ANNUAL REPORT

2000-2001

NATIONAL RESEARCH CENTRE
FOR ONION AND GARLIC
RAJGURUNAGAR, DIST. PUNE 410 505.
(MAHARASHTRA) INDIA.

NRCOG

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INDIAN COUNCIL OF AGRICULTURAL RESEARCH

RAJGURUNAGAR, DIST. PUNE 410 505. (MAHARASHTRA) INDIA.

NRCOG

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EXECUTIVE SUMMARY

The National Research Centre for Onion and Garlic has completed three years of its existance at Rajgurunagar since its shifting from Nashik. During these three years the centre has made few strides in different areas of onion and garlic research planning. The research at the centre is conducted under four broad themes viz., Crop Improvement, Crop Production, Crop Protection and Post Harvest Technology. A few salient acheivements of the centre during 2000-2001 are summarized below :

In Crop Improvement, germplasm collection from Gujarat and Orissa was done. Germplasm evaluation in onion and garlic on the basis of seasonal adaptability, colour uniformity and productivity was done to identify lines with desirable horticultural traits. This is an ongoing process and will take minimum of four to five years to identify desirable promising lines. In addition to this, maintenance of germplasm in onion and garlic is a priority issue keeping in mind the biodiversity issues. The centre procured wild species from Centre for Genetic Resources, Netherlands for evaluation and maintenance purpose. Moreover, commercial varieties of onion and garlic are being evaluated for their seasonal adaptability and improvement purpose. Among them Baswant 780 was found suitable for *kharif* and *late kharif* season, while N-2-4-1 and Arka Niketan were found best varieties for *rabi* season. Incidently these *rabi* season varieties had better storability also. With the growing interest in biotechnology, scientists are involved in developing protocol for onion haploids and for somaclones in garlic. Although a small step towards fulfilment of this goal has been undertaken, the future research will focus on molecular characterisation of varieties for their identification status.

Heterosis breeding in onion has been lacking in onion because of its biennial nature and heterozygosity coupled with inbreeding depression. The result is that only one or two commercial hybrids are available. Hence work on development of onion hybrids has been taken up to answer the future need of export oriented market.

In Crop Production, emphasis on development of suitable cropping system to make onion cultivation lucrative and a monetarily rewarding profession is underway. Foreseeing the future problem of labour and water scarcity, research on efficient utilisation of water through drip and sprinkler irrigation has been taken up. From this year's study, it was clear that drip and sprinkler are economical in terms of water usage with an added advantage of increased production. More trials at the centre and farmer's field are needed to make farmers aware and confident of this technology. In addition, research on implementation of direct seeding method and use of bigger cloves for garlic as planting material is underway to minimise cost of production and increase return per acre.

This year the soil map of the experimental field was built to characterise the soil properties and in order to foretell the effect of micro and macro elements on research trials and soil health. It is a well known fact that phosphorous and sulphur affect the quality of produce. Hence, experiments in this direction have been undertaken. With the concept of organic farming gaining precedence in the recent times, the centre has initiated trials to develp a cost effective package for obtaining organic vegetable with good quality and economic feasibility.

In Crop Protection, diseases like purple blotch, stemphylium blight and insects like *thrips* create havoc with the crop. Hence, work on altering the date of transplanting, use of different bio-pesticides, botanicals and different fungicides are being worked out to minimise the insect pest damage. Moreover, screening of germplasm to identify new sources of resistance is also underway. Alternatively, studies to

predict the time for spraying fungicides by counting the spores and correlating with disease intensity and threshold level of *thrips* is ongoing. This will help in reducing the use of these hazardous chemicals and also the cost of production.

Onion being a highly perishable crop, losses touch almost 80% in tropical weather. Research efforts to identify lines having good storage potential, both in onion and garlic are underway.

In order to give first hand information to the farmers, the centre imparted training to farmers regarding onion and garlic production. One more publication, *'Lasoon Utpadan'* in Marathi was published by the centre for information to the farmers.

This year, the centre in collaboration with Indian Society of Vegetable Sciences and National Horticultural Research and Development Foundation, Nashik, organized a National Symposium on 'Onion and Garlic Production and Post Harvest Management – Challenges and Strategies' at Yashawantrao Chavan National Open University, Nashik.The Hon'ble Union Minister for Agriculture, Sh. Nitish Kumar inaugurated the symposium, where, about 170 scientists, private agencies, experts, planners and policy makers from all over the country had participated.

The foundation stone laying ceremony of laboratory-cum-administrative building of the centre was organized on 18th November, 2000 with Dr. R.N. Pal, Dy. Director General (Hort.) as chief guest for this occasion. The *bhoomi poojan* ceremony was done by Dr. R.N. Pal, Dr. B.S. Dhankar welcomed the dignitaries on the behalf of the centre and Dr. Kirti Singh summarised the development of the centre from its inception to present state of development. All the dignitaries appreciated the enthusiastic efforts of the staff towards the overall growth in infrastructure and research achievements. Shri. Narayanrao Pawar advised the farmers to adopt new technology for better yield and higher benefits from onion and garlic crop. Shri. B.B. Gupta, SE, CPWD gave the details of the proposed building, which will occupy an area of 15000 sq. feet and will cost Rs. 2.25 crores.

CONTENTS

Common Abbreviations used :

AGB	A Grade Bulbs
B	Bolters
BGB	B Grade Bulbs
C	Colour
CGB	C Grade Bulbs
D	Doubles
DAP	Days After Planting
DAS	Days After Sowing
DM	Days of Maturity
DOH	Date of Harvesting
DOP	Date of Planting
DOS	Date of sowing
DOT	Date of Transplanting
ED	Equatorial Diameter
EIL	Economic Injury Level
FRBD	Factorial Randomised Block Design
FYM	Farm Yard Manure
LA	Leaf Angle
LC	Leaf Colour
LR	Light Red
LW	Leaf Waxiness
MR	Medium Red
NOC	No. of Cloves
NOL	No. of leaves
NT	Neck Thickness
P	Pink
PD	Polar Diameter
PE	Pan Evaporation
R	Red
RBD	Randomised Block Design
SLB	Stemphylium Leaf Blight
TSS	Total Soluble Solids
W	White
Y	Yellow

I. INTRODUCTION

National Research Centre for Onion and Garlic was established on 4th July, 1994 during the VIII plan with its headquarters at Nashik, a concentrated onion growing area of Maharashtra. The Centre was having 100 acres of research farm at Pimpri which is 40 kms away from Nashik city. The establishment and development of the centre suffered due to remoteness of farm, shortage of irrigation water, delay in recruitment of scientific staff including the Director and other administrative matters. Keeping in view the lacunae, ICAR took the decision for shifting the centre to Rajgurunagar in Pune District. The centre started active functioning at the new location since June 1998.

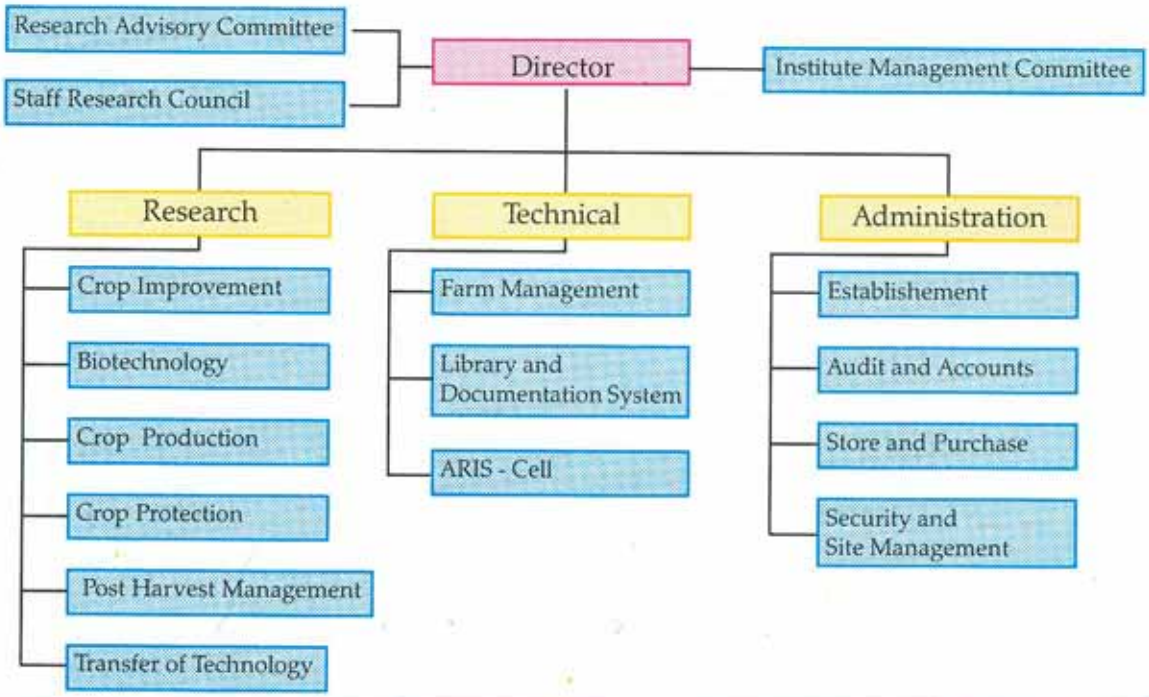
Location :

he centre is located at Rajgurunagar, 43 kms away from Pune city on Pune-Nashik highway with a latitude of 18.32°N and longitude 73.51°E and is 553.8 m high above m.s.l.. The temperature ranges between 7.6°C to 40.3°C with a total rainfall of 550 mm. The centre is located 3 km from Rajgurunagar tehsil headquaters.

