathogens in onion and garlic, an experiment was designed combining spray schedule involving broad spectrum systemic and contact fungicides in alternate fashion during peak disease period i.e. 30-60DAT. Treatment T4, involving first spray of Mancozeb (0.25%) + Methomyl (0.8g/L) at 30 DAT, Tricyclazole (0.1%) + Carbosulphan (2ml/L) at 45 DAT and Hexaconazole (0.1%) + Profenophos (1ml/L) at 60 DAT were found effective for the management of *Stemphylium* Blight and Purple Blotch.

Table 10.1: Details of spray schedule experiment for the management of fungal diseases of onion

Treatment	First spray (30 DAT)	Second spray (45 DAT)	Third spray (60 DAT)
T1	Mancozeb 0.25%	Propiconazole 0.1%	Copper oxychloride 0.25%
T2	Mancozeb 0.25%	Tricyclazole 0.1%	Hexaconazole 0.1%
T3	Mancozeb 0.25% Methomyl 0.8g/L	Propiconazole 0.1% Carbosulfan 2ml/L	Copper oxychloride 0.25% Profenofos 1ml/L
T4	Mancozeb 0.25% Methomyl 0.8g/L	Tricyclazole 0.1% Carbosulfan 2ml/L	Hexaconazole 0.1% Profenofos 1ml/L
T5	Untreated check	----	----
T6	Methomyl 0.8g/L	Carbosulfan 2ml/L	Profenofos 1ml/L

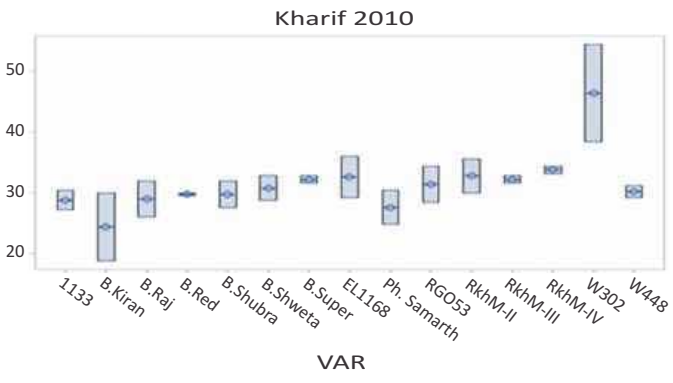
Table 10.2: Effect of spray schedule on the management of fungal diseases of onion

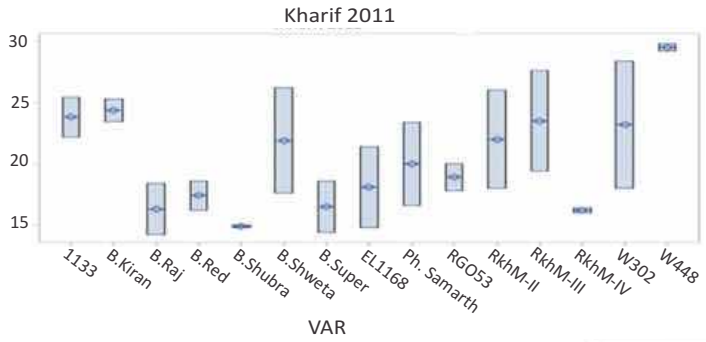
Treatment	Per cent Disease Index			Yield	
	SLB	PB	An	MY(ton/ha)	TY(ton/ha)
T1	7.00	0.42	2.58	12.69	12.69
T2	7.50	0.25	1.92	17.29	17.29
T3	5.58	1.92	2.25	28.63	28.71
T4	5.08	2.08	0.83	34.69	34.77
T5	10.83	0.00	3.17	8.40	8.44
T6	6.58	1.75	3.58	24.58	24.58
S.E.D.	0.60	0.86	1.22	4.30	4.29
C.D.	1.28	1.84	2.61	9.17	9.15
C.V.	11.96	114.17	72.37	28.86	28.84

Where; SLB – Stemphylium Blight, PB – Purple blotch, An – Anthracnose/ Twister, MY – Marketable yield and TY – Total yield.

Screening of genotypes for resistance to Anthracnose

For locating sources of resistance against *Collitotrichum gleosporoides*, causing Anthracnose / Twister disease of onion, 15 genotypes were screened during *kharif* season of 2010, 2011 and 2012. Bhima Raj consistently recorded lowest PDI value for Anthracnose, whereas genotype W-302 recorded high degree of susceptibility (Fig.10.3).





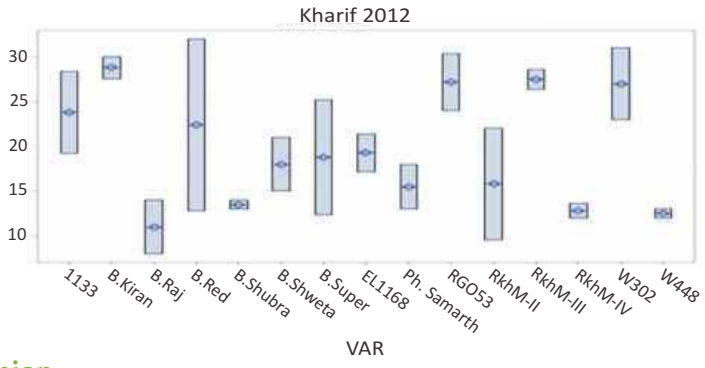


Fig. 10.3: Response of onion genotypes to Anthracnose infection in *Kharif* season of 2010, 2011 and 2012. Figures in Y axis indicates disease incidence in terms of PDI value.

Seasonal incidence of major foliar diseases in onion

Effect of planting dates on seasonal variation of foliar diseases *viz; Stemphylium* blight, Purple blotch and Anthracnose were studied by planting onion on 15 different dates starting from 15th June 2011 to 15th Jan 2012 at 15 days intervals. The highest incidence of *Stemphylium* blight was observed in 15th November planted crop, Purple blotch was found at its highest level in 15th September planted crop and the highest incidence of Anthracnose was recorded in 15th June planted crop. The highest yield was recorded in 15th September planted crop under unprotected condition. Peak incidence of Anthracnose was observed during 15th August to 15th September. Further, peak incidence of *Stemphylium* Blight was observed during 15th March to 15th April. Low level of incidence throughout the year was observed in case of Purple Blotch (Fig.10.4).

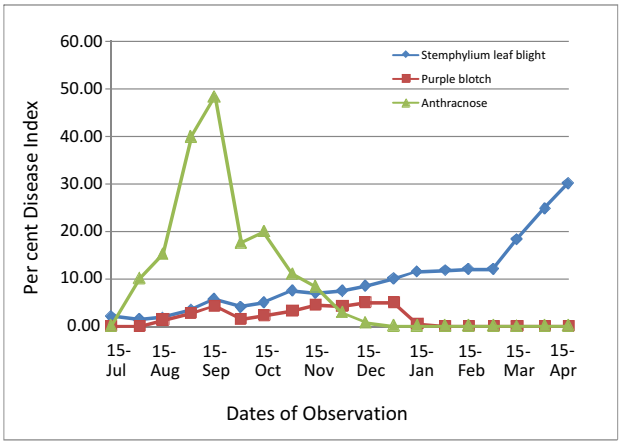


Fig. 10.4: Seasonal incidence of three major diseases viz. *Stemphylium* Blight, Purple Blotch and Anthracnose

Development of Reverse Transcription Polymerase Chain Reaction (RT-PCR) based detection protocol for *Garlic common latent virus* (GCLV)

GCLV is one of the major carlavirus known for its degenerative effect on yield of garlic. To develop detection methodology for GCLV, RT-PCR based detection protocol has been standardized by using degenerate primers flanking its coat protein (CP) gene. A full length CP gene amplicon of

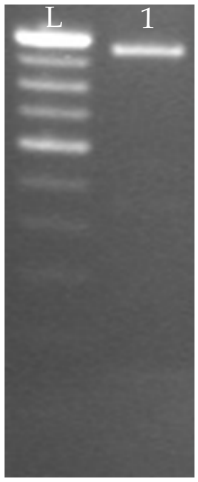


Fig. 10.5: Electropherogram of GCLV-CP gene; Lane L: 100bp DNA ladder, lane 1: 960bp CP gene amplicon

about 960bp was obtained through this protocol (Fig 10.5). Further to confirm specificity of amplicon, amplified CP gene was sequenced on ABI platform. A sequence of 960bp CP gene was obtained and sequence further was submitted in NCBI GenBank. This protocol was further validated by testing field samples of garlic.

Expression of *Iris yellow spot virus* (IYSV)-N gene for recombinant antigen production.

N gene of IYSV has been characterized for recombinant antigen production for the preparation of indigenous ELISA kits. Further, primers for expression were designed as per strategy of expression vector. N-gene amplicon of 820bp was obtained (Fig. 10.6). The work on cloning of IYSV N-gene in expression vector is under progress.

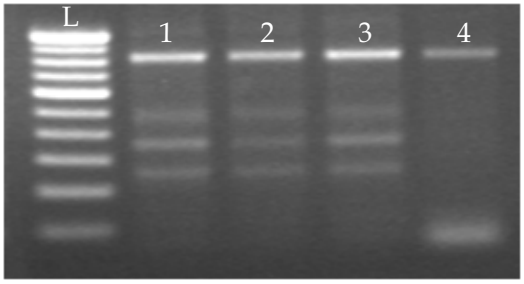


Fig. 10.6: Electropherogram of IYSV-N gene amplified under different temperature gradient; Lane L: 100bp DNA ladder, lane 1-4: 820 bp CP gene amplicon

Incidence of GCLV on wild and under-utilized Alliums.

Out of a total 22 accessions of wild and under-utilized alliums tested through RT-PCR for natural incidence of GCLV, 9 accessions were found positive for the virus (Fig 10.7).

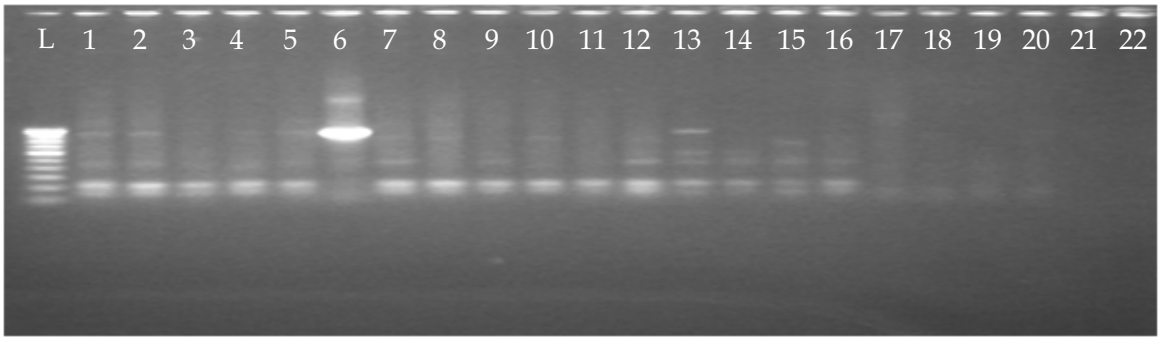


Fig. 10.7: Electropherogram of GCLV-CP gene amplicon from different wild accessions; Lane L: 100bp DNA ladder, lane 1-22: 960bp CP gene amplicon

Seed Technology

Quality seed production is the pre-requisite for better productivity. Seed technology section aims at developing techniques for quality seed production and also developing novel methods for increased seed production.

Project 11: Refinement of Seed Production Technology in Onion and Garlic

11.1 Breeder seed production in onion

Vernalization studies in onion for seed production

Vernalisation is exposure of meristem to low temperatures either in natural conditions or in artificial cold treatment that induces flowering. Onions being a biannual crop, bulbs are stored for different periods before planting in *rabi* for seed production. After planting due to prevailing low temperatures in the month of November-January bulbs undergo vernalization where in differentiation of vegetative bud to floral bud takes place. Seed bulbs of onion variety Bhima Kiran and Bhima Super were exposed to three different temperatures (0, 5 and 10^{0}C) for 10, 20, 30 or 40 days durations with two levels of GA3 (500 and 1000 ppm) to study its effect on reproductive and vegetative growth.

Vernalization treatment significantly enhanced the number of scapes and days to first scape emergence in both the varieties. The treatment T9 (10 ^{0}C for 10 days) and T7 (0 ^{0}C for 10 days) significantly enhanced the number of scapes in variety Bhima Kiran and Bhima Super respectively (Fig 11.1).

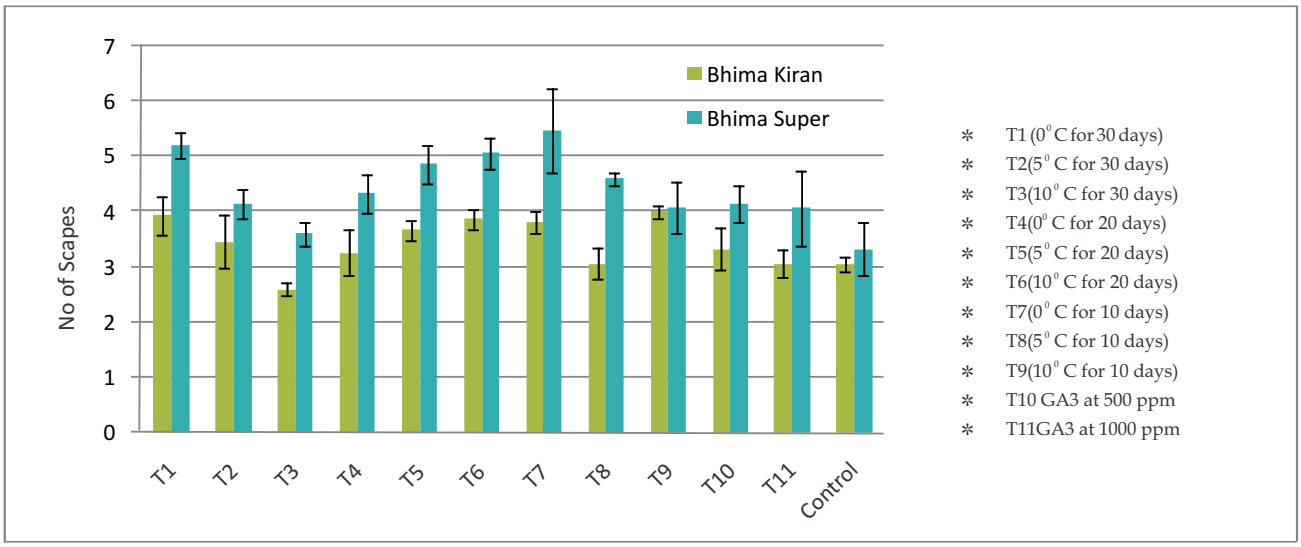


Fig. 11.1: Effect of vernalization treatment on number of scapes per plant

The vernalization treatment resulted in early scape initiation. In variety Bhima Kiran days to first scape emergence was the lowest (34.83) in treatment T9 (10 ^{0}C for 10 days), which was 11.64 days earlier over control and in case of variety Bhima Super days to first scape emergence was the lowest (37.94) in treatment

T1 (0 °C for 30 days), which was 6.44 days earlier than control (Fig 11.2 and 11.3). GA3 which is known to break dormancy and aid vernalization did not show any beneficial effect and the treated plants remained stunted and chlorotic indicating the toxic effect possibly due to high dosage.