Mandate :

- To collect, maintain and act as a national repository for onion and garlic
- To develop hybrids/varieties suitable for domestic as well as export market coupled with resistance to biotic and abiotic stresses.
- To enhance and sustain productivity and quality of seed as well as bulb crop through agronomic manipulations.
- To develop packages for post harvest handling and value addition.
- To act as clearing house of research and general information relating to onion and garlic.

ORGANOGRAM OF NRC ONION & GARLIC



About the centre

Immediately after the establishment of the centre at Rajgurunagar, emphasis was given for creation of infrastructural facilities at the site. Since the regional station of CPRI was under the process of closing, it suffered badly for want of maintenance and timely repairs.

Farm :

The centre has a total area of 21.954 ha, out of which 16.06 ha is available for conducting experiments while the remaining is under structure and earmarked for civil works and landscaping. The farm was levelled and properly demarcated having about 0.8 ha in each plot. All the unwanted plants growing on the bunds were cleared. The old irrigation system was completely changed and reinstalled with PVC underground pipeline with openings for every 0.8 ha block. The irrigation well has been renovated. Faclities for conducting experiments on micro irrigation and fertigation have been developed. Boundries of farm on all sides are protected by providing compound wall and barbed wire fencing. Farm roads was renovated with appropriate layouts.

Office cum laboratory :

The office has been established in the 7 rooms of old CPRS building. There were two storage structures and four residential quarters occupied by the CPRS staff. All the structures were 30 years old and were badly in need of repair because of leakage and poor electricity connections. The office building, laboratories, stores and quarters have been renovated. The main gate and the approach road were also given a facelift.

Atomic Absorbtion Spectrophotometer

Shaping up of the Horticulture, Plant Biotechnology, Soil Science and Plant Protection laboratories and equipping them with necessary equipments is completed. The plan for new administrative cum laboratory building and residential quarters was approved to the tune of 247 lakhs. Foundation stone was laid down on 18.11.2000. The construction work is in progress and will be handed over in Feb-March, 2002.

Library :

A part of the laboratory has been modified into the library cum conference hall. Books and journals worth Rs. 3.82 lakhs have been purchased in the current year. Current contents on CD-ROM and Hort-CD have been made available for reference. Presently 126 books have been purchased and 2 international and 20 national journals are being subscribed regularly. Students of MPKV, Rahuri have used Hort-CD facilities besides being used by the staff.

Administration :

The administration section comprising of establishment, audit and accounts, cash & bill and stores section is effectively providing all the required research support.

ARIS Cell :

As per the directions and specification from ADG (ARIS), an ARIS cell has been initiated with complete E-mail and Internet facilities. ARIS cell is equipped with 11 computers, five printers and one scanner, connected with Local Area Network. ARIS Cell also maintains market data of onion as well as meterological data from the year 1992.

Technical Cell :

Three technical bulletins in Marathi have been published for the use of farmers.

Agro-Meterological observatory :

The old CPRS farm has an agro-meteorological observatory at the centre. Parameters like weekly total rainfall, minimum and maximum temperature, relative humidity and evaporation for the period April 1998 to March, 1999 are available. We have data base of meterological parameter from 1992 onwards.

Table 1 : Evaluation of onion germplasm during *kharif*, 2000

Acc. No.	Pl. Ht. (cm)	NOL	PD(cm)	ED(cm)	NT(cm)	TSS (°B)	Mkt. Yield (t/ha)
509	36.0	5.1	3.72	4.24	0.32	9.08	10.0
508	42.6	6.4	4.32	4.14	0.26	9.95	13.5
506	38.0	6.3	3.50	4.28	0.42	9.70	10.0
510	43.6	5.3	3.58	4.18	0.34	9.91	12.0
503	46.7	6.0	3.88	3.88	0.38	9.96	10.5
515	41.2	6.2	3.78	4.70	0.30	10.39	09.5
502	39.7	5.5	3.86	4.10	0.48	11.37	04.0
514	40.7	7.0	3.46	4.46	0.22	9.38	09.5
505	34.1	5.9	4.57	4.47	0.30	9.89	09.5
519-R	38.1	7.0	4.08	4.44	0.38	10.69	12.5
520	37.4	6.0	4.36	4.58	0.38	8.71	09.3
519-W	27.7	6.0	3.54	4.16	0.32	8.64	07.0
522	39.8	6.4	3.50	4.14	0.24	10.71	03.0
529	35.8	4.5	4.20	4.18	0.38	9.82	12.8
533	38.2	5.6	3.50	4.08	0.24	9.82	07.8
523	48.5	6.9	3.63	4.43	0.27	9.40	10.8
525	49.4	6.9	3.90	4.40	0.34	9.36	08.5
527	33.7	5.0	4.26	4.74	0.36	9.52	10.5
535	46.1	7.0	4.56	3.74	0.32	10.57	13.5
528	49.1	7.9	4.14	5.06	0.36	10.22	12.5
502-S	44.3	6.5	3.66	4.04	0.38	10.36	10.0
FS-84	43.7	7.0	3.66	4.38	0.74	10.17	11.0
505-S	32.4	6.5	4.04	3.80	0.34	9.39	14.5
B-780	47.1	7.1	4.53	5.28	0.52	12.03	18.0
CD(0.05)						1.17	0.39

Table 2 : Evaluation of onion germplasm during *rangda* 2000

Acc. No.	PD (cm)	ED (cm)	NT (cm)	Mkt. Yield	TSS (°B)	Doubles (%)	Bolters (%)	Bulb Colour
574	4.77	5.31	0.53	39.5^{yl}	13.7	9.80	0.98	MR
678	4.99	6.11	0.70	36.3^{yl}	12.5	9.09	3.03	R
616	4.68	5.50	0.80	36.0^{yl}	13.3	11.50	0.00	R
636	4.95	5.41	0.76	34.5^{yl}	13.7	25.44	1.75	LR
637	5.06	5.57	0.82	34.3^{yl}	14.1	13.59	9.71	LR
634	5.09	5.86	0.92	34.0^{yl}	12.2	27.43	1.77	LR
685	4.97	5.73	0.75	33.5^{yl}	14.0	5.36	3.57	LR
B-780	5.14	6.40	0.95	48.3x	11.5x	0.00	9.09	R
N-2-4-1	4.93	5.37	1.19	30.8y	13.0y	21.74	4.35	LR
CD (0.05)		12.3	2.5					

Table 2.1 : For TSS (°B)

Acc. No.	PD (cm)	ED (cm)	NT (cm)	Mkt. Yield (t/ha)	TSS (°B)	Doubles (%)	Bolters (%)	Bulb Colour
559	4.61	5.74	0.89	22.3	16.3y	15.31	3.06	R
631	5.11	5.51	1.09	24.0	15.1	0.00	14.58	LR
638	4.89	5.43	0.81	17.5	15.1	15.09	33.96	LR
614	5.10	4.89	0.79	29.5	15.0	11.65	2.91	R
674	5.34	5.60	0.63	27.5	15.0	22.94	7.34	R
741	1.80	2.23	0.38	2.3	15.0	60.87	8.70	LR
581	4.44	4.60	0.83	16.5	14.9	13.54	7.29	LR
603	4.94	5.41	0.61	19.0	14.9	23.36	11.21	R
590	5.14	5.67	0.76	20.3	14.8	12.50	3.33	LR
686	5.34	6.27	1.10	27.0	14.8	6.93	10.89	R
554	4.80	5.29	0.87	22.5	14.7	5.66	11.32	R
625	5.60	5.96	0.89	13.0	14.7	39.34	8.20	R
645	4.81	5.43	0.84	15.0	14.6	39.60	7.92	LR
680	5.25	5.38	0.65	27.6	14.6	17.24	10.34	R
655	5.07	6.05	0.94	24.3	14.4	13.39	40.18	LR
551	5.02	4.75	1.12	12.8	14.3	1.12	16.85	LR
547	4.76	5.38	0.75	26.3	14.2	15.69	8.82	LR
576	4.71	5.30	0.84	16.8	14.2	6.90	12.07	LR
589	4.44	5.27	0.92	20.0	14.2	15.00	7.00	R
624	4.69	5.29	1.01	18.3	14.2	13.39	9.82	LR
649	5.59	5.93	0.83	24.3	14.2	49.54	0.00	LR
684	5.00	5.22	0.77	12.0	14.2	41.51	18.87	LR
739	3.60	4.49	0.83	6.0	14.2	39.74	7.69	LR
542	4.61	5.40	0.60	17.5	14.1	32.22	8.89	R
567	4.15	4.78	0.76	14.5	14.1	17.35	8.16	LR
591	4.85	5.50	0.93	19.3	14.1	28.57	7.79	R
611	5.21	5.58	1.08	20.3	14.1	15.45	2.73	LR
637	5.06	5.57	0.82	34.3y1	14.1	13.59	9.71	Lr
642	4.89	5.48	1.11	12.8	14.1	15.93	30.97	Lr
652	5.13	6.10	1.09	5.5	14.1	51.35	24.32	R
B-780	5.14	6.40	0.95	48.3x	11.5x	0.00	9.09	R
N-2-4-1	4.93	5.37	1.19	30.8y	13.0y	21.74	4.35	LR
CD (0.05)				12.3	2.5			

Table 2.2 For doubles (%)

Acc. No.	PD (cm)	ED (cm)	NT (cm)	Mkt. Yield (t/ha)	TSS (°B)	Doubles (%)	Bolters (%)
631	5.11	5.51	1.09	24.0	15.1	0.00	14.58
551	5.02	4.75	1.12	12.8	14.3	1.12	16.85
635	5.28	5.61	1.10	23.8	13.8	1.16	2.33
822	4.90	6.18	0.64	18.3	11.6	5.21	45.83
685	4.97	5.73	0.75	33.5y1	14.0	5.36	3.57
554	4.80	5.29	0.87	22.5	14.7	5.66	11.32
576	4.71	5.30	0.84	16.8	14.2	6.90	12.07
686	5.34	6.27	1.10	27.0	14.8	6.93	10.89
600	4.71	5.32	0.82	25.3	13.0	7.78	13.33
568	4.82	5.25	0.73	21.5	12.4	8.00	23.00
B-780	5.14	6.40	0.95	48.3x	11.5x	0.00	9.09
N-2-4-1	4.93	5.37	1.19	30.8y	13.0y	21.74	4.35

Table 2.3 For bolters (%)

Acc. No.	PD (cm)	ED (cm)	NT (cm)	Mkt. Yield (t/ha)	TSS (°B)	Doubles (%)	Bolters (%)
616	4.68	5.50	0.80	36.0y1	13.3	11.50	0.00
588	5.02	6.07	0.67	27.5	12.4	12.50	0.00
607	4.25	4.94	0.72	18.8	13.2	23.00	0.00
596	4.69	5.31	0.78	22.3	13.9	25.26	0.00
539	4.87	4.99	1.11	8.5	13.5	31.31	0.00
740	4.23	5.04	0.79	11.5	13.9	44.74	0.00
649	5.59	5.93	0.83	24.3	14.2	49.54	0.00
574	4.77	5.31	0.53	39.5y1	13.7	9.80	0.98
555	4.86	5.19	0.93	8.5	13.8	55.88	0.98
B-780	5.14	6.40	0.95	48.3x	11.5x	0.00	9.09
N-2-4-1	4.93	5.37	1.19	30.8y	13.0y	21.74	4.35

Table 3.1 : For TSS (°B)

Acc.No.	PD (cm)	ED (cm)	NT (cm)	TSS (°B)	Mkt. Yield (t/ha)
674	4.60	5.65	0.75	15.1	37.8
741	4.00	5.35	0.55	14.5	5.00
567	5.15	5.90	0.90	14.3	41.8
561	5.10	5.95	0.80	14.3	39.8
677	5.00	6.10	0.85	14.2	59.5
606	5.35	6.20	0.80	14.2	40.3
738	4.50	6.30	0.55	14.1	27.5
739	4.25	5.75	0.50	14.1	29.8
554	5.35	6.50	0.70	14.0	36.3
N-2-4-1	5.10	6.00	1.00	12.9[x]	51.3[x]
ALR	4.90	5.85	0.85	14.6[y]	49.3[y]
A. Niketan	5.00	6.15	0.90	13.0[z]	34.8[z]
CD(0.05)				2.51	20.79

Table 3 : Promising lines of *rabi* onion germplasm on the basis of marketable yield (t/ha)

Acc.No.	PD (cm)	ED (cm)	NT (cm)	TSS (°B)	Mkt. Yield (t/ha)
618	4.95	5.95	0.85	13.6	68.8[a1]
574	4.80	5.85	0.60	13.5	60.0[a1]
677	5.00	6.10	0.85	14.2	59.5[a1]
624	5.45	5.75	0.90	13.0	59.3[a1]
632	4.55	5.65	0.90	13.2	58.0[a1]
600	5.45	6.45	0.55	12.8	57.5[a1]
686	4.95	5.85	0.70	12.5	57.5[a1]
625	5.30	5.65	0.50	13.7	57.0[a1]
680	5.10	6.05	0.40	12.9	57.0[a1]
623	4.80	5.85	0.90	12.4	56.5[a1]
564	4.60	5.95	0.40	12.9	56.0[a1]
N-2-4-1	5.10	6.00	1.00	12.9[x]	51.3[x]
ALR	4.90	5.85	0.85	14.6[y]	49.3[y]
A. Niketan	5.00	6.15	0.90	13.0[z]	34.8[z]
CD (0.05)				2.51	20.79

Table 3.2 : For doubles (%)

Acc. No.	PD (cm)	ED (cm)	NT (cm)	TSS (°B)	Mkt. Yield (t/ha)	Doubles (%)	Bolters (%)
N-2-4-1	5.10	6.00	1.00	12.9x	51.3X	9	9
ALR	4.90	5.85	0.85	14.6y	49.3Y	16	1
A.Niketan	5.00	6.15	0.90	13.0z	34.8Z	5	37
545	5.30	6.20	0.85	12.7	49.5	0	11
655	5.00	5.95	0.75	13.3	37.3	1	32
631	5.25	5.95	0.95	12.3	55.3	2	6
574	4.80	5.85	0.60	13.5	60.0[a1]	3	0
507	5.15	5.80	0.65	12.9	50.7	3	5
618	4.95	5.95	0.85	13.6	68.8[a1]	3	0
627	5.25	5.75	0.70	12.9	53.8	4	14
576	5.35	6.30	0.60	11.8	51.3	4	7
613	5.00	6.55	0.75	11.5	46.5	4	11
536	4.95	5.65	0.75	12.6	54.5	4	9
553	5.05	5.80	0.75	13.3	54.3	4	15
547	4.95	5.95	1.05	13.1	51.3	4	21

Table 3.3 : For bolters (%)

Acc. No.	PD (cm)	ED (cm)	NT (cm)	TSS (°B)	Mkt. Yield (t/ha)	Doubles (%)	Bolters (%)
N-2-4-1	5.10	6.00	1.00	12.9x	51.3[x]	9	9
ALR	4.90	5.85	0.85	14.6y	49.3[y]	16	1
A.Niketan	5.00	6.15	0.90	13.0z	34.8[z]	5	37
574	4.80	5.85	0.60	13.45	60.0[x1]	3	0
618	4.95	5.95	0.85	13.6	68.8[x1]	3	0
624	5.45	5.75	0.90	13.0	59.3[x1]	9	0
611	5.30	6.05	1.15	12.1	54.3	14	0
564	4.60	5.95	0.40	12.9	56.0[x1]	14	0
588	4.85	6.05	0.60	13.7	51.8	14	0
590	5.35	6.15	0.75	12.8	44.0	18	0
679	4.45	5.85	0.65	10.5	41.5	31	0

During *rabi* 2000, 88 lines were evaluated for yield and other horticultural traits. The experiment was laid out in randomized block design in two replications having plot size of 1mx1m area along with standard check N-2-4-1, ALR and Arka Niketan. Planting of the material was done on 22 Nov. and harvesting on 14 Mar. 2001. In terms of marketable yield expressed in terms of tons per hectare, eleven accessions performed better than the check varieties N-2-4-1, ALR and Arka Niketan (Table 3). Acc. no. 618, 574, 677, 624, 632, 600, 686, 625, 680, 623 and 564 performed significantly superior than Arka Niketan and were at par with N-2-4-1 and ALR.

In terms of TSS, nine lines were having equal or higher TSS (15.1-14.0° B) than the check varieties but no accession was having significantly higher TSS than the check variety (Table 3.1). Acc. no. 674 (15.1) recorded higher TSS among the lines evaluated during *rabi* season. Twelve lines (having doubles percentage less than 5%) were selected (Table 3.2). Acc. no 545 recorded no doubles, which can be further used for improvement work. For bolters, eight lines having no bolters were selected (Table 3.3).