Fig. 11.2: Effect of vernalization treatment on days to first scape emergence

Fig. 11.3: Effect of vernalization treatment on plant growth

The vegetative traits like plant height (Fig.11.3) and dry weight were significantly higher in control than in vernalized plants. Similar results were found in the previous year that the untreated plants accumulated more vegetative biomass as compared to the treated plants. The highest seed yield in variety Bhima Kiran and Bhima Super was recorded in treatment T2 (5 °C for 40 days) and T9 (10 °C for 10 days), respectively (Fig.11.4).

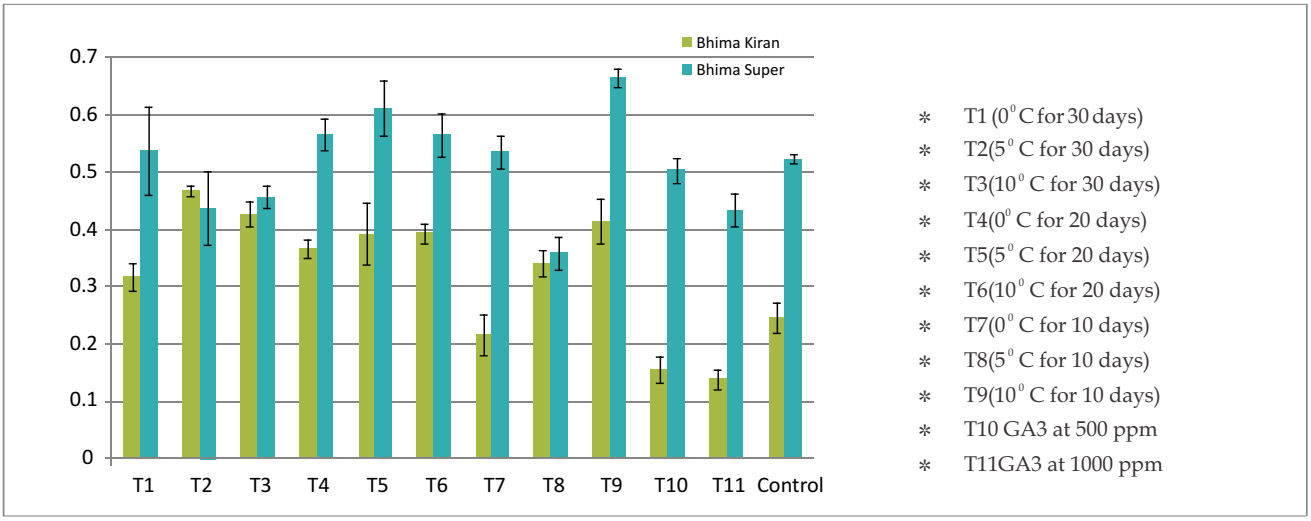


Fig.11.4: Effect of vernalization on seed yield per plot

Project 11.2: Breeder seed production in garlic

a. Standardization of protocol for development of microbulbils *in vitro* and establishment

The meristems (0.1 – 0.3 mm size) were excised aseptically and inoculated on the basal medium B5 fortified with different combinations of phytohormones (Table 11.1) and 3% sucrose in petriplates. The fortification of basal medium by phytohormones increased the response from 70% to 100%.

Table 11.1: Effect of phytohormones on *in vitro* shoot proliferation through meristems in garlic

Treatment	Days for proliferation		No of shoots/ explant	
	B. Omkar	B. Purple	B. Omkar	B. Purple
Basal medium (B5) without hormones	9-10	8-9	2-3	3-5
B5+ 0.1 NAA (mg/l)+ 1 Kin (mg/l)	6-8	6-7	2-3	3-5
B5+0.1 NAA(mg/l) + 1 BAP (mg/l)	6-8	6-7	2-3	3-5
B5+0.5 NAA (mg/l)+ 1 Kin (mg/l)	6-8	6-7	3-6	3-7
B5+0.5 NAA(mg/l) + 1 BAP (mg/l)	6-8	6-7	3-6	3-7

The proliferated meristems were subcultured on B5 medium devoid of growth hormones in test tubes. The plantlets of 50 – 56 days were shifted to the same medium with 6% sucrose concentration for *in vitro* bulbil development. The bulbils developed after 10 – 15 days of subculturing along with roots. The plantlets with bulbils and roots were subcultured twice after 25-28 days and matured and dried bulbils were harvested. The harvested bulbils were planted either directly or by giving a cold treatment for 10 days. The data on percent germination and days to complete germination were recorded (Table 11.2). The cold treatment of bulbils before planting was found to increase the germination and reduced the period required for complete germination than the control. No mortality was observed in germinated seedlings.

In vitro induction of micro-bulbils

Hardening of germinated bulbils

In vitro raised mericlones

Harvested micro-bulbils

Fig. 11.5: *In vitro* production of microbulbils in garlic

Table 11.2: Effect of cold treatment on germination of *in vitro* produced microbulbils of garlic

Variety	No. Bulbils	Germination %		Duration to complete Germination	
		Control	Cold treatment	Control	Cold treatment
G-41	56	50	81	87 days	33 days
B. Omkar	62	52	79	89 days	39 days
B. Purple	72	49	86	79 days	24 days

b. Standardization of protocol for micropropagation of garlic through root tip explant

The root tip explant (2-3 mm) was used to standardize the micropropagation protocol. Different phytohormone compositions of BAP and NAA were used with B5 basal medium (Table 11.3). The explants did not respond to basal medium devoid of phytohormones. In general the explants responded in about 5-7 days after inoculation. Compact and yellowish callus development was observed in some cultures which, after about seven days turned green (Fig 11.6). The highest frequency of direct shooting from explants was recorded in B5 + 0.5 mg/l NAA + 1 mg/l BAP.

Table 11.3: Micropropagation in garlic using rot tip as explant

Treatment (mg/l)	Direct shoot proliferation (%)	Callus induction (%)
B5 + 0.5 NAA (mg/l)+ 0.5 BAP (mg/l)	9	53
B5 + 0.5 NAA (mg/l)+ 1.0 BAP (mg/l)	48	39
B5 + 1.0 NAA (mg/l)+ 0.5 BAP (mg/l)	37	52
B5 + 1.0 NAA (mg/l)+ 1.0 BAP (mg/l)	33	54

Fig. 11.6: Callus induction in root tip explants

Postharvest Technology

Postharvest losses are a matter of major concern as it reduces the total availability of produce, if not attended properly. The physiological weight loss during storage, sprouting and microbial decay are major threats in the postharvest management of onion and garlic. These maladies could be managed either by preharvest applications or postharvest management practices. The present attempt aims to evaluate both the options for evaluation.

Project 12: Reduction of Postharvest Losses in Onion and Garlic

i. Preharvest application of phytochemicals in *rabi* crop:

As the meristem is deep seated in onion, application of phytochemicals after harvest may not reach meristem to effectively suppress sprouting. Thus experiments were designed for preharvest application of chemicals for suppression of meristem growth during storage. Two varieties viz. Bhima Kiran and B. Shakti were grown in a field layout of RBD. The preharvest application of 1 % and 1.5 % isopropyl N-(3-chlorophenyl) carbamate (CIPC) and 0.25 and 0.5% of $CoCl_2$ was done in *rabi* crop after 90 and 105 days after planting (DAP). The produce was harvested 120 DAP. The physical parameters viz. physiological weight loss, sprouting and microbial decay were recorded for 60 and 120 days of storage to assess the postharvest storage losses. The biochemical parameters were analyzed to assess the quality attributes and identify the markers for storability.

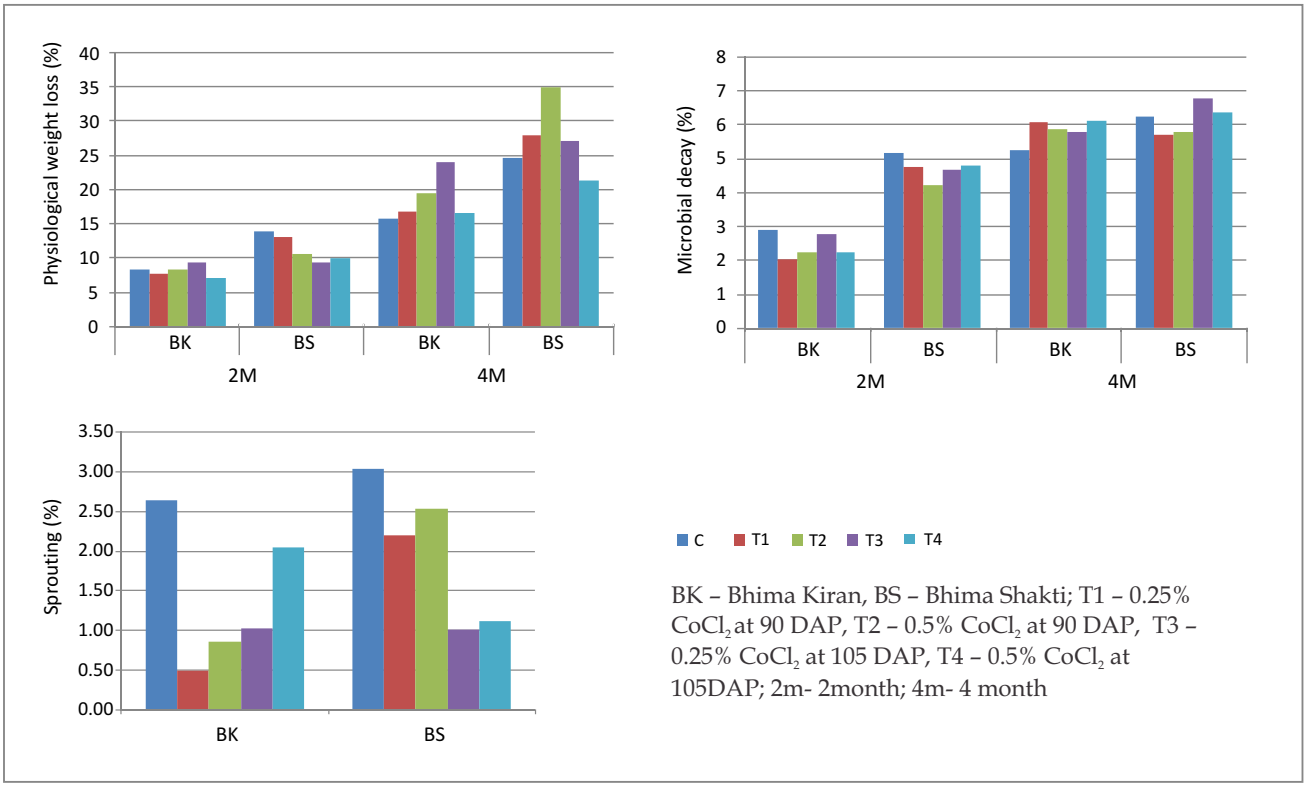
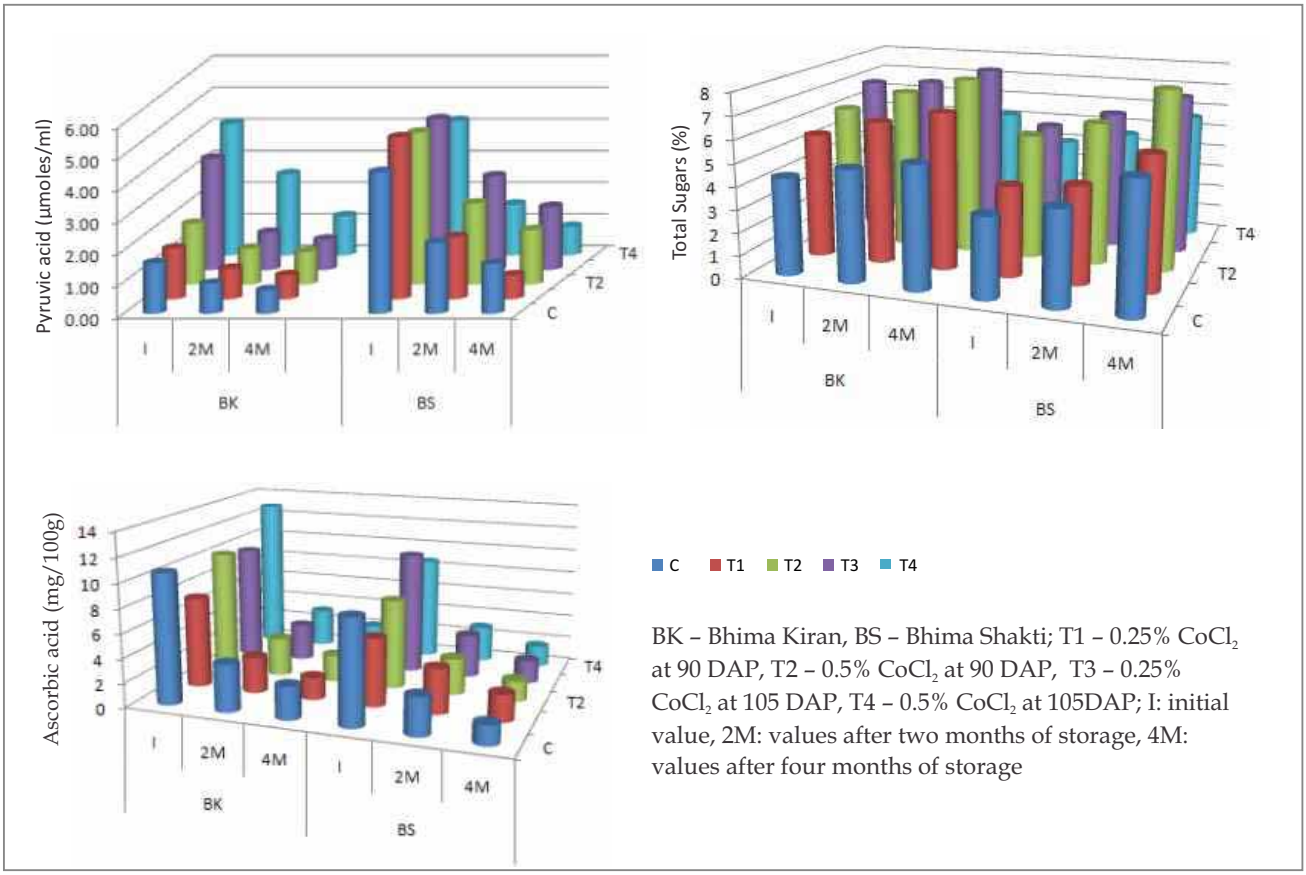


Fig. 12.1a: Effect of $CoCl_2$ on physiological parameters of onion

Results revealed that the physiological weight loss and microbial decay increased over the period of storage and could not be altered by any of the treatment. B. Kiran was found to be better storer than B. Shakti. The sprouting was initiated only after two months of storage in both the varieties. Though, sprouting was found to be arrested by $CoCl_2$ (Fig. 12.1a), in both the varieties, CIPC was found ineffective. During storage, pyruvic acid, an indicator of pungency and total sugars reduced while ascorbic acid increased. Irrespective of treatments the varietal difference was apparent in all biochemical parameters (Fig.12.1b).