Conclusion Table

Rangda

Acc.No.	Mkt. Yield (t/ha)	TSS (°B)	Doubles (%)	Bolters (%)	Bulb Colour
574	39.5	13.7	9.80	0.98	LR
616	36.0	13.3	11.50	0.00	LR
637	34.3	14.1	13.59	9.71	LR
B 780	48.3	11.5	0.00	9.09	R
N-2-4-1	30.8	13.0	21.74	4.35	LR

Rabi

Acc.No.	Mkt. Yield (t/ha)	TSS (°B)	Doubles (%)	Bolters (%)	Bulb Colour
618	68.9	13.6	3	0	LR
574	60.0	13.5	3	0	LR
677	59.5	14.2	*	*	LR
N-2-4-1	51.3	12.9	9	9	LR
ALR	49.3	14.6	16	1	LR
Arka Niketan	34.8	13.0	5	37	R

It is clear from the conclusion table that acc. no 574 performed better in both the seasons, which will be used for further selection and improvement.

B.3 Promising Lines Evaluation

In *rangda* 2000, 13 lines selected in previous year on the basis of storability and TSS were evaluated along with standard check varieties N-2-4-1 and B 780 (Table 4) in a randomized block design with two replications and plot size of 2m x 1m area. The planting was done on 19 Sep. 2000 and harvesting on 3 Jan 2001. Out of the lines evaluated, acc. no. 597 recorded significantly higher marketable yield (36.16t/ha) than N-2-4-1 (25.92 t/ha) and was at par with B-780 (29.49 t/ha). For TSS, expressed in terms of percentage, acc no. 650 (14.52) and 671 (14.52) observed significantly higher TSS than N-2-4-1 (13.42) and B 780 (12.91) ,whereas, acc. no 546 (14.12) and 670 (13.75) were significantly superior than B 780 (12.91).

Table 4 : Evaluation of promising lines of onion during *rangda* season

Acc. No.	NOL	Pl. Ht. (cm)	PD (cm)	ED (cm)	NT (cm)	TSS (°B)	Mkt. Yield (t/ha)	Bulb Colour
654	6.9	49.90	4.57	5.08	0.43	12.83	24.07	LR
592	7.6	51.65	4.74	5.18	0.41	13.53	26.62	LR
651	7.9	49.35	4.77	5.10	0.58	13.15	22.16	LR
546	7.5	54.90	5.25	5.62	0.65	[2]14.12	29.80	LR
597	8.3	56.95	5.15	5.62	0.67	13.45	[1]36.16	LR
650	8.2	51.10	4.89	5.43	0.52	[1,2]14.82	25.18	R
657	8.2	48.12	5.13	5.61	0.53	13.50	23.32	LR
595	7.5	51.35	4.76	5.02	0.69	12.91	27.26	LR
670	8.7	54.90	4.93	5.35	0.63	[2]13.95	24.35	LR
571	10.1	58.18	5.02	5.41	0.57	13.43	31.21	LR
671	8.4	52.00	4.91	5.39	0.52	[1,2]14.52	31.10	LR
538	7.5	47.15	4.42	5.16	0.43	10.51	7.44	W
654-S	7.9	52.70	4.73	4.96	0.72	13.33	32.65	LR
N-2-4-1	7.6	51.90	4.81	5.37	0.65	13.42	25.92	LR
B-780	7.1	45.30	4.75	5.46	0.41	12.91	29.49	MR
CD (0.05)						0.75	7.82	

Table 5 : Evaluation of promising lines of onion during *rabi* 2000

Acc.No.	PD (cm)	ED (cm)	NT (cm)	TSS (°B)	Doubles (%)	Bolters (%)	Mkt. yield (t/ha)	Bulb Colour
597	4.7	5.6	0.7	12.2	3.5	0.8	54.6[yz]	LR
595	4.8	5.5	0.8	12.0	6.6	2.5	48.8	LR
571	4.9	5.9	0.9	13.1[z]	18.0	1.9	48.5	LR
592	4.9	5.3	1.0	13.0	7.0	4.9	46.3	LR
654	4.7	5.6	0.9	13.1[z]	16.8	8.3	44.0	LR
671	4.6	5.2	0.9	15.9[xyz]	16.6	7.4	42.7	LR
670	4.9	5.3	0.9	12.7	18.1	6.7	40.1	LR
546	5.1	5.6	0.8	12.4	14.1	10.3	40.0	LR
650	4.9	5.3	0.8	13.4[z]	6.0	8.7	33.9	R
651	4.8	5.5	0.9	13.6[z]	33.8	8.1	33.8	LR
538	4.8	5.6	0.4	11.0	37.8	34.0	9.1	W
ALR	5.4	6.5	1.0	*13.2*[y]	14.4	5.3	*55.1*[y]	LR
N-2-4-1	5.2	5.6	0.9	*13.1*[y]	8.6	12.8	*56.2*[y]	LR
B-780	4.7	5.5	0.7	*11.8*[z]	7.4	2.3	*53.8*[y]	R
CD (0.05)				1.27			8.2	

During *rabi* season, 11 lines selected on the basis of yield and other horticultural traits were evaluated along with standard check varieties N-2-4-1, ALR and B 780 (Table 5) in a randomized block design with two replications and plot size of 2m x 1m area. Planting was done on 24 Nov. 2000 and harvesting on 22 Jan 2001. Acc. no 597 (54.6t/ha) was significantly at par with B 780 (53.8t/ha) whereas, regarding TSS, acc no 671 (15.9) was significantly superior to ALR (13.2), N-2-4-1 (13.1) and B 780 (11.8). Acc. No. 571 (13.1), 654 (13.1), 650 (13.4) and 651(13.6) were significantly superior to check variety B 780 (11.8) and at par with ALR and N-2-4-1.

In both the seasons, acc no. 597 recorded significantly higher marketable yield than other accessions and acc no. 671 and 650 recorded significantly higher TSS. Moreover, acc no. 597 recorded less bolters than the check variety in *rabi* season. In future experiments, purelines of acc. no. 597 will be developed for development of varieties with higher marketable yield and of acc. no. 671 and 650 for varieties with higher TSS.

Allium spp. obtained from CGN, Netherlands

Evaluation of wild species :

Table 6 : Evaluation of *Allium* germplasm obtained from CGN, Netherlands

Date of sowing : 29.9.2000 Date of Harvesting : 18.04.2001 Plot Size : 1m x 1m

NBPGR NUMB	GENUS	SPECIES	DONOR NUMB	NOL	Pl. Ht. (cm)	LC	LA	LW	Remarks
EC 461722	ALLIUM	OSCHANINII O. Fedtsch	CGN 20169	9.5	34	A	B	A	No bulb formation
EC 461723	ALLIUM	SCHERGIANUM	CGN 18764	*	*	*	*	*	No Seed Germination
EC 461724	ALLIUM	ROYLEI Stearn	CGN 20520	7.8	35	A	B	B	No bulb formation
EC 461725	ALLIUM	TUBEROSUM Rottl.	CGN 16373	9.8	28.8	A	C	C	No bulb formation
EC 461726	ALLIUM	TUBEROSUM Rottl.	CGN 16412	7.8	26	A	B	C	No bulb formation
EC 461727	ALLIUM	AMPELOPRASUM	CGN 14711	8.4	45.8	A	C	B	No bulb formation
EC 461728	ALLIUM	AMPELOPRASUM	CGN 14710	6.4	41.8	A	B	C	No bulb formation
EC 461729	ALLIUM	AMPELOPRASUM	CGN 14712	11	54.3	A	C	A	No bulb formation
EC 461730	ALLIUM	AMPELOPRASUM	CGN 18735	*	*	*	*	*	No Seed Germination
EC 461731	ALLIUM	AMPELOPRASUM	CGN 14713	6	37	A	C	B	No bulb formation
EC 461732	ALLIUM	GUTTATUM Stev	CGN 16418	*	*	*	*	*	No Seed Germination
EC 461733	ALLIUM	SENESCENS	CGN 15758	11.6	17.4	A	B	C	No bulb formation
EC 461734	ALLIUM	GALANTHUM Kar.	CGN 18742	9.3	42.5	A	C	A	32 Bulbs (3.9 Kg) 2A/30D Grade Bulbs (Yellow & Red)
EC 461735	ALLIUM	GALANTHUM Kar.	CGN 18743	7.2	33.6	A	B	A	No bulb formation
EC 461736	ALLIUM	FLAVUM	CGN 15757	*	*	*	*	*	No Seed Germination
EC 461737	ALLIUM	ALTAICUM	CGN 14770	6.6	40.4	A	B	A	No bulb formation
EC 461738	ALLIUM	ALTAICUM	CGN 14768	*	*	*	*	*	No Seed Germination
EC 461739	ALLIUM	ALTAICUM	CGN 14769	6.6	52.8	A	A	A	No bulb formation
EC 461740	ALLIUM	ALTAICUM	CGN 14767	7.6	50.6	A	B	A	No bulb formation
EC 461741	ALLIUM	ALTAICUM	CGN 16417	7.2	47.6	A	B	A	No bulb formation
EC 461742	ALLIUM	VAVILOVII M. Pop	CGN 18744	12.8	42.8	A	B	A	No bulb formation
EC 461743	ALLIUM	VAVILOVII M. Pop	CGN 15756	12	48.6	A	C	A	40 Bulbs (4.90 Kg) 14A/11B/15D Grade Bulbs(Red & Yellow)
EC 461744	ALLIUM	VAVILOVII M. Pop	CGN 15759	13.2	44.6	A	C	A	No bulb formation
EC 461745	ALLIUM	VAVILOVII X CEPA	CGN 14771	11.2	53	A	C	A	18 Bulbs (1.5 Kg) D Grade Bulbs (Red & Yellow)
EC 461746	ALLIUM	FISTULOSUM	CGN 14760	8.4	55.2	A	C	A	No bulb formation
EC 461747	ALLIUM	FISTULOSUM	CGN 14763	9.4	55	A	A	A	No bulb formation
EC 461748	ALLIUM	FISTULOSUM	CGN 14762	7.4	52	A	A	A	No bulb formation
EC 461749	ALLIUM	FISTULOSUM	CGN 14761	7.2	54.2	A	C	A	No bulb formation
EC 461750	ALLIUM	FISTULOSUM	CGN 14766	8.2	55.8	A	C	A	No bulb formation
EC 461751	ALLIUM	FISTULOSUM	CGN 14758	9.6	50.6	A	B	A	No bulb formation
EC 461752	ALLIUM	FISTULOSUM	CGN 14764	7.4	50	A	B	A	No bulb formation
EC 461753	ALLIUM	FISTULOSUM	CGN 14765	9	57	A	B	A	No bulb formation
EC 461754	ALLIUM	CEPA	CGN 16362	12	57.4	A	C	A	No bulb formation
EC 461755	ALLIUM	CEPA	CGN 16352	*	*	*	*	*	No Seed Germination
EC 461756	ALLIUM	CEPA	CGN 15742	10.6	68.4	A	B	A	26 Bulbs A Grade (White & Yellow) 4 Kg.
EC 461757	ALLIUM	CEPA	CGN 18732	11.2	58.2	A	C	B	11 Bulbs (1.80 Kg) D Grade(Red)