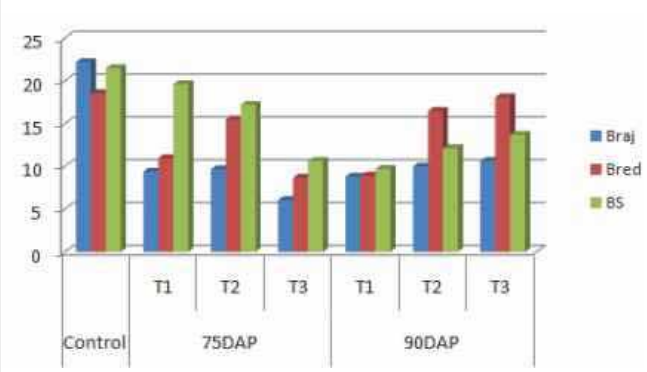


BK – Bhima Kiran, BS – Bhima Shakti; T1 – 0.25% $CoCl_2$ at 90 DAP, T2 – 0.5% $CoCl_2$ at 90 DAP, T3 – 0.25% $CoCl_2$ at 105 DAP, T4 – 0.5% $CoCl_2$ at 105DAP; I: initial value, 2M: values after two months of storage, 4M: values after four months of storage

Fig. 12.1b: Effect of $CoCl_2$ on biochemical parameters of onion

ii. Preharvest application of phytochemicals in *kharif* crop

The preharvest application of CIPC (1.0, 1.5 and 2.0%) was carried out during *kharif* 2012 on three varieties viz. B. Super, B. Raj and B. Red. The spaying was done at 75 and 90 DAP and data were recorded for physical and biochemical parameters after 60 days of storage. The results showed that physiological weight loss and microbial degradation could not be altered due to application of CIPC. However, sprouting was restricted. The varieties showed differential response to the treatments (Fig.12.3). The highest reduction was in B. Red upon spraying of CIPC 2% at 75



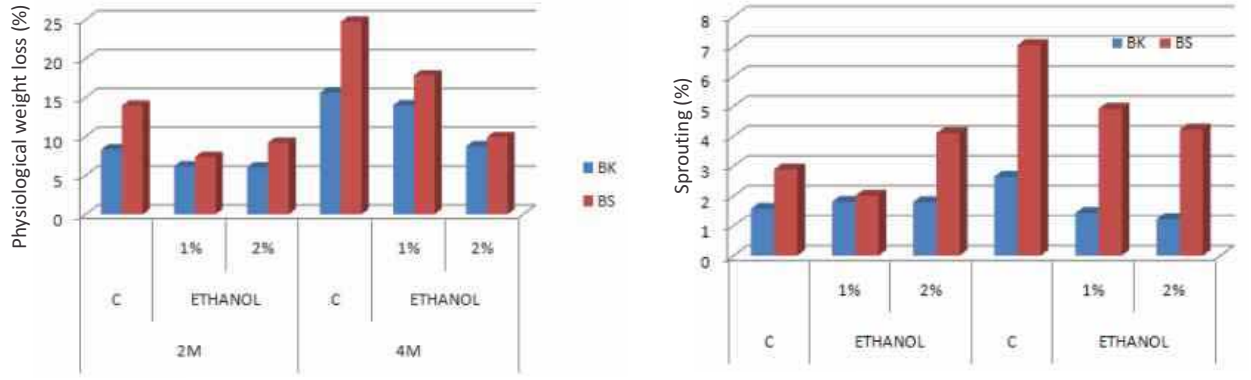
Braj – Bhima Raj, Bred – B. Red, BS – B. Super; T1 – CIPC 1%, T2 – CIPC 1.5%, T1 – CIPC 2%

Fig. 12.3: Effect of CIPC as preharvest application on sprouting of onion varieties

DAP. In B. Super, the application of CIPC 1% at 90 DAP was also found equally effective as CIPC 2%. Application of CIPC 1% at 90 DAP was better than control.

iii. Postharvest application of phytochemicals on *rabi* crop produce

To assess the effectiveness of phytochemicals for suppression of sprouting during storage, post harvest application of chemicals were tried on *rabi* crop produce. The postharvest trials were conducted with ethephon and ethanol (1 and 2%) on varieties B. Shakti and B. Kiran. The physical parameters viz. physiological weight loss and sprouting were noted for 60 and 120 days of storage to assess the postharvest storage losses. The biochemical parameters were analyzed to assess the quality attributes and identify the markers for storability. The sprouting was initiated only after two months of storage in both the varieties. The treatment of ethanol (2%) was found superior to reduce postharvest losses in terms of physical parameters up to four months (Fig.12.2). Ethephon was found effective only up to two months; however, after two months the losses were observed to be very high.



BK – Bhima Kiran, BS – Bhima Shakti

Fig.12.2 : Effect of ethanol on physiological parameters of onion

Extension

The extension programmes were undertaken to assess the need of stakeholders, disseminate the improved technologies developed by the Directorate and evaluate the impact of disseminated technologies.

Programme 13: Extension and Impact Studies of Onion and Garlic Technologies

Diffusion of onion seed of DOGR

DOGR developed different red onion varieties *viz*.; Bhima Super, B. Raj, B. Red, B. Kiran and B. Shakti for farmers to improve their yield and level of income. During 2012, total of 177 farmers from different villages purchased 518.34 kg onion seed of these varieties produced by DOGR. The variety Bhima Super was purchased by majority of the farmers (36.72%) while Bhima Red was purchased by only 12.99% farmers. Seed sale was the highest for Bhima Shakti (157.32 kg, 30.35%) followed by Bhima Super (140.74 kg, 27.15%) and Bhima Kiran (138.81 kg, 26.78%). Among five onion varieties, the lowest purchase was of Bhima Raj (36.27 kg, 7%).

In total, 23 private companies from different regions purchased 133.5 kg onion seed of varieties produced by DOGR. The variety Bhima Super was purchased by majority (78.26%) of the companies while varieties, Bhima Kiran and Bhima Raj were purchased by only 34.78% companies. It was found that the seed quantity of Bhima Super purchased by companies was the highest (57.10 kg i.e. 42.77%). The lowest purchase was of Bhima Raj (15.10 kg, 11.31%). Also, 1981 kg bulbs of Bhima Super, 800 kg bulbs of Bhima Shakti and 500 kg bulbs of Bhima Kiran were purchased by various companies for further seed production.

Table 13.1: Purchase of onion seed of DOGR varieties by farmers

S No	Variety	Farmers purchased seed		Quantity (kg)	(%) Quantity
		Number	Percentage		
1	Bhima Super	65	36.72	140.74	27.15
2	Bhima Raj	25	14.12	36.27	7.00
3	Bhima Red	23	12.99	45.20	8.72
4	Bhima Kiran	28	15.81	138.81	26.78
5	Bhima Shakti	50	28.24	157.32	30.35
	Total			**518.34**	

Table 13.2: Purchase of onion seed of DOGR varieties by Companies

S No	Variety	Companies purchased seed		Quantity (kg)	(%) Quantity
		Number	Percentage		
1	Bhima Super	18	78.26	57.10	42.77
2	Bhima Raj	08	34.78	15.10	11.31
3	Bhima Red	12	52.17	24.10	18.05
4	Bhima Kiran	08	34.78	18.10	13.56
5	Bhima Shakti	10	43.47	19.10	14.31
	Total			**133.50**	

Frontline demonstrations

To demonstrate newly released crop production and protection technologies and its management practices in the farmers field under different agro-climatic regions and farming situations, three districts of Maharashtra *viz*., Sangli, Latur and Jalna were selected. Varieties *viz*., Bhima Super, Bhima Raj and Bhima Red were demonstrated in *kharif* season. For this purpose, 600 gm onion seed (200 gm of each variety) was provided by DOGR through KVKs of selected district. The seed of local varieties was from the farmers. In each district, two progressive farmers were selected.

Frontline demonstrations in Sangli district:

Two progressive farmers *viz*.; Shri. Kishor Jamdar and Shri. Vaibhav Mane were selected from villages- Vasumbe and Kawalpur, respectively for carrying out frontline demonstrations.

Date of sowing/transplanting : 04/07/2012 (Nursery), 05/09/2012 (transplanting)

Nursery: Raised beds of convenient size (1.5 m width x 4 m length x 15 cm height) were prepared. At the time of bed preparation, 1½ basket of FYM and 10 kg vermicompost were used. Seeds were sown on raised beds by line sowing method, distance between two lines was kept 8 cm, depth of sowing was 1-1½ cm and seeds were covered with fine soil and then watered to keep the bed moist by watering can.

Seed rate: 35 gm per bed (for nursery raising).

Treatments:

1) Before sowing, the beds were moistened by watering can and then sprayed with weedicide pendimethalin @ 2 ml/l.
2) Seeds were treated with carbendazim @ 0.3gm/100 gm of seed.
3) Seeds were mixed with sand and vermicompost, and then sown in line on bed.

Germination percentage: Bhima Super (95%), Bhima Raj (95%), Bhima Red (90%), N-53 (80%)

Good germination was found without any weed except Lavala and Harali. Drenching of carbendazim (2gm/l) and humic acid (3 gm/l) was done after 12 days to encourage the growth of seedlings. Foliar sprays of cypermethrin (15 ml/10 l) and carbendazim (25 gm/10 l) were undertaken alternately at 15 days interval up to transplanting.

Land preparation and transplanting

The field was prepared to fine tilth and one bullock cart FYM was added at the time of land preparation. Seedlings were transplanted on broad bed furrows of 1.2 m width, 15 cm height and 60 m length with drip irrigation. Before transplanting, the bed was wetted by drip irrigation and weedicide pendimethalin (2 ml/l) was sprayed. After uprooting of the seedlings, 1/3rd part of leaves was cut and the roots were washed by clean water and then seedlings were kept for an hour in 10 l water having 15 gm carbendazim. Transplanting was done 64 days after sowing (seedlings of 3-4 leaves, bulb of chick pea size with 10-15 cm height) in the main field at spacing of 15x10 cm.

Application of manures and fertilizers: One bullock cart of FYM was applied at the time of field preparation. NPK 19:19:19 (1 kg) was applied after 15 days of transplanting as1st top dressing and, NPK 00:52:34 and NPK 12:61:00 (3 kg each) were applied after 13 days of 1st top dressing by drip fertigation.

Irrigation: Inline dripper of 16 mm lateral with 40 cm distance between two drippers was used and discharge of 4 l/ hour was released. Drip irrigation was given for half an hour twice a day on daily basis. Irrigation was stopped before 20 days of harvesting.

Pest and disease: NIL

Harvesting: After more than 50-60% neck fall, harvesting was done 110 days after planting. The harvesting date was 26/12/2012. Bulbs of DOGR developed varieties were attractive red in color, round in shape; thin necked and only 2% double bulbs were found in DOGR varieties while 6% double bulbs were found in local variety.

Fig. 13.1: Observation pertaining to pests at Sangli district

Fig. 13.2: Measuring girth of cv. Bhima Red from demo plot at Sangli district

Table 13.3: Details of cultural practices of frontline demonstrations in Sangli district

Size of each plot **600 sq.m**	Spacing **15x10 cm**
Date of sowing/ transplanting	04/07/12 (sowing in nursery), 05/09/12 (transplanting)
Balanced dose of organic growth stimulant	
Basal dose-date	03/09/2012
Products	FYM
Quantity	2000 Kg/ha
1st top dress-date	21/09/2012
Product	19:19:19 NPK
Quantity	01 Kg/ha
2nd top dress-date	05/10/2012
Product	12:61:00, 00:52:34 NPK
Quantity	03, 03 Kg/ha
Date of harvesting	26/12/2012

Table 13.4: Performance of different varieties in frontline demonstrations in Sangli district

Variety	Avg bulb Girth (cm)	Weight of one fresh bulb (gm)	Marketable bulb yield q/ha
Bhima Super	9.33	93.53	484.42
Bhima Raj	8.43	87.40	468.62
Bhima Red	9.00	86.26	430.77
N-53 (local)	8.23	73.96	386.72

Frontline Demonstrations in Latur district:

Two progressive farmers *viz.*; Shri. Somnath Bhalekar and Shri. Prakash Kadam were selected from villages-Chincholi and Chiurda, respectively for carrying out frontline demonstrations.

Date of sowing/transplanting: 11/07/2012 (Nursery), 07/09/2012 (transplanting)

Nursery: Raised beds of 1m width x 50 m length x 15 cm height were prepared. At the time of bed preparation, 2 baskets of FYM and mixed fertilizers were used. Seeds were sown on raised beds and distance between two lines was kept 8 cm, depth of sowing was 1cm. Seeds were covered with fine soil and then watered by watering can to keep the bed moist.

Seed rate: 35 gm per bed (for raising nursery).

Treatments:

1) Before sowing seeds were treated with carbendazim @ 0.3 gm/100 gm of seed.
2) Before sowing the beds were sprayed with weedicide pendamethalin @ 2 ml/l.
3) Seeds were mixed with sand and sown by broadcasting method on bed with help of sieve.

Germination: Bhima Super (95%), Bhima Raj (95%), Bhima Red (90%), N-53 (75%). At nursery stage, Bhima Super, Bhima Raj and Bhima Red were found early in germination over check (N-53).

Good germination percentage of onion seedlings with low incidence of weed was observed. Drenching with carbendazim (2gm/l) and humic acid (3 gm/l) was done for better establishment of seedlings after 10 days. Foliar sprays of carbendazim (25 gm/10 l) were undertaken at 15 days interval up to transplanting.

Land preparation and transplanting: The field was prepared to fine tilth and one bullock cart of FYM was added at the time of land preparation. Seedlings were transplanted on broad bed furrows of 1.2 m width, 15cm height and 60 m length with drip irrigation. Transplanting was done after 58 days of sowing in main field at the spacing of 15x10 cm. Nursery bed was moistened by watering for easy uprooting the seedlings. After uprooting of the seedlings, 1/3rd part of leaves was cut and the roots were washed by clean water and then seedlings were dipped for 1 hour in 10 l water containing 15 gm carbendazim.

Application of manures and fertilizers: FYM of 1200 kg was applied as a basal dose. NPK 19:19:19 (1 kg) was applied after 16 days of transplanting as1st top dressing and, NPK 00:52:34 and NPK 12:61:00 (3 kg each) were applied after 14 days of 1st top dressing by drip fertigation.

Irrigation: Inline dripper of 16 mm lateral with 40 cm distance between two drippers was used and discharge of 4 l/ hour was released. Drip irrigation was given for half an hour twice a day on daily basis. Irrigation was stopped before 20 days of harvesting.

Pest and disease: NIL

Harvesting: After more than 30-40% neck fall, harvesting was done after 113 days of planting. The harvesting date was 28/12/2012. Double bulbs were 3% in N-53. No double bulbs or bolters were observed in DOGR varieties.

Table 13.5: Details of cultural practices of frontline demonstrations in Latur district

Size of each plot **600 sq.m**	Spacing **15x10 cm**
Date of sowing/ Planting	04/07/12 (nursery), 07/09/12 (Transplanting)
Balanced dose of organic growth stimulant	
Basal dose-date	05/09/2012
Products	FYM
Quantity	1200 Kg/ha
1st top dress-date	24/09/2012
Product	19:19:19 NPK
Quantity	01 Kg/ha
2nd top dress-date	09/10/2012
Product	12:61:00, 00:52:34
Quantity	03, 03 Kg/ha
Date of harvesting	28/12/2012

Table 13.6: Performance of different varieties in frontline demonstrations in Latur district

Variety	Avg bulb Girth (cm)	Weight of one fresh bulb (gm)	Marketable bulb yield q/ha
Bhima Super	9.10	92.16	480.58
Bhima Raj	8.40	86.31	432.41
Bhima Red	8.70	86.20	421.19
N-53 (local)	8.10	71.10	378.68

It was observed that the highest average bulb weight was in Bhima Super (93.53 gm in Sangli and 92.16gm in Latur). Average bulb girth was also found to be the highest in Bhima Super (9.33 cm in Sangli and 9.10 cm in Latur) in both the districts. The yield of Bhima Super (484.42 q/ha in Sangli and 480.58 q/ha in Latur) was the highest as compared to other varieties in both the districts. Bhima Raj (468.42 q/ha and 432.41 q/ha in Latur) and Bhima Red (430.77q/ha in Sangli and 421.19 q/ha in Latur) also yielded more than the local variety (386.72q/ha in Sangli and 378.68 q/ha in Latur).

Frontline demonstrations in Jalna district:

Two progressive farmers *viz*.; Shri. Uddhav Khedekar and Shri. Gautam Deshmukh were selected from villages-Shivani and Ranjani, respectively for carrying out frontline demonstrations.

Date of sowing in nursery: 10/07/2012

Nursery: Raised beds of convenient size (1.5 m width x 4 m length x 15 cm height) were prepared. At the time of bed preparation, 2 baskets of FYM and 10 kg vermicompost were added. Seeds were sown on raised beds by line sowing method, distance between two lines was kept 8 cm, depth of sowing was 1 cm and seeds were covered with fine soil and then watered to keep the bed moist by watering can.

Seed rate: 35 gm per bed.

Treatments:

1) Before sowing, the beds were moistened by watering can and then sprayed with weedicide pendimethalin @ 3 ml/l.
2) Seeds were treated with carbendazim @ 0.15 gm/100 gm seed.
3) Seeds were mixed with sand and vermicompost, and then sown in line on bed.

Germination percentage: Bhima Super (95%), Bhima Raj (90%), Bhima Red (85%), Local Red (70%)

Better germination was found in DOGR varieties in comparison to local variety. Drenching of carbendazim (3gm/l) and humic acid (3 gm/l) was done after 10 days to encourage the growth of seedlings. Foliar spray of cypermethrin (15 ml/10 l) was applied after 15 days. More than 80% mortality was observed due to damping off in all the varieties after 20 days of sowing. Carboxin (2gm/l) was applied to control damping off but was not able to control the disease. Demonstrations in Jalna district were abandoned due to non-availability of sufficient number of seedlings for transplanting.

Research Programmes and Projects at DOGR

(Concluded in September 2012)

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

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

Programme 3:	Improvement of garlic through conventional and biotechnological approaches
	A. Khar
Project 3.1	Collection, evaluation and maintenance of garlic germplasm
Project 3.2	Development of high yielding garlic varieties suitable for different production areas through clonal selection
Project 3.3	Studies on somaclonal variations in garlic
Project 3.4	Production of virus free garlic through *in vitro* meristem tip culture
Project 3.6	Molecular analysis of genetic diversity in garlic

Programme 4:	Onion improvement through biotechnological approaches
	S. Anandhan
Project 4.1	Induction of haploids in onion
Project 4.2	Micropropagation studies in onion
Project 4.3	DNA profiling of onion lines using molecular markers

Programme 5:	Collection, characterization and screening of wild species for *Allium* improvement
	A. Khar
Project 5.1	Screening of wild species for biotic stresses and introgression of desirable genes in *Allium cepa*

Programme 6:	Integrated nutrient management for onion and garlic
	A. Thangasamy
Project 6.4	Studies on nutrient deficiency symptoms in garlic
Project 6.5	Appraisal of nutrient requirement at different stages of onion and garlic
Project 6.6	Nutrient uptake studies in onion and garlic

Programme 7:	Enhancement of production of onion and garlic through agronomic innovations
	V. Sankar
Project 7.4	Studies on organic production of onion and garlic
Project 7.5	Weed management studies in onion and garlic
Project 7.6	Studies on foliar feeding of nutrients and growth regulators in onion and garlic

Programme 8:	Production technologies for seed crop
	V. Sankar
Project 8.2	Micro-irrigation and fertigation studies in onion seed crop

Programme 9:	Integrated pest management in onion and garlic
	B.R. Jayantimala
Project 9.1	Population dynamics of thrips in onion and garlic
Project 9.2	Bio-intensive pest management in onion and garlic
Project 9.3	Virus-vector relationship in onion and garlic

Programme 10:	Integrated disease management in onion and garlic
	C.R. Ramesh, S.J. Gawande
Project 10.1	Geospatial pathogenic and molecular characterization of fungal diseases in onion and garlic detection, management and risk analysis
Project 10.2	Management of soil borne diseases of onion and garlic
Project 10.3	Management of foliar diseases of onion and garlic
Project 10.4	Diagnostic of *Allium* viruses

Programme 11:	Reduction of postharvest losses in onion and garlic
	A.A. Murkute
Project 11.1	Studies on effect of preharvest practices on storage life of onion and garlic
Project 11.2	Studies on effect of postharvest practices on storage life of onion and garlic

Programme 12:	Seed quality management in onion and garlic
	Y.R. Vishwanath, V. Sankar
Project 12.1	Seed packing and storage studies
Project 12.2	Improvement of seed quality by invigoration
Project 12.3	Disease free seed production
Project 12.4	Studies on seed pelleting in onion
Project 12.5	Vernalisation studies in onion seed production
Project 12.6	Screening for onion varieties for seed longevities

Programme 13:	Socio-economic studies of onion and garlic growers
	S.S. Gadge
Project 13.1	Constraint analysis of onion and garlic production and post harvest technology management
Project 13.2	Collection, documentation and validation of Indigenous Technical Knowledge (ITK)s among onion and garlic farmers
Project 13.3	Impact analysis of different technologies generated and developed by DOGR for onion and garlic growers

Ongoing Research Projects at DOGR

(From October 2012)

Project 1:	**Management and enhancement of *Allium* germplasm**
	V. Mahajan, Anil Khar, A.J. Gupta, S. Anandhan, Ashwini A. Chavan, V. Sankar, A. Thangasamy, C.R. Ramesh, S.J. Gawande, B.R. Jayantimala, A.A. Murkute
Project 2:	**Breeding for improved onion varieties**
	V. Mahajan, A.J. Gupta, Ashwini A. Chavan, S.J. Gawande, B.R. Jayantimala
Project 3:	**Breeding for improved garlic varieties**
	Anil Khar, Ashwini A. Chavan, C.R. Ramesh, B.R. Jayantimala
Project 4:	**Development of parental lines and hybrids in onion**
	A.J. Gupta, V. Mahajan, S. Anandhan, Ashwini A. Chavan
Project 5:	**Marker assisted selection in onion**
	S. Anandhan, Anil Khar, A.A. Murkute, C.R. Ramesh, B.R. Jayantimala
Project 6:	**Integrated diseases management in onion and garlic**
	C.R. Ramesh, S. Anandhan
Project 7:	**Management and diagnostics of onion and garlic viral diseases**
	S.J. Gawande, S. Anandhan
Project 8:	**Integrated pest management in onion and garlic**
	B.R. Jayantimala, S.J. Gawande
Project 9:	**Development of improved production technology for onion and garlic**
	V. Sankar, A. Thangasamy, V. Mahajan, S.J. Gawande, B.R. Jayantimala
Project 10:	**Refinement of nutrient management technology for onion and garlic**
	A. Thangasamy, V. Sankar, S.J. Gawande, A.A. Murkute
Project 11:	**Refinement of seed production technology in onion and garlic**
	Y.R. Vishwanath, A.A. Murkute, S.J. Gawande, V. Sankar, A. Thangasamy, S. Anandhan

Project 12:	**Reduction of postharvest losses in onion and garlic**
	A.A. Murkute, C.R. Ramesh, S.J. Gawande, V. Sankar, A. Thangasamy

Project 13:	**Extension and impact studies of onion and garlic technologies.**
	S.S. Gadge, V. Sankar, A. Thangasamy, V. Mahajan, A.J. Gupta, Y.R. Vishwanath

Other Projects

Project 1	**All India Network Project for Onion and Garlic**
	V. Mahajan, Nodal Officer Funding: ICAR

Project 2	**DUS testing through ICAR-SAU's system**
	A.J. Gupta, Nodal officer Funding: PPV & FRA

Project 3	**Mega Seed Project "Seed production in agricultural crops and fisheries".**
	Y.R. Vishwanath, Nodal officer Funding: ICAR

Project 4	**Outreach Research Programme on sucking pests**
	B.R. Jayantimala, Nodal officer Funding: ICAR

Project 5	**Intellectual Property Management and Transfer/Commercialization of Agricultural Technology Scheme (IPMT-CATS), ICAR**
	Anil Khar, Member Secretary Funding: ICAR

Project 6	**Development of hybrids in onion: A joint venture**
	A.J. Gupta, PI Funding: Bejo Sheetal Seeds Pvt. Ltd. and DOGR

Publications

Papers in referred journals

1. Aslam M, Grover A, Sinha VB, Fakher B, Pande V, Yadav PV, Gupta SM, Anandhan S, Ahmed Z. 2012. Isolation and characterization of cold responsive NAC gene from *Lepidium latifolium*. *Mol Biol Rep*. (in press)

2. Bhoyar MS, Mishra GP, Naik PK, Murkute AA, Srivastava RB. 2012. Genetic variability studies among natural populations of *Capparis spinosa* from cold arid desert of trans-Himalayas using DNA markers. *National Acad. Sci. Lett.*, 35: 505-515.

3. Gopal J, Kumar V, Kumar R, Mathur P. 2013. Comparison of different approaches to establish a core collection of andigena (*Solanum tuberosum* Group *andigena*) potatoes. *Potato Research* (in press).

4. Gupta AJ, Verma TS, Bhat R, Mufti S. 2012. Studies on genetic variability and character association in temperate carrot. *Indian J. Hort.*, 69: 75-78.

5. Gupta N, Rathore M, Goyary D, Khare N, Anandhan S, Pande V, Ahmed Z. 2012. Marker-free transgenic cucumber expressing *Arabidopsis* CBF1 gene confers chilling stress tolerance. *Biologia Plantarum* 56: 57-63.

6. Kadian MS, Luthra SK, Patel NH, Bonierbale M, Singh SV, Sharma N, Kumar V, Gopal J, Singh BP. 2012. Identification of short cycle, heat-tolerant potato (*Solanum tuberosum*) clones for the semi-arid agro-ecology. *Indian J. Agr. Sci.*, 82: 814-818.

7. Khar A. 2012. Cross amplification of onion derived microsatellites and mining of garlic ESTdatabase for assessment of genetic diversity in garlic. *Acta Hort.*, 969: 289-295.

8. Kumar J, Mishra GP, Murkute AA, Phanikumar G, Naik PK, Srivastava RB. 2012. Exploring genetic relationships in *Artemisia* species growing in trans - Himalayan cold arid desert using RAPD markers. *Indian J. Hort.*, 69: 239-245.

9. Kumar R, Gopal J, Pandey SK. 2012. Genetic improvement for yield and tuber size in andigena potatoes (*Solanum tuberosum* subsp. *andigena*) after one cycle of recurrent selection. *Indian J. Agri. Sci.*, 82: 885-888.

10. Kumar SR, Anandhan S, Dhivya S, Zakwan A, Sathishkumar R. 2013. Isolation and characterization of cold inducible genes in carrot by suppression subtractive hybridization. *Biologia Plantarum* 57: 97-104.

11. Patil VU, Gopal J. Singh BP. 2012. Improvement for bacterial wilt resistance in potato by conventional and biotechnological approaches. *Agricultural Res.*, 1: 299-316.

12. Singh RK, Singh S, Pandey P, Anandhan S, Goyary D, Pande V, Ahmed Z. 2012. Construction of cold induced subtracted cDNA library from *Cicer microphyllum* and transcript characterization of identified novel wound induced gene. *Protoplasma*. (in press)

13. Tiwari J, Gopal J, Singh BP. 2012. Marker-assisted selection for virus resistance in potato: options and challenges. *Potato J.*, 39: 101-117.

14. Uchinoa H, Iwamaa K, Jitsuyamaa Y, Ichiyamma K, Sugiuraa E, Yodatea T, Nakamuraa S, Gopal J. 2012. Effect of interseeding cover crops and fertilization on weed suppression under an organic and rotational cropping system 1. Stability of weed suppression over years and main crops of potato, maize and soybean. *Field Crop Res.*, 127: 9-16.

15. Warghat AR, Bajpai PK, Murkute AA, Sood H, Chaurasia OP, Srivastava RB. 2012. Genetic diversity and population structure of *Dactylorhiza hatagirea* (Orchidaceae) in cold desert Ladakh region of India. *J. Medicinal Plants Res.*, 6: 2388-2395.

Papers in conference/symposia

1. Gorrepati K, Samuel DVK, Kar A, Jha SK, Sethi S, Parsad R, Singh B. 2012. Storage study of maize based extruded snack: effect of packaging material and water activity on quality parameters. 47th Annual Convention of ISAE and International Symposium on Bio-Energy - Challenges and Opportunities. Hyderabad. January 28-30, 2013.

2. Khar A, 2012. Cross Amplification of Onion Derived Microsatellites and Mining of Garlic EST Database for Assessment of Genetic Diversity in Garlic. 6th International Symposium on Edible Alliaceae held during May 21-24, 2012 at Fukuoka, Japan.

3. Khar A, Masaye S, Gopal J. 2012. Farmers Friendly Technologies in Horticulture- Directorate of Onion and Garlic Research. In: Souvenir of the Fifth Indian Horticulture Congress - 2012 -An International Meet on "Horticulture for Food and Nutritional Security", November 6-9, 2012, held at PAU, Ludhiana, New Delhi, pp. 112-116.

Book Chapters

Singh BK, Gupta AJ, Singh L. 2012. Improvement of faba bean (*Vicia faba* L.) *In:* Faba Bean (*Vicia faba* L.) A Potential Leguminous Crop of India (*Eds.* Singh AK and Singh BP). ICAR RC for Eastern Region, Patna. 119-141.

Singh L, Singh AK, Singh P, Gupta AJ, Kumar P, Dimree S. 2012. Nutritional management in faba bean (*Vicia faba* L.) *In:* Faba Bean (*Vicia faba* L.) A Potential Leguminous Crop of India (*Eds.* Singh AK and Singh BP). ICAR RC for Eastern Region, Patna. 227-247.

Yalamalle VR, Shankar V, Kuchlan MK. 2013. Performance of Mega Seed Project at Directorate of Onion and Garlic Research, Pune. In: ICAR Seed Project- Seed Production In Agricultural Crops And Fisheries A Way To Sustainable Quality Seed Supply In India (*Eds.* Prasad R, Somasundharam S, Vijaykumar G, Tonapi HP, Kamble VA, Natarajan S, Dandapani R, Mandal AK). pp. 132-133.