EC 461758	ALLIUM	CEPA	CGN 15743	14.2	70.2	A	B	A	6 Bulbs (1.25 Kg) D Grade Bulbs
EC 461759	ALLIUM	CEPA	CGN 20187	12	70.6	A	C	A	No bulb formation
EC 461760	ALLIUM	CEPA	CGN 18752	*	*	*	*	*	No Seed Germination
EC 461761	ALLIUM	CEPA	CGN 16413	*	*	*	*	*	No Seed Germination
EC 461762	ALLIUM	CEPA	CGN 15745	13.4	69.8	A	B	A	16 BULBS (D Grade) 3.25 Kg.(Yellow)
EC 461763	ALLIUM	CEPA	CGN 18723	12	65.2	A	B	A	17 Bulbs (D Grade) 2.25 Kg (Yellow)
EC 461764	ALLIUM	CEPA	CGN 16372	10.4	63.6	A	B	B	Flowering Initiation on 19.2.2001
EC 461765	ALLIUM	CEPA	CGN 18722	12.3	63.3	A	B	B	3 Bulbs (0.4 Kg) D Grade (Yellow)
EC 461766	ALLIUM	CEPA	CGN 20179	11.6	62.6	A	C	A	43 Bulbs (1.5 Kg) C Grade Bulbs (Red)
EC 461767	ALLIUM	CEPA	CGN 15744	12.6	74.6	A	B	A	46 Bulbs (4.4 Kg) 8A/3C/35D Grade (Red & Yellow)
EC 461768	ALLIUM	CEPA	CGN 14706	11.8	64.6	A	A	A	4 Bulbs (.5 Kg) D Grade (Red)
EC 461769	ALLIUM	CEPA	CGN 20182	12	67.8	A	C	A	4 Bulbs (0.3 Kg) C Grade Bulbs (Yellow)
EC 461770	ALLIUM	CEPA	CGN 16349	13.5	71.5	A	C	A	1 (0.75) D Grade Bulb (Red)
EC 461771	ALLIUM	CEPA	CGN 15740	11.6	67.4	A	B	A	Flowering on 28.2.2001
EC 461772	ALLIUM	CEPA	CGN 20180	13	49	A	C	A	No bulb formation
EC 461773	ALLIUM	CEPA	CGN 15739	*	*	*	*	*	No Seed Germination
EC 461774	ALLIUM	CEPA	CGN 18762	13.2	55.6	A	C	B	14 Bulbs (1.0 Kg) D Grade Bulbs (White)
EC 461775	ALLIUM	CEPA	CGN 15741	12.4	67.8	A	B	A	27 Bulbs (4.7 Kg) 5A/3C/19D Grade Bulbs (Yellow & Red)
EC 461776	ALLIUM	CEPA	CGN 14725	14.4	67	A	A	B	19 Bulbs (3.5 Kg) 2A/17D Grade Bulbs (Red & Yellow)
EC 461777	ALLIUM	CEPA	CGN 16415	*	*	*	*	*	No Seed Germination
EC 461778	ALLIUM	CEPA	CGN 14707	13.4	68	A	A	A	56 Bulbs (5.60 Kg) 10A/12B/34D Grade Bulbs (Red & Yellow)
EC 461779	ALLIUM	CEPA	CGN 15746	11	76	A	B	B	8 Bulbs (Yellow) 1 White 5A/3B 1.5Kg.
EC 461780	ALLIUM	CEPA	CGN 14736	13.4	66.8	A	C	A	No bulb formation
EC 461781	ALLIUM	CEPA	CGN 18761	7.6	64.8	A	A	A	No bulb formation
EC 461782	ALLIUM	CEPA	CGN 15747	12.6	57.6	A	C	A	No bulb formation
EC 461783	ALLIUM	CEPA	CGN 16351	11.6	70.4	A	B	A	9 Bulbs (1.45 Kg) 1 A/ 8D Grade Bulbs (Red & Yellow)
EC 461784	ALLIUM	CEPA	CGN 20186	11.6	72.4	A	C	A	9 Bulbs (0.6 Kg) D Grade Bulbs (Red & Yellow)
EC 461785	ALLIUM	CEPA	CGN 18759	9.6	55.8	A	C	B	Flowering Initiation on 8.03.2001

EC 461786	ALLIUM	CEPA	CGN 18750	13.7	51	A	C	B	3 Bulbs (0.6 Kg) D Grade (White)
EC 461787	ALLIUM	CEPA	CGN 14738	11.6	74	A	C	B	38 Bulbs (1.5 Kg) C Grade Bulbs (Yellow)
EC 461788	ALLIUM	CEPA	CGN 20172	14	67	A	A	A	Flowering initiation

Leaf Colour	A - Dark Green	B = Mid Green	C - Light green
Leaf Angle	A - Erect	B= Moderately Erect	C - Leaves fall down easily
Leaf waxiness	A - Waxy	B= Moderately Waxy	C - Non Waxy

GARLIC GERMPLASM

Evaluation of garlic germplasm

During *rabi* 2000, 117 garlic accessions were evaluated along with the standard check variety G 41 in a randomised block design having two replication with a plot size of 1m x 1m area. Planting was done on 27 Oct. and harvesting on 12 March 2001. Two recommended varieties of Gujarat, GG2 and GG3 were also used for evaluation along with the germplasm lines.

No line performed significantly superior over the check variety G 41. Ten accessions recorded gross weight (including leaves) at par with the check variety G 41 (Table 7). Regarding number of cloves per bulb (Table 7.1) ten accessions having less number of cloves were selected with cloves ranging from 10-13 per bulb. On the basis of average weight of 50 cloves (Table 7.2), eight lines exhibited weight significantly at par with G 41 (50 gm). Acc no 316 (70gm) recorded highest weight among the germplasm lines. For average weight of five bulbs (Table 7.3), acc. no. 329 showed significantly at par level with G 41 (12.5) whereas other lines having weight greater than 100 gm were selected for further clonal selection. On the basis of overall performance and their selection for various traits, some germplasm lines were selected for further improvement (Table 7.4)

Elite Germplasm Evaluation

Some germplasm lines selected on the basis of vigour and plant stand for previous two years (1998-2000) were evaluated to study their performance along with the check variety G-41 in a randomized block design with two replications. Plot size was 2m x 1m and the date of planting and harvesting were 27 Oct 2000 and 16 March 2001, respectively.

In terms of gross weight per plot, no accession was found to be superior than the check variety G 41. However, six accessions recorded significantly at par yield with G 41 (3.37 Kg/plot). Acc. no 183 (3.94 Kg/plot) recorded higher yield among the germplasm lines studied (Table 8).