Technical bulletin/News letter

1. Mahajan V, Khar A, Gupta AJ, Gopal J. 2012. Onion and Garlic Varieties of DOGR, Technical Bulletin No. 20, Directorate of Onion and Garlic Research, Rajgurunagar, Pune, 9p.

2. Gupta AJ, Negi KS. 2012. Exploration and collection of *Allium* germplasm from Sikkim and West Bengal. *DOGR News.*, 16: 2-3.

3. Murkute AA. 2012. Evaluation of onion varieties in ambient storage. *DOGR News.*, 16: 2-3.

4. Anandhan S. 2012. Prospects in inbred development in onion (*A. cepa*) through induction of haploids. *DOGR News.*, 16: 2.

5. Jayantimala BR. 2012. *Ceranisus sp.* – A new parasitoid of onion thrips (*T. tabaci* L.). *DOGR News.*, 16: 2.

Popular Articles

1. Gadge SS, Khar A. 2012. *Chala Sudharit Tantradnyanane Karuya Lasanachi Sheti*. Agrowon. Pune. December 1, 2012:11.

2. Gadge SS, Khar A. 2012. *Olakh Lasun Pikavareel Keed Roganchi*. Agrowon. Pune. December 2, 2012: 7.

3. Mahajan V. 2012. *Tantra kharif kanda utpadanache*. Agrowon, June 25, 2012: 11.

4. Mahajan V. 2012. *Tantra kanda lagawadiche*. Agrowon, October 10, 2012: 13.

5. Mahajan V. 2013. *Khat vyavasthapan, peek sanrakshan kade laksh have*. Agrowon, January 22, 2013: 9 -13.

Transfer of Technology

Lectures delivered

Topic	Event and Organizer	Date and Venue
Jai Gopal		
Role of PPV & FR act	Training programme on PPV & FR organized by DOGR, Rajgurunagar and PPV & FRA, N. Delhi.	January 19, 2013 at DOGR, Rajgurunagar
Role of PPV & FR act	Training programme on PPV & FR organized by DOGR, Rajgurunagar, PPV & FRA, N. Delhi and KVK, Narayangaon	February 14, 2013 at KVK, Narayangaon
Advanced technologies in onion and garlic cultivation	Farmers field day organized by DOGR, Rajgurunagar and PDKV, Akola	February 26, 2013, at village Deoalgaon, Akola
V. Mahajan		
Onion production technology	Training on 'Scientific cultivation of onion and garlic' organized by DOGR, Rajgurunagar under ATMA scheme	June 4, 2012 at DOGR, Rajgurunagar
Varietal improvement in onion	Training on 'Scientific cultivation of onion and garlic' organized by DOGR, Rajgurunagar under ATMA scheme	June 5, 2012 at DOGR, Rajgurunagar
Processing and self employment through onion and garlic	Arts and Commerce College, Chakan	September 25, 2012 at Chakan.
Scientific cultivation of onion	*Kanda utpadan tantragyan- Shetakari melawa and shiwar feri* organized by MPKV, Rahuri and Maharashtra State Agril. Dept.	December 29, 2012 at village Bahirwadi
Process of benefit sharing, farmers' and researchers' right	Training programme on PPV & FR organized by DOGR, Rajgurunagar and PPV& FRA, N. Delhi.	January 19, 2013 at DOGR, Rajgurunagar
Process of benefit sharing, farmers' and researchers' right	Training programme on PPV & FR organized by DOGR, Rajgurunagar, PPV & FRA, N. Delhi and KVK, Narayangaon	February 14, 2013 at KVK, Narayangaon
Scientific cultivation of onion	Farmers field day organized by DOGR, Rajgurunagar and PDKV, Akola	February 26, 2013, at village Deoalgaon, Akola

Topic	Event and Organizer	Date and Venue
Anil Khar		
Cross Amplification of Onion Derived Microsatellites and Mining of Garlic EST database for Assessment of Genetic Diversity in Garlic	6th International Symposium on Edible Alliaceae (ISEA 2012), Japan	May 21-24, 2012 at Fukuoka, Japan
Garlic Production Technology	Training on 'Scientific cultivation of onion and garlic' organized by DOGR, Rajgurunagar under ATMA scheme	June 1 and 4, 2012 at DOGR, Rajgurunagar
Varietal trials - Garlic	All India Network Research Project on Onion and Garlic, IIIrd AINRPOG Group Meeting held at JAU, Junagadh, Gujarat	June 22-23, 2012 at JAU, Junagadh, Gujarat
Procedure for filling of application form for registration of farmers variety	Training cum awareness programme on "Protection of plant varieties and farmers rights" under DUS project conducted at DOGR, Pune	January 19, 2013 at DOGR, Rajgurunagar
A. J. Gupta		
Varietal improvement in onion	Training on 'Scientific cultivation of onion and garlic' organized by DOGR, Rajgurunagar under ATMA scheme	May 30, 2012 at DOGR, Rajgurunagar
Nutraceutical importance of onion and garlic	Training on 'Scientific cultivation of onion and garlic' organized by DOGR, Rajgurunagar under ATMA scheme	May 30, 2012 at DOGR, Rajgurunagar
Onion varieties developed by DOGR for *rabi* season	Farmers Training Programme, KVK, Narayangaon	October 31, 2012 at Dhamalemala, Pune
DUS characteristics and varietal details of onion and garlic	Training-cum-Awareness Programme on PPV & FR, organized by DOGR and PPV & FRA, New Delhi	January 19, 2013 at DOGR, Rajgurunagar and February 14, 2013 at KVK, Narayangaon
Recording of DUS data in onion and garlic varieties	Training-cum-Awareness Programme on PPV & FR, organized by DOGR and PPV & FRA, New Delhi	January 19, 2013 at DOGR, Rajgurunagar and February 14, 2013, KVK, Narayangaon
S.S. Gadge		
Role of Self Help Groups in improving socio-economic status of onion and garlic farmers	Training on 'Scientific cultivation of onion and garlic' organized by DOGR, Rajgurunagar under ATMA scheme	May 31 and June 4, 2012 at DOGR, Rajgurunagar

Topic	Event and Organizer	Date and Venue
Government policies for onion and garlic growers	Training on 'Scientific cultivation of onion and garlic' organized by DOGR, Rajgurunagar under ATMA scheme	May 31 and June 4, 2012 at DOGR, Rajgurunagar
Rabi onion production technology	DOGR, Rajgurunagar and KVK, Narayangaon	October 31, 2012 at Dhamalemala, Dist. Pune
Rabi onion production technology	Technoserve India, Narayangaon	January 10, 2013 at Ozar, Dist. Pune
Onion and garlic cultivation opportunities in Vidarbha region	AGROVISION 2013, Nagpur	January 27, 2013 at AGROVISION 2013, Nagpur
Improved onion and garlic varieties developed by DOGR	AGROVISION 2013, Nagpur	January 27, 2013 at AGROVISION 2013, Nagpur
S.J. Gawande		
Management of insect pest and diseases of onion and garlic	Department of Horticulture, Government of Madhya Pradesh	March 9, 2013 at Hotel Redisson, Indore, M.P.
Disease management in onion and garlic	Training on 'Scientific cultivation of onion and garlic' organized by DOGR, Rajgurunagar under ATMA scheme	May 31, 2012 and June 5, 2012 at DOGR, Rajgurunagar
A.A. Murkute		
Postharvest management of onion and garlic	Training on 'Scientific cultivation of onion and garlic' organized by DOGR, Rajgurunagar under ATMA scheme	May 31, 2012 and June 5, 2012 at DOGR, Rajgurunagar
Processing and value addition of onion and	Training on 'Scientific cultivation of onion and garlic' organized by DOGR, Rajgurunagar under ATMA scheme	May 31, 2012 and June 5, 2012 at DOGR
Postharvest management of onion and garlic	AGROVISION 2013, Workshop, National Expo and Conference	January 27, 2013 at AGROVISION 2013, Nagpur
Cold chain management in onion	AGROVISION 2013, Workshop, National Expo and Conference	January 27, 2013 at AGROVISION 2013, Nagpur
S. Anandhan		
Role of biotechnology in onion and garlic	Training on 'Scientific cultivation of onion and garlic' organized by DOGR, Rajgurunagar under ATMA scheme	May 31, 2012 and June 5, 2012 at DOGR, Rajgurunagar

Topic	Event and Organizer	Date and Venue
A. Thangasamy		
Integrated Nutrient management for onion and garlic	Training on 'Scientific cultivation of onion and garlic' organized by DOGR. Rajgurunagar under ATMA scheme	May 31, 2012 and June 5, 2012 at DOGR, Rajgurunagar
Nursery management and micro-irrigation	Training on 'Scientific cultivation of onion and garlic' organized by DOGR, Rajgurunagar under ATMA scheme	May 31, 2012 and June 5, 2012 at DOGR, Rajgurunagar

Participation in Exhibitions

Title	Organizer (s)	Venue and Date
S.S. Gadge and staff members		
Agrowon Agri Expo 2012	Sakal Media Group, Pune	College of Agriculture, Pune, December 1-5, 2012
S.S. Gadge and staff members		
KISAN Agri Expo 2012	Kisan Forum Pvt Ltd, Pune	Moshi, Pune December12-16, 2012
S.S. Gadge and A.R. Wakhare		
Rashtriya Kisan Mela	NRCC, Nagpur	NRCC, Nagpur February 22-23, 2013
S.S. Gadge and R. Bombale		
Agricultural Exhibition	NHRDF, Nashik	NHRDF, Nashik March 17-18, 2013

Human Resource Development Activities

Participation of scientists/staff in conferences/courses/meetings/trainings, etc during 2012-13

Title and Venue	Period
Jai Gopal	
Meeting of Scientific Advisory Committee of KVK, Narayangaon organized by Krishi Vigyan Kendra, Narayangaon, Dist. Pune	June 5, 2012.
One day workshop on 'Disposal of Appeal under RTI' conducted by ISTM, New Delhi and organized by Dy. Secretary (WS), ICAR, N. Delhi	June 8, 2012
All India Network Research Project on Onion and Garlic, III AINRPOG Group Meeting held at JAU, Junagadh, Gujarat.	June 22-23, 2012
QRT meeting organized by DOGR in consultation with Chairman, QRT-DOGR at IARI, New Delhi	July 17, 2012, and October 18-19, 2012
137th Management Committee Meeting of NHRDF at Mumbai organised by NHRDF, Nashik.	July 30, 2012
Knowledge Meet at New Delhi organized by ICAR Hqrs., New Delhi	August 21-22, 2012
DBT meeting on "Genetic improvement of fruits and vegetable crops for beneficial traits" at NRCPB, New Delhi organized by DBT, New Delhi	October 17, 2012
Meeting on supply chain management of onion at Pune organized by NABARD, Mumbai.	October 9, 2012
XXII ICAR Regional Committee No.VII meeting at ICAR Research Complex, Goa organized by CICR, Nagpur	November 9-10, 2012
ICAR Hub meeting at NRC Grapes, Pune organized by NRC Grapes, Pune.	January 4, 2013
RFD meeting with DG, ICAR at NASC Complex, New Delhi at RFD Unit, ICAR New Delhi.	January 16, 2013
XXII Group meeting of AICRP on Floriculture at YASHDA, Pune organized by Directorate of Floriculture, New Delhi	January 31, 2013
Meeting to explore research collaborations with NIASM, Baramati at Baramati	February 7, 2013
Meeting at NHRDF, Nashik regarding research work between DOGR and NHRDF.	February 13, 2013
Meeting of Directors' and Project Coordinators' of Horticulture Division with DDG (Hort) regarding budget and XII EFC at ICAR, New Delhi	March 12-13, 2013
Directors' conference at ICAR, New Delhi	March 19-20, 2013

Title and Venue	Period
V. Mahajan	
All India Plant Breeder's Meet held at NBPGR, New Delhi,	May 3-4, 2012
All India Network Research Project on Onion and Garlic, III AINRPOG Group Meeting held at JAU, Junagadh, Gujarat	June 22-23, 2012
QRT meeting organized by DOGR in consultation with Chairman, QRT-DOGR at IARI, New Delhi	July 17, 2012, and October 18-19, 2012
Chaired session in a meeting on working guidelines of seed certification standards for onion and garlic and bulb production held at NHRDF, Nashik	July 25, 2012
Meeting for finalization of technical programme for onion and garlic under NICRA project held at IIHR, Begaluru	August 30, 2012
Meeting with Secretary Agril., Maharashtra State Agril. and Commissioner Agriculture, Pune at Sakhar Sankul, Pune	December 7,2012
National Consultation on "Management of Genetic Resources of Horticultural Crops" at NBPGR, New Delhi,	December 18 – 19, 2012
Meeting with HOD and Scientists of Horticulture to finalize research programme on onion and garlic at MPKV, Rahuri	December 27, 2012
Anil Khar	
All India Network Research Project on Onion and Garlic, III AINRPOG Group Meeting held at JAU, Junagadh, Gujarat	June 22-23, 2012
Completion workshop and Nodal Officers workshop cum Installation training for NAIP Consortium "Strengthening Statistical Computing for NARS" at CIFE, Mumbai	June 30, 2012
Sensitization workshop on Consortium for e-Resources in Agriculture (CeRA), a subproject of NAIP, organised by NRC for Grapes, Pune	December 20, 2012
ICAR Hub meeting held at National Research Centre for grapes, Pune	January 4, 2013
V. Sankar	
Sensitization workshop on Consortium for e-Resources in Agriculture (CeRA), a subproject of NAIP, organised by NRC for Grapes, Pune	December 20, 2012
ICAR Hub meeting held at National Research Centre for grapes, Pune	January 4, 2013
Meeting to explore research collaborations with NIASM, Baramati at Baramati	February 7, 2013
A.J. Gupta	
6th DUS Review Meeting and PGSC Award function at NASC Complex, New Delhi	May 21-22, 2012

Title and Venue	Period
All India Network Research Project on Onion and Garlic, III AINRPOG Group Meeting held at JAU, Junagadh, Gujarat	June 22-23, 2012
Sensitization workshop on Consortium for e-Resources in Agriculture (CeRA), a subproject of NAIP, organised by NRC for Grapes, Pune	December 20, 2012
7th DUS Review Meeting at IIVR, Varanasi (UP)	February 28-March 1, 2013
S.S. Gadge	
Workshop on 'Glut management in horticultural crops with special emphasis on onion' at NHRDF, Nashik	March 17-18, 2013
Sensitization Workshop on Consortium for e-Resources in Agriculture (CeRA) at NRCG, Pune	December 20, 2012
AGROVISION 2013 National Workshop, Expo and Conference at Nagpur	January 27, 2013
S.J. Gawande	
All India Network Research Project on Onion and Garlic, III AINRPOG Group Meeting held at JAU, Junagadh, Gujarat.	June 22-23, 2012
Meeting of RFD Nodal officers at ICAR, New Delhi	November 23, 2012
Meeting for finalization of technical programme for onion and garlic under NICRA project held at IIHR, Begaluru	August 30, 2012
Meeting of PME Cell Nodal officers at NDRI, Karnal	December, 9, 2012
RFD meeting with DG, ICAR at NASC Complex, New Delhi at RFD Unit, ICAR New Delhi	January 16, 2013
A.A. Murkute	
Meeting on supply chain management of onion at Pune organized by NABARD, Mumbai	October 9, 2012
AGROVISION 2013 National Workshop, Expo and Conference at Nagpur	January 27, 2013
S. Anandhan	
All India Plant Breeder's Meet held at NBPGR, New Delhi	May 3-4, 2012
A. Thangasamy	
All India Network Research Project on Onion and Garlic, III AINRPOG Group Meeting held at JAU, Junagadh, Gujarat	June 22-23, 2012

Title and Venue	Period
Meeting to explore research collaborations with NIASM, Baramati at Baramati	February 7, 2013
Y.R. Vishwanath	
Meeting on working guidelines of seed certification standards for onion and garlic and bulb production held at NHRDF, Nashik	July 25, 2012
Sensitization Workshop on Consortium for e-Resources in Agriculture (CeRA) at NRCG, Pune	December 20, 2012
Joint monitoring of breeder seed production programme NHRDF, Nashik	February 28, 2013
Ashwini A. Chavan	
Workshop on "Foresight and future pathways of agricultural research through youth" in India organized by ICAR, New Delhi	March 1-2, 2013
Kalyani Gorrepati	
47th Annual Convention of ISAE and International Symposium on Bio-Energy - Challenges and Opportunities. Hyderabad	January 28-30, 2013

International

Dr. Anil Khar, Senior Scientist (Horticulture) participated in 6th International Symposium on Edible Alliaceae held during May 21-24, 2012 at Fukuoka, Japan. Dr. Khar also chaired the session on 'Genetic Resources'.

Training programmes attended by scientists

Name and Designation	Duration	Event
B.R. Jayanthimala Scientist	March 19-22, 2012	Workshop on 'Scientific Report Writing and Presentation' organized by NAARM, Hyderabad
S.S. Gadge Sr. Scientist	August 1 -7, 2012	Workshop on 'Institutional Innovations in Agricultural Extension for Inclusive Growth' at NAARM, Rajendranagar, Hyderabad.
S.J. Gawande Sr. Scientist	September 11 -17, 2012	MDP Workshop on 'Policy and Prioritization, Monitoring and Evaluation (PME) Support to Consortia-based Research in Agriculture' at NAARM, Rajendranagar, Hyderabad.
S. Anandhan Sr. Scientist	September 21 – 25, 2012	Training programme on 'Intellectual Property Rights and Biotechnology' at NAARM, Rajendranagar, Hyderabad.

Name and Designation	Duration	Event
V. Sankar Sr. Scientist	Nov. 21 to Dec. 11, 2012	Training programme on 'Sustainable Weed Management Options - Approaches and Applications' at TNAU, Coimbatore
Jai Gopal Director	December 16 – 21, 2012	Executive Development Programme on 'Leadership Development' for newly recruited Directors at Hyderabad organised by NAARM, Hyderabad
All scientists and technical staff	February 01-02, 2013	SAS for research data analysis' organized by CIFE, Mumbai held at DOGR, Rajgurunagar
Anil Khar Sr. Scientist	February 11-16, 2013	Researcher's training program on 'SAS for data reduction and multivariate analysis' at CIFE, Mumbai
Kalyani Gorrepati Scientist	February 7 – 13, 2013	PG Diploma in Technology Management in Agriculture, NAARM, Hyderabad

Institutional Activities

Institute Research Council (IRC) Meet

The 15th Institute Research Council (IRC) meeting was held on 02-03 April 2012 at Rajgurunagar, under the chairmanship of Dr. Jai Gopal, Director. Scientists presented the progress reports and salient achievements of the projects. The critical gaps in the ongoing research programmes were discussed at length and the technical programmes were finalized with appropriate modifications. New programmes were initiated to coincide with the XII plan.

DOGR Celebrates Foundation Day

Foundation Day of Directorate of Onion and Garlic Research (DOGR) was celebrated on June 16, 2012 to commemorate glorious past, vibrant present and promising future. Founded as National Research Centre for Onion and Garlic Research in 1999 at Nashik, Maharashtra, it was rechristened as Directorate of Onion and Garlic Research in 2008 by virtue of augmented responsibilities of All India Network Research Project on Onion and Garlic.

Mr. Dilip Mohite Patil, MLA, Khed addressing the gathering

Dr Jai Gopal, Director DOGR extended warm welcome to dignitaries and participants including farmers. In welcome address he focused on the ramifications of onion and garlic industry in the country. He also elaborated the various endeavors being taken by DOGR to enhance the production and productivity of onion and garlic. The foundation day lecture was delivered by Dr K.E. Lawande, Vice Chancellor, Dr. BS Konkan Krishi Vidyapeeth, Dapoli. He opined that the varieties released by DOGR are being well adopted and doing excellent in the country. Dr Lawande emphasized that the country needs to store about 40 lakh ton of onion to stabilize supply chain and commended the designs of storage structures developed by DOGR. Chief Guest of the function Mr. Dilip Mohite Patil, MLA, Khed, discussed the adverse effects of industrialization on agriculture and shrinkage of arable land. He advocated pro-farmers' policies including minimum support price, and adequate compensation in adversaries. The progressive farmers were felicitated on the occasion who also shared their experiences. Dr V. Mahajan coordinated the programme and proposed vote of thanks.

III Group Meeting of AINRP on Onion and Garlic Research

The third group meeting of All India Network Research Project on Onion and Garlic Research was held at Junagadh Agricultural University, Junagadh on 22-23rd June, 2012. The meeting was inaugurated and chaired by Shri Dileep Sanghani, Hon'ble Minister of Agriculture, Animal Husbandary, Fisheries and Cow breeding, Prison, Law and Justice, Legislative and Parliamentary Affairs, Government of Gujarat, and Co-chaired by Shri Kanubhai Bhalala, Hon'ble Minister of State, Agriculture and Water Resources. They emphasized the importance of onion and garlic in daily life and export. Dr. K.E. Lawande, Vice Chancellor, BSKKV, Dapoli was the chief guest. He advised to develop varieties and hybrids resistant to pests and

Inauguration of III[rd] AINRPOG group meeting

diseases besides increasing the storage capacity of onion in onion growing areas. Dr. N.C. Patel, Vice Chancellor, JAU, Junagadh was guest of honour. He gave priority to mechanization of onion and garlic cultivation. Dr. Jai Gopal, Director, DOGR in his key note address introduced the importance of onion and garlic network project and its achievements and ongoing research programmes. He also spoke about national and international status of these important crops and researchable issues to increase productivity and stabilize production. Dr. C.J. Dangaria, DRS, JAU, Junagadh spoke about the achievements of the University and welcomed the guests. Organizing Secretary of the group meeting was Dr. L.K. Dhaduk, Research Scientist (Garlic and Onion), JAU. He proposed vote of thanks during inaugural session.

There were four technical sessions viz. General Session, Crop improvement, Crop production and Crop protection. Research achievements and planning of next year experiments were thoroughly discussed. Dr. B.S. Dhankhar, Ex ADG (Hort), Dr. P.S. Naik, Director, IIVR, Dr. B. Singh, Project Co-ordinator(VC), Shri U.B. Pandey, Ex Director, NHRDF, Dr. P. Kalia, Head, Division of Veg. Crops, IARI, New Delhi, Dr. I.U. Dhruj, ADR, JAU, Junagadh were invited experts. They acted as Chairman/Co-Chairman of various sessions. Scientists from different parts of the country from public and private sectors participated in the group meeting to formulate and conduct the research programmes in the country. Plenary session was chaired by Dr. N.C. Patel, Vice Chancellor and co-chaired by Dr. B.S. Dhankhar, Ex ADG (VC). Vote of thanks was proposed by Dr. Vijay Mahajan, Nodal Officer, AINRPOG and Principal Scientist, DOGR. An exhibition of DOGR varieties and technologies was also arranged on the occasion for the benefit of participants and farmers. The two days deliberations were fruitful and the meeting was a grand success, as was evident from its appreciation by one and all.

Meeting of Institute Management Committee at Directorate

The 16[th] meeting of Institute Management Committee (IMC) of Directorate of Onion and Garlic Research (DOGR) was held on August 27, 2012 at DOGR, Rajgurunagar, Pune. It was chaired by Dr. Jai Gopal, Director, DOGR and attended by all other members including Dr. Madhuban Gopal, National Fellow, Division of Agri. Chemicals, IARI, New Delhi, Dr. G.S. Karibasappa, Principal Scientist, NRC for Grapes, Pune and Dr. L. Pugalendhi, Professor and Head, Deptt. of Vegetable Crops, TNAU, Coimbatore.


Meeting of IMC

The welcome of the committee members was followed by a presentation by Director about the activities of the directorate and significant achievements. He elaborated the aspirations of the directorate for the XII Plan EFC. Dr. Jai Gopal also expressed that the primary focus of DOGR is on innovative measures to provide healthy working ambience. Following the chairman's remarks, the committee discussed the agenda items. The members offered valuable suggestions in the light of ICAR guidelines and the need of the directorate. QRT recommendations, purchase of spill over items and other agenda items were approved by IMC. The meeting ended with the vote of thanks by Mr. Subodh Neeraj, Member Secretary, IMC. The IMC members also visited the different sections and laboratories of the directorate and discussed various issues with the scientists and the staff to accommodate their views amicably.

Research Advisory Committee Meeting of the Directorate


RAC during field visit

The fifteenth RAC meeting of DOGR was held on November 5-6, 2012. Dr. B.S. Dhankhar, Former Assistant Director General (VC), ICAR, New Delhi chaired the meeting. Other RAC members were Prof. M. Udayakumar, UAS, Bangalore, Dr. Hari Har Ram, Vice President (R&D) Krishidhan Seeds Pvt. Ltd., Dr. S.J. Singh, Former Head, IARI Regional Station, Pune, Dr. Umesh Srivastava, ADG (Vegetable Crops) ICAR, New Delhi, Dr. R.P. Gupta, Director, NHRDF, Nashik, Dr. Jai Gopal, Director DOGR and Dr. C.R. Ramesh, Member Secretary. All the scientists of DOGR were also present in the meeting. Dr Jai Gopal, Director felicitated the Chairman and other members and briefed the RAC about the salient achievements of DOGR and the proposed programmes. Dr. C.R. Ramesh presented the Action Taken Report. The progress reports and future plans of the different programmes were presented by respective scientists. Each presentation was followed by in-depth discussion. The issues of impact of climate change on onion and garlic production, flower induction in garlic and molecular breeding for quality attributes were highlighted. The thought provoking interaction of RAC with DOGR scientists led to thirty recommendations in different disciplines and helped to prioritize the R&D endeavors. Efforts were also made to streamline the research programmes in the light of XII EFC. A visit to field experiments at Rajgurunagar and Manjri farms was also organized for RAC members.

प्याज एवं लहसुन अनुसंधान निदेशालय में हिन्दी सप्ताह का आयोजन

प्याज एवं लहसुन अनुसंधान निदेशालय, राजगुरूनगर, पुणे में दिनांक 14/09/2012 से 20/09/2012 तक हिन्दी सप्ताह मनाया गया, जिसमें दिनांक 14/09/2012 को हिन्दी दिवस के दिन हिन्दी कार्यशाला का आयोजन रखा गया था। हिन्दी कार्यशाला में श्री आर. पी. वर्मा, वरिष्ठ सहायक निदेशक (राजभाषा), हिन्दी शिक्षण योजना, राजभाषा विभाग, पुणे (महाराष्ट्र), ने कम्प्यूटरों में युनीकोड़ के माध्यम से हिन्दी एवं अन्य सभी भारतीय भाषाओं में कार्य करने से अवगत कराया, जिसमें अन्य भाषाओं से सबंधित साफ्टवेयर लोड करने की आवश्यकता नहीं होती। यह सुविधा कम्प्यूटरों में पहले से ही उपलब्ध होती है। हिन्दी सप्ताह के दौरान निदेशालय में प्रश्न मंजुषा, शुध्द लेखन, हिन्दी

अनुवाद, वाद-विवाद, कविता पाठ एवं निबंध प्रतियोगिताओं का आयोजन किया गया जिसमें समस्त अधिकारियों / कर्मचारियों ने बढ़चढ़ कर भाग लिया।

हिन्दी सप्ताह समारोह

हिन्दी सप्ताह समापन समारोह मुख्य अतिथि महोदय डॉ. सुनील केशव देवधर, कार्यक्रम अधिकारी, आकाशवाणी केन्द्र पुणे की अध्यक्षता में सम्पन्न हुआ। डॉ. जयगोपाल, निदेशक प्याज एवं लहसुन अनुसंधान निदेशालय ने मुख्य अतिथि का स्वागत किया तथा निदेशालय की उपलब्धियों से अवगत कराया एवं हिन्दी में किये जा रहे कार्यो की जानकारी दी। मुख्य अतिथि महोदय ने अध्यक्षीय भाषण में हिन्दी भाषा को राजभाषा से राष्ट्रभाषा बोलने में जो संकोच होता है, उस पर अपना मत व्यक्त किया तथा हिन्दी को एक मत से राष्ट्रभाषा का दर्जा देने के लिए आह्वान किया। मुख्य अतिथि द्वारा विजेताओं को पुरस्कार वितरित किये गए। डॉ. विजय महाजन ने सूत्र संचालन किया तथा श्री सुबोध नीरज, प्रशासनिक अधिकारी के आभार प्रदर्शन के साथ हिन्दी सप्ताह का सफलतापूर्वक समापन हुआ।

सतर्कता जागरूकता सप्ताह का आयोजन

केन्द्रीय सतर्कता आयोग, भारत सरकार, नई दिल्ली और भा.कृ.अनु. परिषद के आदेशानुसार इस वर्ष भी सतर्कता जागरूकता सप्ताह दिनांक 29 अक्टूबर 2012 से 2 नवम्बर 2012 तक मनाया गया। इस वर्ष सतर्कता सप्ताह का विषय था 'सार्वजनिक खरीद में पारदर्शिता'। सतर्कता सप्ताह के दौरान दिनांक 29 अक्टूबर 2012 को निदेशालय के समस्त कार्मिकों ने प्रात: 11 बजे सभा कक्ष में लोक सेवा, सत्यनिष्ठा, ईमानदारी, पारदर्शिता एवं अपने संस्थान को भ्रष्टाचार रहित बनाए रखने के लिए प्रतिज्ञा ली। जिसके प्रचार प्रसार के लिए निदेशालय के मुख्य प्रवेश द्वार पर बैनर एवं सूचनापट्ट पर परिपत्रों द्वारा जागरूकता लाने का प्रयास किया गया।

सतर्कता सप्ताह के समापन समारोह का कार्यक्रम दिनांक 02 नवम्बर 2012 को अपरान्ह 3.30 बजे रखा गया। जिसमें निदेशालय के सतर्कता अधिकारी डॉ. विजय महाजन, प्रशासनिक अधिकारी श्री सुबोध नीरज, एवं संस्थान के निदेशक डॉ. जयगोपाल ने अपने विचार व्यक्त किये, जिसमें विशेष रूप से समस्त कार्मिकों से आवाहन किया कि सतर्कता सप्ताह को केवल औपचारिकता मात्र न माना जाएं बल्कि अपने वास्तविक जीवन में आत्म सात किया जाना चाहिए एवं सार्वजनिक खरीद में नियमों का पूर्णत: पालन किया जाना चाहिए जिससे हमारे द्वारा किये गये कार्यो की पारदर्शिता झलकती रहे। निदेशक महोदय के विचारों के साथ ही सतर्कता जागरूकता सप्ताह का समापन हुआ।

NAIP Sponsored Training on SAS at DOGR

A two days training-cum-awareness programme on "SAS for Research Data Analysis", was organized by Directorate of Onion and Garlic Research, Rajgurunagar, Pune in collaboration with the Central Institute of Fisheries Education (CIFE), Mumbai from Feb. 1-2, 2013. The programme was coordinated by Dr. Anil Khar and Dr V.Sankar from DOGR along with Dr. Shrinivas Jahageerdar, CCPI (SAS) and Principal Scientist (CIFE). The training programme was inaugurated by Dr. Jai Gopal, Director, Directorate of Onion and Garlic Research, Rajgurunagar who briefed about the importance of SAS in agricultural data analysis for bringing quality research publications.