For average number of cloves per bulb (Table 8.1), five accessions were recorded to have less number of cloves per bulb ranging from 14-18 cloves per bulb. Whereas, five accessions were found to be significantly at par with G 41 in terms of average weight of 50 cloves (Table 8.2). Acc no 100 (52.5gm) recorded higher weight within the lines and also G 41 (47.5 gm). In terms of average weight of 5 bulbs, acc no 183 , 263 and 74 recorded significantly at par weight with G 41 (Table 8.3).

Germplasm Maintenance

Bulbs of 165 lines of *rabi* onion lines and 23 lines of *kharif* onion were planted for seed production. Seeds have been harvested, cleaned and stored for evaluation in next season.

Resistance to biotic and abiotic stresses

Germplasm was provided to entomology and pathology for screening against pests and diseases during *kharif*, *rangda* and *rabi* season.

In addition to this, interspecific hybridiza-

tion work was initiated between *Allium cepa* and *Allium fistulosum*. In *rabi* 1999-00, crosses between N-2-4-1 and *A. fistulosum* were carried and the material obtained has been planted for evaluation purpose. Also *Allium fistulosum* lines viz., TA 104, TA 106 and AF 468 were planted for crossing with ALR, Phule Safed, Arka Kalyan, B-780, Punjab Naroha, N-2-4-1 and Arka Niketan using *A. cepa* as female and also in reciprocal crosses. The main idea is to study the effect of genotypes on crossing behavior and to vouch for plants having desirable genes of interest.

Table 7 : Evaluation of Garlic Germplasm

Acc. No.	Colour	Pl. Ht. (cm)	NOL	Leaf area (cm^2)	Gross yield (t/ha)	PD (cm)	ED (cm)	NT (cm)	No Clv/blb	Wt. 50 Clv (gm)	Wt. 5 Blbs. (gm)
316	W/P	55.9	9.6	59.0	21.5	3.33	3.30	0.92	20	70.0	115.0
200	W	54.3	10.6	51.0	18.4	2.98	3.03	0.94	19	37.5	80.0
303	W/R	55.0	9.4	54.6	15.3	2.36	2.87	0.69	12	62.5	77.5
320	W/P	65.5	9.9	58.2	13.9	2.41	3.24	0.76	34	15.0	67.5
237	W/P	57.0	10.7	50.1	12.7	2.49	2.74	0.96	21	25.0	60.0
88	W	62.8	9.5	39.2	12.3	2.47	2.77	0.69	25	20.0	70.0
279	W/P	60.1	9.4	50.0	12.3	2.70	3.10	0.65	32	27.5	80.0
177	W/P	62.4	8.2	50.6	12.3	2.83	3.10	0.65	16	55.0	90.0
281	W/P	70.8	10.7	57.6	12.2	2.39	3.23	0.73	29	32.5	75.0
G-41	W	60.2	11.1	60.5	18.8	3.22	3.36	1.02	23	50.0	122.5
CD (0.05)					6.10						

Table 7.1 : For No. of Cloves per Bulb

Acc. No.	Colour	Pl. Ht. (cm)	NOL	PD (cm)	ED (cm)	NT (cm)	Gross yield (t/ha)	No Clv./blb	Wt. 50 Clv (gm)	Wt. 5 Blbs. (gm)
326	W	58.3	9.6	2.41	2.73	0.81	6.70	10	30.0	50.0
323	W	58.4	9.7	2.47	2.46	0.92	6.30	11	32.5	37.5
GG 3	W	59.9	10.9	2.41	2.48	0.81	5.50	11	27.5	42.5
303	W/R	55.0	9.4	2.36	2.87	0.69	15.30	12	62.5	77.5
220	W	64.3	11.1	2.18	2.92	0.93	7.70	12	45.0	55.0
332	W	62.3	9.3	2.57	2.75	0.90	7.80	12	40.0	45.0
203	W	66.1	9.8	1.95	2.81	0.85	10.60	12	30.0	47.5
297	W	64.8	9.2	2.30	2.55	0.74	8.30	13	37.5	52.5
322	W	58.5	10.6	2.43	2.61	0.77	10.00	13	30.0	42.5
95	W	48.2	8.9	2.45	2.55	0.96	4.90	13	30.0	47.5
G-41	W	60.2	11.1	3.22	3.36	1.02	18.80	23	50.0	122.5

Table 7.2 : For Average weight of 50 Cloves (gm)

Acc. No.	Colour	Gross Yield (t/ha)	No Clv/blb	Wt. 50 Clv (gm)	Wt. 5 Blbs.(gm)
316	W/P	21.50	20	70.0	115.0
303	W/R	15.30	12	62.5	77.5
321	W/P	12.50	18	62.5	115.0
48	W/P	8.30	15	55.0	75.0
315	W/P	10.80	15	55.0	75.0
177	W/P	12.30	16	55.0	90.0
292	W	7.70	17	55.0	95.0
299	W	5.50	17	52.5	80.0
G-41	W	18.80	23	50.0	122.5
CD(0.05)				23.8	

Table 7.3 : For average weight of 5 Bulbs (gm)

Acc. No.	Colour	Pl. Ht. (cm)	Gross Yield (t/ha)	No. Clv./blb	Wt. 50 Clv (gm)	Wt. 5 Blbs. (gm)
329	W	65.8	10.9	27	50.0	132.5
316	W/P	55.9	21.5	20	70.0	115.0
321	W/P	56.2	12.5	18	62.5	115.0
302	W/P	60.0	5.7	22	40.0	100.0
G-41	W	60.2	18.8	23	50.0	122.5
CD(0.05)						44.5

Table 7.4 : Performance of few promising lines of garlic

Acc No	Gross Wt. (t/ha)	No Clv/Blb	Wt. 50 Clv. (gm)	Wt. 5 Blbs (gm)
316	21.5	20	70.0	115
303	15.3	12	62.5	77.5
321	12.5	18	62.5	115
G 41	18.8	23	50.0	122.5

Table 8: Evaluation of Elite Germplasm for Gross Yield(t/ha)

Acc No.	C	Leaf Area (cm)	Gross Yield (t/ha)	PD (cm)	ED (cm)	NT (cm)	NoClv./Blb	Wt. 50 Clv (gm)	Wt. 5 Blb (gm)
183	W	48.7	19.7	3.22	3.62	1.27	31	47.5	130.0
219	W/P	42.9	18.8	3.16	3.44	1.05	24	42.5	105.0
221	W	47.8	18.8	3.08	3.45	1.13	22	50.0	112.5
200	W	50.2	18.6	3.21	3.43	1.06	23	50.0	115.0
229	W	43.9	18.0	3.03	3.12	0.86	22	47.5	102.5
263	W/P	44.9	17.2	3.07	3.43	1.14	29	47.5	125.0
G-41	W	47.4	16.9	3.11	3.30	0.95	24	47.5	117.5
CD(0.05)			7.2						

Table 8.1 For average no. of Cloves per Bulb

Acc No.	Colour	Gross Yield (t/ha)	NoClv./Blb	Wt. 50 Clv (gm)	Wt. 5 Blb (gm)
50	W/P	13.0	14	35.0	57.5
61	P	9.8	16	42.5	67.5
38	W/P	11.6	17	40.0	46.5
66	W/P	9.0	18	35.0	70.0
GG 2	W	5.9	18	27.5	52.5
G-41	W	16.9	24	47.5	117.5

Table 8.2 : For Average Weight of 50 Cloves (gm)

Acc No.	Colour	Gross Yield (t/ha)	NoClv./Blb	Wt. 50 Clv (gm)	Wt. 5 Blb (gm)
100	W/P	10.5	24	52.5	102.5
174	W/P	9.1	20	50.0	70.0
221	W	18.8	22	50.0	112.5
200	W	18.6	23	50.0	115.0
229	W	18.0	22	47.5	102.5
G-41	W	16.9	24	47.5	117.5
CD(0.05)				19.3	

Table 8.3 For Average weight of 5 bulbs (gm)

Acc No.	Colour	Gross Yield (t/ha)	PD (cm)	ED (cm)	NT (cm)	No Clv./ Blb	Wt. 50 Clv (gm)	Wt. 5 Blb (gm)
183	W	19.7	3.22	3.62	1.27	31	47.5	130.0
263	W/P	17.2	3.07	3.43	1.14	29	47.5	125.0
74	W/P	12.3	3.20	3.64	1.00	26	42.5	120.0
G-41	W	16.9	3.11	3.30	0.95	24	47.5	117.5
CD(0.05)								20.1

Screening Onion germplasm for *thrips* resistance during the year 2000

D.O.P: 20.09.2000 (*rangda*) 25.11.2000 (*rabi*) Plot size: 1 x 1 m
D.O.H: 30.01.2001 (*rangda*) 29.03.2001 (*rabi*)

During *kharif* season 35 lines of onion were preliminarily screened for thrips resistance (Table 9). 18 lines rotted because of rainfall. Among all the lines, B-780 recorded the highest yield of 19t/ha. Higher numbers of thrips were recorded in acc.nos 525(52.8/plant), 502(52.4/plant) 535(51.8/plant) and B-780 (50.6/plant).