A total of 23 participants including 13 scientists, 2 technical personnel and 8 SRF/JRFs attended the training programme. Lectures on SAS basics, descriptive statistics, data standardization, use of graphics and design of experiments were imparted to the participants by Dr. S. Jahageerdar and Dr. J. S. Dhekale. The feedback provided by the participants elucidated that the training programme was well organised and quite useful. It was stressed that 5-6 days training programme on specific modules in breeding, genomics, production, social science and other areas shall be conducted by CIFE the nodal agency for SAS training program for western zone. Director, DOGR appreciated the efforts of SAS team and emphasised the need of such trainings to improve the research output of the institutes.

DOGR Explores R & D Collaboration with NIASM, Baramati

Meeting at NIASM, Baramati

Earlier this year Dr. P.S. Minhas, Director, National Institute of Abiotic Stress Managament (NIASM), Baramati visited Directorate of Onion and Garlic Research (DOGR), and expressed a view to start collaborative projects suited to the interest of both the institutes. Accordingly a meeting was convened on February 7, 2013 to explore possible collaboration between NIASM and DOGR. The meeting was attended by Dr. Jai Gopal, Director, DOGR, Dr. V. Sankar, Senior Scientist, Dr. A. Thangasamy, Scientist, DOGR. Dr. P.S. Minhas, Director NIASM and Heads of different schools and scientists of NIASM, Baramati were present. A field visit was followed by briefing by Dr. P.S. Minhas, Director about the activities of NIASM and efforts taken for reshaping of land, farm and other infrastructure development to carry out world class research work at NIASM, Baramathi. Dr. Jai Gopal appreciated efforts of NIASM for development of Deemed University at Baramati and emphasized the importance of abiotic stress management in onion and garlic. Later, the issues related to effect of climate change affecting phenology and productivity of onion and garlic, the impact of altered climate factor on their productivity and quality and adaptation and mitigation options for optimum production of both the crops were discussed. Discussions were made at length related to research prioritization of abiotic stress and its management in onion and an attempt was made to carve a road map for research work to be conducted at both the institutes. Mutually it was agreed that the research work would be directed for identifying superior lines of onion for major abiotic stresses and elucidating mechanisms of tolerance to stress. Resource management options to mitigate stress may also be included in due course. It was decided that, a MoU will be signed between DOGR and NIASM after prioritization of research programmes. The new initiative to explore collaborations will surely widen the gamut of DOGR in future.

Joint Meeting of DOGR Rajgurunagar and NHRDF, Nashik

The meeting of Research Advisory Committee (RAC) of Directorate of Onion and Garlic Research (DOGR) had suggested that DOGR and National Horticultural Research Development Foundation (NHRDF), Nashik both being public funded organizations, may streamline the R&D priorities to avoid any duplication of work. In consonance of this a meeting was held at NHRDF, Nasik on 13.2.2012 under the Chairmanship of Dr. Jai Gopal, Director, DOGR and Co-Chairman, Dr. R.P. Gupta, Director, NHRDF. Dr. V. Mahajan, Member Secretary RAC and Dr. V. Sankar, Member Secretary, IRC from DOGR, and Dr. S. R. Bhonde, Additional Director, NHRDF and all Scientists from NHRDF were present. Research activities of NHRDF

were presented by Mr. Hari Prakash Sharma, Deputy Director followed by a presentation for DOGR by Dr. V. Sankar, Senior Scientist. Discussions were made thoroughly to focus on the research areas of strength at both the institutes. It was amicably decided that, NHRDF may concentrate on evaluation of onion and garlic germplasm at Karnal location as at DOGR, germplasm conservation, evaluation and maintenance is the main mandate. Since the direct seeding trial work at DOGR in collaboration with CIAE, Bhopal and MPKV, Rahuri has already been in vogue, seed drill developed by M/S Jain System Ltd. which NHRDF is testing, may be included in this experiment at DOGR. Further, the drip irrigation trials at NHRDF may be dropped as it has been already concluded at DOGR. It was suggested that Nasik and Karnal centres of NHRDF may be included under AINRPOG as voluntary centres for conducting the trials related to effect of climate change and environmental factors on thrips and diseases. Experiments on production of seed of *rabi* varieties in one year have been already done by NHRDF; hence, DOGR will not conduct this trial. It was also decided that both the organizations will work in tandem for mutual benefits. The meeting ended with the vote of thanks.

Meeting at NHRDF, Nashik

Participation of DOGR sports team in ICAR Zonal Tournament

The sports team of DOGR participated in ICAR Zonal Sports Tournament–West Zone 2013 held at National Research Centre on Camel, Bikaner during February 27-March 2, 2013. The team participated in Carom, Chess, Race, Table Tennis and Badminton events. Mr. D. B. Mundharikar of DOGR received a silver medal in carom. Badminton team of DOGR also reached in quarter final.

Mr. D. B. Mundharikar receiving silver medal

Extension Activities

Farmers' Training Programmes at DOGR


Valedictory function of farmers' training programme

DOGR regularly arranges training programmes for the dissemination of technical knowledge and R&D innovation to the targeted clientele. During the past six months, three training programs were organized for the farmers of different regions on 'Scientific cultivation of onion and garlic'. Under ATMA scheme, fifteen onion and garlic growers from Bhusawal taluka of Jalgaon district participated in the training programme organized during March 5 to 7, 2012. The two training programmes were organized during May 30 to June 1, 2012 and June 4 to 6, 2012. These were sponsored by NCAP and *Gramin Vikas Kendra*, Bihar Sharif, Bihar for the farmers of Nalanda District, Bihar. The relevant topics were covered by the scientists under these programmes. Lectures were delivered on varieties, cultivation practices, fertilizer management, micro-irrigation, pest control, harvesting, storage and postharvest management including processing. The various agro-practices were demonstrated to farmers with experiments laid at Rajgurunagar, Manjri and Kalus farms of the Directorate. The famers were also exposed to different agro-innovative technologies. A visit to the laboratories of Directorate was also organized during this period. Dr Jai Gopal, Director DOGR had extensive deliberations with the farmers in the valedictory functions to know their specific constraints related to sustainable production techniques. To manage frequent price fluctuations and get appropriate market price, Dr Jai Gopal emphasized that farmers should develop a professional attitude and follow storage and processing of onion and garlic. The training programmes were coordinated by Dr S.S. Gadge, Senior Scientist (Extension).

Training Programme for Farmers with KVK, Narayangaon

Dr. S.S. Gadge delivering a lecture at training programme

A training programme was organized for the farmers' of Dhamalemala, Dist Pune in collaboration with Gramonnati KVK, Narayangaon, Dist. Pune on October 31, 2012. On the occasion, Dr. S.S. Gadge, Sr. Scientist delivered lecture on *rabi* onion production technology while Dr A.J. Gupta, Sr. Scientist elaborated onion varieties developed by DOGR for *rabi* season. The scientists also demonstrated the nursery raising techniques to the participants.

Training-cum-Awareness Programme on PPV & FR Organized by DOGR

One day training-cum-awareness programme on "Protection of Plant Varieties and Farmers' Rights" with special reference to onion and garlic was organized by Directorate of Onion and Garlic Research, Rajgurunagar, Pune in collaboration with the Protection of Plant Varieties and Farmers' Rights Authority (PPV & FRA), New Delhi on 19th January, 2013 at DOGR Campus, Rajgurunagar, Pune. A total of 160 participants including progressive farmers, students, extension workers, agriculture officials, staff from KVKs and private companies attended the programme. The event was inaugurated by Chief Guest Dr. D.G. Bakwad, Director of Horticulture, Government of Maharashtra. Dr. B.S. Rajput, Programme Coordinator, KVK, Narayangaon and Mr. K. Karkhile, SDAO, Department of Horticulture, Rajgurunagar also graced the occasion.

Dr. Jai Gopal, Director, DOGR formally welcomed the participants, and elaborated the role of PPV & FRA, theme of the training programme and briefed about the research and other activities of DOGR. Lectures were delivered by experts on different topics. Dr. V. Mahajan briefed about the benefit sharing provisions under PPV & FRA. Dr. A.J. Gupta, Nodal Officer, DUS Project spoke about Distinctness, Uniformity and Stability (DUS) and varietal details of onion and garlic, which are essential for registering new varieties under PPV & FRA. Dr. Anil Khar made the audience aware about how to fill the registration form.

The dignitaries welcomed the initiative of DOGR for timely organization of this training programme and emphasized that there is a scope for registering farmers' varieties especially in onion and garlic. They also urged that the farmers should educate other farmers in their vicinity. The programme ended with distribution of certificates to the participants followed by vote of thanks by Dr. A.J. Gupta. A field visit was also organized for the farmers to acquaint them with the latest technologies and cultural practices in onion and garlic.

DOGR organizes Training-cum-Awareness Programme on PPV & FRA with KVK, Narayangaon

One day Training-cum-Awareness Programme on "Protection of Plant Varieties and Farmers' Rights Act" for farmers, NGOs, researchers, and students was organised by Directorate of Onion and Garlic Research, Rajgurunagar, Pune in collaboration with Protection of Plant Varieties and Farmers Rights Authority (PPV & FRA), New Delhi and KVK, Narayangaon on 14th February, 2013 at KVK, Narayangaon. The training was aimed at creating awareness among the farmers/ scientists/ students/ NGOs/ public at large about the provisions available in Plant Varieties and Farmers' Rights. The training programme structured with both lectures on PPV & FR Act, DUS (Distinctness, Uniformity and Stability) Testing and field visit. The programme was coordinated by Dr. A. J. Gupta, Nodal Officer DUS Project and Dr. B. S. Rajput, Programme Coordinator, KVK. The training programme was inaugurated by Shri. Anil G. Meher, Chairman, KVK, Narayangaon and programme chaired by Dr. Jai Gopal, Director, DOGR, Rajgurunagar. A total of 108 participants from different parts of Maharashtra were participated in the programme.

Dr. Jai Gopal, Director, DOGR formally welcomed the participants, and elaborated the role of PPV & FRA, theme of the training programme and briefed about the research and other activities of DOGR. He also said the Government of India has come up with this legislation to provide an effective system for protection of plant varieties, the rights of farmers and plant breeders and to encourage the development of new varieties of plants. He apprised the trainees to aware their rights envisaged in PPV & FR Act to conserve, improve and making available plant genetic resources for the development of the new plant varieties.

Lectures were delivered by experts on different topics. Dr. V. Mahajan briefed about the benefit sharing provisions under PPV & FRA. Dr. A.J. Gupta, Nodal Officer, DUS Project spoke about DUS testing and varietal details of onion and garlic, which are essential for registering new varieties under PPV & FRA. Dr. B. S. Rajput made the audience aware about how to fill the registration form. This was followed by feedback from the farmers and practical demonstration of recording data according to DUS guidelines by Dr. A. J. Gupta. A field visit was also organized for the farmers to acquaint them with the latest technologies and cultural practices at KVK Narayangaon. In the end, participation certificates were awarded to all the participants of the PPV & FRA training-cum-awareness programme.

DOGR Exhibition at Agrowon 2012 and Kisan 2012

DOGR participated in agricultural exhibition 'Agrowon Agri Expo 2012' during December 1-5, 2012 at College of Agriculture, Pune organized by Sakal Media Group, Pune. It was inaugurated by Hon'ble Union Minister of Agriculture Shri. Sharad Pawar. Around 200 public and private organizations related to seed, agricultural implements, etc participated in it with their stalls. About two lakh farmers from different states visited the exhibition.

DOGR also participated in agricultural exhibition 'Kisan Agri Expo 2012' during December 12-16, 2012 at Moshi, Pune organized by Kisan Forum Pvt Ltd., Pune. It was inaugurated by the five farmers who were first to visit Expo. Around 400 organizations participated in it with their stalls. About five lakh farmers from different states visited the exhibition.

DOGR stall received a great response from farmers and large numbers of publications were sold out in these exhibitions. There was huge demand for Marathi publications like Kanda Lagwad, Lasun Utpadan and Kanda Va Lasun Sathawan. DOGR developed technologies- onion varieties such as Bhima Super, Bhima Raj, Bhima Red, Bhima Kiran, Bhima Shakti, Bhima Shubhra and Bhima Shweta and garlic varieties such as Bhima Omkar and Bhima Purple were demonstrated in these exhibitions.

DOGR Organizes Workshop at AGROVISION 2013 at Nagpur

A workshop on 'Opportunities in Vidarbha for onion and garlic cultivation' was organized by DOGR, Rajgurunagar on January 27, 2013 in National level Agricultural Exhibition 'Agrovision 2013' at Reshimbag, Nagpur. The lectures on 'Onion and Garlic cultivation opportunities in Vidarbha region' and 'Improved Onion and Garlic varieties developed by DOGR' were delivered by Dr. S. S. Gadge and 'Postharvest management of onion and garlic' and 'Cold chain arrangements' by Dr. A. A. Murkute in the session. The queries from the farmers regarding different aspects pertaining to selection of varieties, production practices including irrigation, fertilizer application, pest control, etc were also answered after the lectures. Shri. Namdeorao Adhau, a progressive farmer from Patur district narrated his success story due to DOGR at the end. About 150 farmers attended the workshop.

DOGR participates in Rashtriya Kisan Mela

Dr. N.K. Krishna Kumar visiting DOGR Stall

DOGR participated in agricultural exhibition 'Rashtriya Kisan Mela 2013' during February 22-23, 2013 at National Research Centre on Citrus, Nagpur. It was inaugurated by Hon'ble Deputy Director General (Horticulture) of ICAR, Dr. Krishna Kumar. About 30 public and private organizations related to seed, fertilizer, pesticides, agricultural implements, etc participated in it with their stalls. Around 500 farmers visited the exhibition. DOGR developed technologies were displayed at DOGR stall. DOGR stall received a great response from farmers. There was demand for Marathi publications like Kanda Lagwad, Lasun Utpadan and Kanda Va Lasun Sathawan.

Field Day at Devalgaon village of Maharashtra

A field day on "Improved Cultivation practices for Onion" was organized by DOGR at farmers' field at village Devalgaon, Taluka Patur, Dist. Akola on 26.2.2013, in collaboration with PDKV, Akola. About 70 onion growers attended the workshop. The programme was chaired by Dr. Jai Gopal, Director, DOGR, Rajgurunagar, Pune and was inaugurated by progressive farmer Krishi Bhushan Shri. Dadaraoji Deshmukh. Dr. D.T. Deshmukh, Deputy Director Seed, Dr. S.M. Ghawade, Associate Professor, Dr. M.J. Patil, Assistant Professor, Dr. P.P. Gawande, Assistant Professor and Shri S.M. Sher, Agriculture Assistant from PDKV Akola, Dr. Vijay Mahajan, Principal Scientist, DOGR and progressive onion grower Krishi Bhushan Shri. Namdev Adhau were also present on this occasion.

Dr. Jai Gopal advised the farmers to adopt advanced technology for cultivation of onion to get better yield along with the quality produce. Farmers should shift cultivation of onion in *kharif* and late *kharif* to get more benefit. He emphasized to cultivate new varieties of onion according to season. Dr. Vijay Mahajan delivered lecture on "Production technology of Onion". He suggested for the use of drip or sprinkler irrigation system to save water, labour and have other added advantages compared to flood irrigation. He also explained the importance of raising healthy nursery, nutrient management, plant protection and storage of onion. Krishi Bhushan Shri Adhau shared his experience about cultivation of *kharif* onion in Vidharbh. He told that four years ago farmers of this area were not aware about cultivation of *kharif* onion. But after adopting the *kharif* onion production technology developed by DOGR, *kharif* onion is becoming popular in Vidharbh region. In Patur taluka the area under *kharif* cultivation has gone from nil to 4000 acres in last 4 years. Many farmers are now adopting micro-irrigation for onion cultivation. The programme was followed by farmers' field visit where on-farm suggestions were given.

DOGR in Agricultural Exhibition at NHRDF, Nashik

DOGR participated in agricultural exhibition during March 17-18, 2013 at National Horticulture Research and Development Foundation, Chitegaon Road, Nashik. It was inaugurated by inaugurated by Dr. S. K.

Goel, Additional Chief Secretary (Agriculture & Marketing) Government of Maharashtra. About 10 public and private organizations related to seed, fertilizer, pesticides, agricultural implements, etc participated in it with their stalls. Around 300 farmers visited the exhibition.

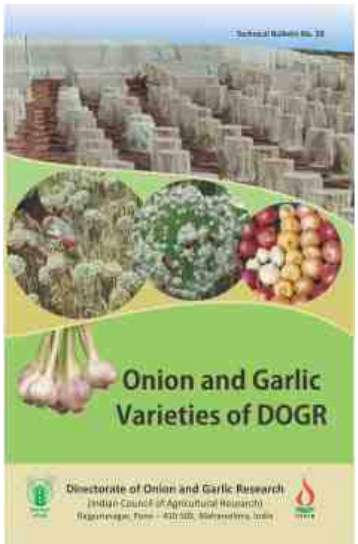
DOGR developed technologies were displayed at DOGR stall. DOGR stall received a great response from farmers. There was demand for Marathi publications like Kanda Lagwad, Lasun Utpadan and Kanda Va Lasun Sathawan.

TV Shows and Radio Talks

- Dr. V. Mahajan, delivered a radio talk on "*Rabi kanda utpadan*" broadcast on 5/10/2012 from All India Radio, Pune.
- Dr. V. Mahajan, delivered a radio talk on "*Kanda hangam vyavasthapan*" broadcast on 7/1/2013 from All India Radio, Pune
- Dr S.S. Gadge, presented three TV shows viz. Saam Marathi (2/7/2012), ABP Maza (5/7/2012), and Sahara Samay (8/7/2012) on different topics related to Kharif production technology for onion growers.
- Dr. S.S. Gadge, delivered a radio talk on January 14, 2013 at All India Radio on Government policies for onion and garlic farmers.
- Dr. S.J. Gawande, delivered a radio talk on January 28, 2013 on 'Pest and diseases of onion crop' at All India Radio.

Release of DOGR Publications

Two publications from Directorate of Onion and Garlic Research, Pune were released on November 9, 2012 at the inaugural function of 22nd Meeting of ICAR Regional Committee – VII, hosted by ICAR Research Complex for Goa. These publications are: a technical bulletin entitled "Onion and Garlic Varieties of DOGR" and a CD on "Micro-Irrigation in Onion and Garlic". His Excellency Shri. Bharat Vir Wanchoo, Governor of Goa was the Chief Guest with Dr. Ramkrishna Kusmaria, Minister of Farmer Welfare and Agricultural Development, Govt. of Madhya Pradesh was Guest of Honor. Dr. S. Ayyappan, Secretary DARE, GoI and DG, ICAR presided over the function. The publications are available at DOGR for stakeholders.



Distinguished Visitors

Chairman ASRB Visits Directorate

Dr. Gurbachan Singh at field experiments

Dr. Gurbachan Singh, Chairman, Agricultural Scientists Recruitment Board (ASRB) visited DOGR on April 17, 2012. Dr. Jai Gopal, Director DOGR received the Hon'ble chairman and briefed him about the various activities of the Directorate. Dr Singh visited the institute's farm and had comprehensive discussion on the on-going projects and related R&D activities. He also visited all the laboratories of the Directorate. Dr. Gurbachan Singh praised the cleanliness in the campus and appropriately laid out experiments in the field. He elaborated innovative steps which are being taken up by ASRB and solicited the suggestions from the scientists to improve the system of assessment and recruitment of scientific staff.

Dr. P.S. Minhas, Director, NIASM Baramati visits DOGR

Dr. P.S. Minhas, Director, National Institute of Abiotic Stress Management, Baramati visited Directorate of Onion and Garlic Research on 25/5/2012. Dr. C.R. Ramesh cordially received Dr. Minhas and introduced him to the scientific staff of DOGR. Dr Minhas expressed deep sense of gratitude and during the course discussed the R&D programmes of directorate vis-à-vis research mandate of NIASM to explore mutual collaborations. He extended the invitation to the Director to visit NIASM to discuss and finalize the mutual collaborations.

Dr P.S. Minhas in discussion with DOGR scientists

Dr. P.K. Gupta visits DOGR

Renowned biotechnologist Dr. P.K. Gupta, Emeritus Professor and NASI Senior Scientist, CCS University, Meerut visited DOGR on 21/01/2013. He visited the various laboratories and experimental farm. He had comprehensive discussion with the scientists on varios ongoing research activities and assured to extend all possible help.

Dr. Gupta during laboratory visit with
Dr. Jai Gopal, Director DOGR

Personnel

Recruitment/New Joining

1. Miss Ashwini Anil Chavan, Scientist (Genetics) w.e.f. 30/06/2012
2. Mrs. Kalyani Gorrepati, Scientist (Agril. Structures and Process Engg.) w.e.f. 26/11/2012.
3. Dr. (Mrs.) Prabha K., Scientist (Plant Pathology) w.e.f. 25/02/2013
4. Mr. Subodh Neeraj, Administrative Officer w.e.f. 12/06/2012
5. Mr. Raj Yaswant Bomble, T-1 (Field/Farm Technician) w.e.f. 18/02/2013
6. Miss Poonam Gopalrao Shinde, T-1 (Laboratory Technician) w.e.f. 1/03/2013

Transfer

1. Dr. C. R. Ramesh, Principal Scientist (Plant Pathology) w.e.f. 15/12/2012 (AN)
2. Smt. Jayanthi Mala B. R., Scientist (Entomology) w.e.f. 11/01/2013 (AN)

Promotion

1. Dr. A. Thangasamy Scientist to Scientist (Senior Scale) w.e.f. 12/06/2012
2. Sh. A. R. Wakhare, T-3 (Field/Farm Assistant) to T-4 w.e.f. 16/12/2011
2. Sh. Hemant S. Gawali, T-1(Field/Farm Technician) to T-2 w.e.f. 12/12/2011

Retirement

1. Sh. V. V. Patil, T-5 (Tech. Officer) – 31/05/2012
2. Sh. P. S. Takale, T-3 (Field/Farm Technician) – 31/05/2012

Staff Position

Category	Sanctioned Posts	Filled up Posts	Vacant
RMP	01	01	-
Scientific	15	12	03
Technical	10	10	-
Administrative	12	10	02
Skilled Supporting Staff	11	11	-
Total	49	44	05

List of Staff

Sl. No.	Name	Designation
Scientific Staff		
1.	Dr. Jai Gopal	Director
2.	Dr. V. Mahajan	Principal Scientist (Horticulture)
3.	Dr. Anil Khar	Sr. Sciensit (Horticulture)
4.	Dr. V. Sankar	Sr. Scientist (Horticulture)
5.	Dr. A. J. Gupta	Sr. Scientist (Horticulture)
6.	Dr. S. S. Gadge	Sr. Scientist (Agri. Extenstion)
7.	Dr. S. J. Gawande	Sr. Sciensit (Plant Pathology)
8.	Dr. A. A. Murkute	Sr. Scientist (Horticulture)
9.	Dr. S. Anandhan	Sr. Scientist (Biotechnology)
10.	Dr. A. Thangasamy	Scientist (Soil Science)
11.	Mr. Vishwanath	Scientist (Seed Technology)
12.	Miss Ashvini Anil Chavan,	Scientist (Genetics)
13.	Dr. (Mrs.) Kalyani Gorrepati	Scientist (Agril. Structures and Process Engg.)
14	Dr. (Mrs.) Prabha K.	Scientist (Plant Pathology)
Technical Staff		
1.	Sh. H.S.C. Shaikh	T-6 (Tech. Officer Computer)
2.	Sh. N. L. Gore	T-5 (Tech. Officer) Field/ Farm
3.	Sh. R. B. Baria	T-4 (Field/Farm)
4.	Sh. S. P. Yeole	T-4 (Driver)
5.	Sh. A. R. Wakhare	T-4 (Field/Farm Assistant)
6.	Sh. D. M. Panchal	T-3 (Lab Technician)
7.	Sh. B. A. Dahale	T-3 (Tractor Driver)
8.	Sh. H. S. Gawali	T-2 ((Field/Farm Technician)
9.	Sh. Ram Yashwant Bomble	T-1 ((Field/Farm Technician)
10.	Miss Poonam Gopalrao Shinde	T-1 (Laboratory Technician)

Sl. No.	Name	Designation
Administrative Staff		
1.	Sh. Subodh Neeraj	Administrative Officer
2.	Sh. C. M. Wakodkar	Assistant Administrative Officer
3.	Miss Vijya N. Chaudhari	Assistant Finance & Accouts Officer
4.	Sh. D. B. Mundharikar	Private Secretary
5.	Sh. S. P. Kandwal	Assistant
6.	Sh. P. S. Tanwar	Assistant
7.	Smt.M. S. Salave	Assistant
8.	Smt. N. R. Gaikwad	Upper Division Clerk
9.	Sh. R. K. Dedage	Upper Division Clerk
10.	Sh. Nilesh S. Warkar	Lower Division Clerk
Skilled Supporting Staff		
1.	Sh. S. K. Said	SSS
2.	Sh. P. K. Khanna	SSS
3.	Sh. P. R. Sonawane	SSS
4.	Sh. P. E. Tadge	SSS
5.	Sh. M. S. Kale	SSS
6.	Sh. R. S. Kulkarni	SSS
7.	Sh. S. D. Waghmare	SSS
8.	Sh. N. H. Shaikh	SSS
9.	Sh. S. B. Tapkir	SSS
10.	Sh. A. D. Fulsundar	SSS
11.	Sh. S. S. Gopale	SSS

Financial Statement

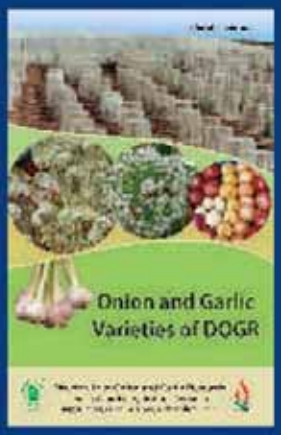
(Up to March 2013)

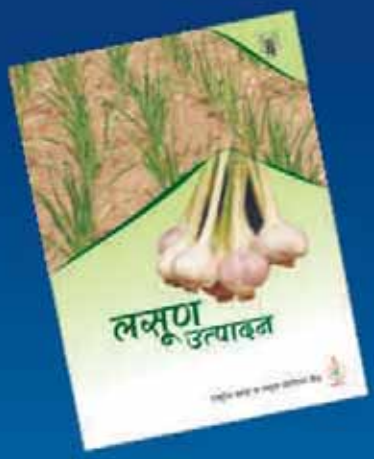
Head of Accounts	Rupees in Lakhs	
	Budget Allocation	Expenditure
Non-Plan	290.48	284.99
Plan including Network Project	395.00	395.00
Pension & Retirement	25.62	25.61
P-Loans & Advances	2.15	2.15
R-Deposit Scheme	7.02	6.81
Total	**720.27**	**714.56**
		Achievement
Revenue Receipts main		**31.73**
RFS		**18.22**
Total		**49.95**

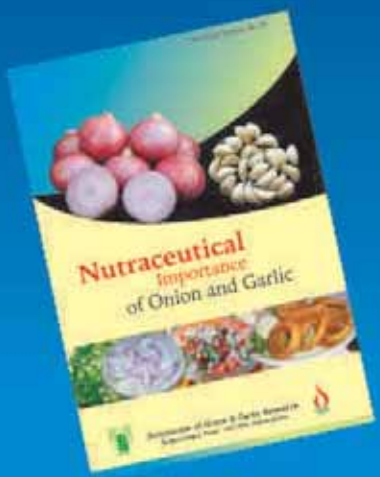
Meteorological data for year 2012-13

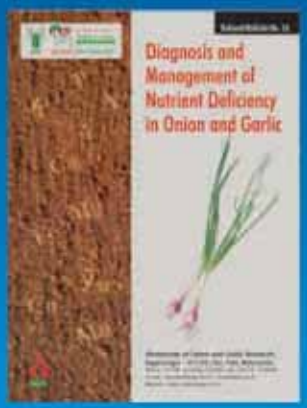
Month	Temperature °C		Relative humidity (%)		Rainfall (mm)	Evaporation (mm)	Sunshine (hours/day)
	Max.	Min.	Max.	Min.			
March	35.4	11.1	57	29	0.00	7.20	8.48
April	37.4	19.0	63	40	0.00	9.73	9.37
May	37.0	21.0	65	38	0.00	9.72	11.00
June	33.0	23.2	77	54	6.00	7.18	6.40
July	27.8	22.0	88	80	196.6	2.70	2.08
August	27.0	21.0	89	80	129.8	2.94	1.39
September	29.2	20.7	87	70	0.00	3.33	5.06
October	32.0	17.5	90	77	154.4	5.30	5.34
November	31.0	17.0	72	55	0.00	6.00	9.31
December	30.8	14.4	79	55	0.00	6.00	8.30
January	31.7	12.0	74	39	0.00	4.23	7.57
February	32.6	14.7	70	42	0.00	5.77	9.40

Recent Publications









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

Phone: 02135- 222697, 222026 Fax: 02135- 224056 Gram: Onionsearch
E-mail: director@dogr.res.in, aris@dogr.res.in Website: http://www.dogr.res.in

DOGR