During *rangda*, 72 lines of onion germplasm including commercial varieties B-780 and N-2-4-1 were preliminarily screened for thrips resistance (Table 10.1). The lines *viz.*, 668, 549, 623, 685, 589, 682, 562, 598, 618, Pilipatti and B-780 were found moderately resistant to thrips with leaf injury rating of 2-2.5 on a 0-5 rating scale. B-780 recorded highest yield of 47.9 t/ha (Table 10.2). Other lines that recorded better yield were accession numbers- 574, 676, 544, 576, 634, 543, 644, 618, 686, 547, 581, 616 and 682. Acc.no. 553 recorded highest number of thrips (159/plant) and leaf injury rating of 4.6.

In *rabi*, 91 lines of onion germplasm were screened for thrips resistance. All the lines were found susceptible to highly susceptible with a leaf injury rating of 3.25-5 on 0-5 rating scale(Table 11.1). Commercial variety N-2-4-1 (recommended for *rabi*) recorded rating of 4.5 (highly susceptible). However, the lines *viz.*, 686, 591, 507, 601, 542, 626, 632, 635, 545, 618, 625, 616, 648, 536, 655, 556, 567, 580, 581, 680, 590, 617, 588, 631, 634, 596, 604, 516, 593, 576, 619, 559, 624, 674, 613, 632 and 679 recorded significantly higher bulb yield than N-2-4-1 (19.4 t/ha)(Table 11.2). This shows that those entries had field tolerance against thrips. The lines with acc. no.s 541, 544, 577, 581, 588, 593, 612, 625, 687, and 742 were found highly susceptible with a rating of 5.0. The acc.no 541 recorded the highest number of thrips (509/plant).

Table 9 : Performance of onion germplasm with respect to yield and *thrips* during *kharif*, 2000

Acc.no	Thrips/Plant	Yield (t/ha)	Acc.no	Thrips/Plant	Yield(t/ha)
B780	50.6	19.0	501	45.8	0*
503	26.2	11.0	510	30.2	0
528	49.4	8.5	505	38.8	0
508	38.0	8.0	504	21.4	0
519	27.2	8.0	514	29.2	0
513	48.0	7.5	521	44.2	0
523	45.6	7.5	540	36.8	0
A.kalyan	44.2	7.0	530	25.8	0
505-S	43.2	6.5	FS-84	47.4	0
527	44.4	6.5	522	43.0	0
529	31.0	6.0	533	41.4	0
506	24.0	5.5	532	25.8	0
509	33.6	5.0	525	52.8	0
511	25.0	5.0	539	46.0	0
520	19.5	4.5	521-S	48.6	0
502	52.4	3.0	535	51.8	0
515	33.6	3.0	508-S	38.4	0
			519-S	28.2	0

* 100% Rotting

Table 10.1 : Reaction of onion germplasm against thrips during *rangda*, 2000

Acc.No.	Avg. thrips/plant	Avg. Rating*	Yield (t/ha)
668	64	2	15
549	108	2.3	24
623	65	2.3	22
685	63	2.3	32
589	75	2.4	29
682	60	2.4	34
562	67	2.5	28
598	71	2.5	14
618	69	2.5	36
Pillipatti	46	2.5	23
B780	**75**	**2.5**	**48**
N-2-4-1	**91**	**3.2**	**34**
568	172	4	16
625	85	4	27
740	62	4	9
574	161	4.1	45
577	168	4.1	31
739	146	4.4	2
553	159	4.6	11

*Rating scale used : 0-5

Highly resistant:0-1;Resistant: 1-2; Moderately resistant: 2-3; Susceptible: 3-4; Highly susceptible: 4-5

Table 10.2 : Performance of onion germplasm with respect to yield during *rangda*, 2000

Acc.No.	Average thrips/plant	Rating	Yield (t/ha)
B780	75	2.5	48
574	161	4.1	45
676	40	2.9	43
634	74	3.0	40
576	157	3.1	40
544	75	3.2	40
543	81	2.7	38
644	98	2.8	38
618	69	2.5	36
686	64	2.8	36
547	74	2.8	35
682	60	2.4	34
616	70	2.7	34
N-2-4-1	91	3.2	34

Table 11.1 : Reaction of onion germplasm to thrips during *rabi*, 2000

Acc.no	Thrips/Plant	Rating*	Yield(t/ha)	Acc.no	Thrips/plant	Rating*	Yield(t/ha)
619	191	3.25	28.5	626	324	4.25	36.0
548	184	3.50	26.3	631	309	4.25	30.8
605	207	3.50	18.4	642	368	4.25	26.3
639	135	3.50	11.3	660	353	4.25	18.8
686	198	3.50	43.5	676	307	4.25	23.3
536	378	3.75	34.1	744	205	4.25	16.1
542	308	3.75	36.0	747	153	4.25	22.1
554	146	3.75	24.8	551	289	4.50	26.3
555	236	3.75	26.6	562	225	4.50	19.5
559	277	3.75	27.8	564	259	4.50	24.8
590	103	3.75	31.1	567	334	4.50	33.0
594	164	3.75	25.5	568	231	4.50	11.6
600	245	3.75	24.0	576	179	4.50	29.3
623	210	3.75	26.3	596	423	4.50	30.0
632	241	3.75	27.0	603	201	4.50	21.8
644	208	3.75	25.1	604	365	4.50	30.0
659	229	3.75	24.8	606	164	4.50	16.1
680	204	3.75	31.5	607	336	4.50	18.8
684	99	3.75	22.9	608	170	4.50	21.0
738	173	3.75	17.6	611	253	4.50	14.6
746	186	3.75	23.3	617	234	4.50	31.1
398	352	4.00	24.8	634	326	4.50	30.4
507	274	4.00	36.8	638	459	4.50	15.8
561	373	4.00	24.8	655	138	4.50	33.8
563	163	4.00	21.8	679	311	4.50	27.0
574	226	4.00	15.0	739	297	4.50	7.5
616	301	4.00	34.5	741	400	4.50	9.8
624	180	4.00	27.8	748	180	4.50	14.3
635	139	4.00	36.0	N-2-4-1	245	4.50	19.4
648	320	4.00	34.5	541	508	5.00	16.5
743	356	4.00	11.6	544	322	5.00	16.9
745	272	4.00	24.4	577	362	5.00	25.1
747	167	4.00	18.0	581	301	5.00	32.3
537	112	4.25	13.5	588	479	5.00	30.8
545	354	4.25	35.6	593	475	5.00	29.6
591	271	4.25	39.4	612	111	5.00	24.0
596	446	4.25	16.5	625	383	5.00	35.3
613	346	4.25	27.0	687	277	5.00	18.0
618	304	4.25	35.3	742	426	5.00	18.4

*Rating scale used : 0-5

0-1: highly resistant; 1-2: resistant; 2-3: moderately resistant; 3-4: susceptible; 4-5: highly susceptible

Table 11.2 : Performance of onion germplasm with respect to yield during *rabi*, 2000

Acc.No.	Thrips/plant	Rating	Avg.Yield (t/ha)	AccNo.	Thrips/plant	Rating	Avg.Yield (t/ha)
686	198	3.50	43.5	680	204	3.75	31.5
591	271	4.25	39.4	590	103	3.75	31.1
507	274	4.00	36.8	617	234	4.50	31.1
601	179	4.75	36.4	631	309	4.25	30.8
542	308	3.75	36.0	588	479	5.00	30.8
635	139	4.00	36.0	634	326	4.50	30.4
626	324	4.25	36.0	596	423	4.50	30.0
545	354	4.25	35.6	604	365	4.50	30.0
618	304	4.25	35.3	516	289	4.75	29.6
625	383	5.00	35.3	593	475	5.00	29.6
616	301	4.00	34.5	576	179	4.50	29.3
648	320	4.00	34.5	619	192	3.25	28.5
536	378	3.75	34.1	559	277	3.75	27.8
655	138	4.50	33.8	624	180	4.00	27.8
567	334	4.50	33.0	674	457	4.75	27.4
580	308	4.75	32.6	632	241	3.75	27.0
581	301	5.00	32.3	613	346	4.25	27.0
S.E.±	3.75			679	311	4.50	27.0
C.D(0.05)	7.35			N-2-4-1	245	4.50	19.4

Screening of garlic germplasm for resistance to thrips and eriophyid mite during *rabi*, 2000

D.O.P: 2.11.2000 D.O.H: 16.3.2001 Plot size: 1 x 1 m

Out of 127 lines of garlic screened during *rabi* season, 42 lines were found resistant to eriophyid mite, *Aceria tulipae* with an injury rating of 1 on a 0-4 rating scale (Table 12.1). The commercial variety G-41 recorded a rating of 1.5. The entries with acc.no 94 and 325 were highly susceptible with a rating 4.0. Other lines, 184, 283, 284, 305, 314, 317, 323 and GG3 recorded a rating of 3.5 (highly susceptible). For thrips resistance, only one line, acc. no.43 was found moderately resistant /tolerant with a rating of 2.8 on 0-5 rating scale (Table 12.2). For rest of the lines the injury rating was ranged between 3.4-5. The entries 229, 278, 282, 296, 314, 319, 326 and 332 recorded a rating of 5 (highly susceptible). Regarding yield (Table 12.3), garlic lines with accession no.s 281, 183, 72, 263, 221, 260, 177, 217, 201 and 200 were on par with commercial variety G41 (7.2 t/ha).

Eriophyid mites & eggs in garlic leaves

Table 12.1 : Reaction of garlic germplasm against eriophyid mite during *rabi*, 2000

Rating*	Accession number	Total
0-1	5, 53, 55, 58, 59, 61, 62, 68, 72, 80, 88, 89, 90, 95, 96, 97, 98, 100, 110, 114, 117, 118, 144, 148, 151, 162, 163, 174, 175, 206, 217, 237, 260, 279, 281, 282, 291, 303, 315, 320, 328, 335	42
1-2	18, 19, 22, 31, 32, 34, 38, 40, 44, 46, 48, 51, 87, 109, 116, 153, 155, 159, 183, 199, 203, 221, 229, 253, 263, 275, 279, 285, 286, 294, 296, 302, 310, 312, 319, 329, 330, GG2, G41	39
2-3	37, 43, 50, 92, 177, 185, 196, 199, 200, 201, 219, 220, 257, 276, 278, 287, 288, 292, 293, 295, 297, 299, 300, 301, 304, 309, 313, 318, 322, 324, 326, 327, 331, 332	34
3-4	17, 94, 184, 194, 280, 283, 284, 289, 305, 314, 317, 323, 325, GG3	14

*on rating scale 0-4

0-1: resistant; 1-2: moderately resistant; 2-3: susceptible; 3-4: highly susceptible

Table 12.2 : Reaction of garlic germplasm to thrips during *rabi*, 2000

Thrips- Leaf Injury Rating	Accession number	Total
1-2	NIL	-
2-3	43	1
3-4	5, 17, 18, 19, 22, 31, 32, 34, 37, 38, 40, 44, 48, 50, 51, 53, 59, 80, 87, 88, 90, 92, 95, 97, 100,110, 144, 148, 151, 153, 155, 163, 174, 183, 184, 185, 201, 206, 217, 221, 253, 260, 263, 276, 280, 281, 283, 285, 287, 288, 297, 299, 300, 301, 302, 304, 313, 315, 319, 320, 328, 329, 335, GG2, G41,	65
4-5	46, 58, 61, 62, 68, 72, 94, 95, 96, 109, 177, 200, 203, 219, 220, 229, 237, 275, 282, 284, 286, 289, 292, 293, 295, 305, 309, 310, 322, 325, 327, 330, GG3	33

* on 0-5 rating scale

0-1: highly resistant; 1-2: resistant; 2-3: moderately resistant; 3-4: susceptible; 4-5: highly resistant

Table 12.3 : Performance of garlic germplasm with respect to yield during *rabi*, 2000

Acc. No.	Yield (t/ha)	Rating for mite	Rating for thrips	No. of thrips/plant
281	8.0	1.0	3.6	74.0
183	7.8	1.5	3.8	38.5
G41	7.2	1.5	4.0	115.8
72	6.3	1.0	4.2	93.2
263	6.3	2.0	3.8	158.2
221	6.3	2.0	3.8	147.4
260	6.0	1.0	3.4	57.2
177	5.9	3.0	4.2	118.8
217	5.7	1.0	4.0	93.8
201	5.5	2.5	4.0	86.4
200	5.4	2.5	4.2	95.0
S.E.±	1.01			
C.D.(0.05)	1.99			

Screening of onion germplasm against SLB during year the 2000

Onion germplasm was transplanted on12.07.2000 in plots of size 1 x1 m and harvested on 21.10.2000. Total 35 lines of onion ,including checks (4) were screened for Stemphylium leaf blight disease during *kharif* season (2000) (Table 13). Disease was present in all the lines.

Table 13: Screening of onion germplasm against SLB during *kharif* season

Acc No	Disease intensity (%)	Yield (t/ha)
501	05.60	5.5
502	16.00	8.0
503	12.80	15.0
505	16.80	20.0
505	17.60	10.5
505	21.60	6.5
506	16.00	14.5
508	9.60	13.5
509	15.20	13.5
510	10.40	11.0
511	12.80	2.5
513	9.60	9.5
514	14.04	10.0
515	11.20	18.0
517	8.00	9.0
519	38.40	8.5
520	12.80	11.0
521	15.20	6.0
522	16.80	3.0
523	15.20	22.0
525	7.20	22.0
527	15.20	11.0
528	12.00	16.0
529	30.40	18.0
530	30.40	18.5
532	7.20	6.0
533	20.00	9.0
535	8.80	9.0
540	10.40	5.0
505-S	24.80	11.5
519	15.20	10.0
521-1	7.20	16.0
FS-84	28.80	10.0
A.Kalyan	20.00	12.0
N-53	25.60	18.0
B-780	33.60	10.0
A.Kalyan	9.60	13.5

Disease intensity was maximum (38.4 %) in accession No.519 and minimum (5.6 %) in acc no 501. Yield was maximum (22.5t/ha) in acc no 523 while in check lines it ranged from 10 to 18 t/ha.

During *rangda* season, onion germplasm was transplanted on 20.09.2000 in 1 x 1 m size plot and harvested on 30.01.2001

Table 14 : Screening of onion germplasm for SLB during *rangda* season

Acc. No	Disease Intensity (%)	Yield (t/ha)	Acc. No	Disease intensity(%)	Yield (t/ha)	Acc. No.	Disease intensity (%)	Yield (t/ha)
516	27.2	26.0	598	22.4	13.0	634	21.6	49.0
542	24.8	21.5	599	20.0	44.0	636	24.0	36.0
543	31.2	42.0	600	32.0	42.0	638	11.2	23.0
545	19.2	45.0	601	17.8	29.0	639	20.0	09.0
547	11.2	50.0	603	19.2	25.0	642	22.4	41.5
549	17.6	48.0	604	24.8	16.0	644	17.6	46.1
549	18.0	19.0	605	36.0	11.2	645	19.2	29.5
553	28.8	07.0	607	21.6	24.0	655	20.0	19.1
554	31.2	42.5	608	31.2	25.0	659	26.4	31.5
555	23.2	33.5	611	14.4	30.0	669	24	39.0
559	28.8	30.0	612	23.2	30.0	674	15.2	32.5
561	32.8	04.1	613	18.4	32.5	676	12.0	45.0
562	25.6	33.0	614	28.8	39.0	682	34.4	41.0
563	26.4	30.0	616	21.6	49.0	685	14.4	30.0
564	27.2	31.0	617	19.2	31.0	686	16.8	38.0
567	26.4	23.0	618	29.6	45.0	738	23.2	07.5
568	28.0	47.0	623	25.6	24.0	739	20.4	06.0
574	26.4	54.0	624	19.2	30.0	740	16.8	21.0
576	18.8	66.0	625	18.4	19.5	741	28.8	02.0
577	36.0	32.0	626	16.8	01.0	N-2-4-1	15.6	47.8
581	17.6	28.0	627	15.2	32.5	B780	25.0	58.5
589	18.0	28.0	631	21.6	34.0	Pilipatti	20.0	32.0
591	19.2	16.0	632	28.0	24.5			
593	23.2	36.0						

Total 70 accession lines were screened during *rangda* season 2000 (Table 14). for stemphylium leaf blight (SLB).Minimum disease intensity of the disease was 11.20 % in accession number 547 and maximum 36% in accession no 605. The minimum yield was 16.8 t/ha in accession no 626 .The maximum yield was 67.5 t / ha in B -780 and 53 t/ha in N-2-4-1 which were used as check lines

During *rabi* season, onion germplasm was transplanted on 20.11.2000 in 1 x1 m plot and harvested on 28.03.2001.

Table 15 : Screening of onion germplasm against SLB during *rabi* season

Acc. No	Disease Intensity (%)	Yield (t/ha)	Acc. No	Disease intensity (%)	Yield (t/ha)	Acc. No.	Disease intensity (%)	Yield (t/ha)
141	10.0	33.0	588	5.6	13.0	638	7.6	19.0
343	7.2	32.0	591	8.0	24.0	642	8.0	37.5
363	9.2	27.0	593	7.0	36.5	644	11.2	15.2
516	8.0	19.0	596	5.6	19.5	648	8.0	22.0
536	8.0	42.5	600	6.4	31.7	655	3.2	20.0
538	8.0	10.0	601	7.2	36.2	659	11.2	22.0
542	8.8	28.0	603	10.8	22.0	660	7.2	25.0
545	5.6	30.0	604	8.4	13.0	680	8.8	34.5
547	6.4	26.0	606	8.0	21.0	684	6.4	20.0
549	8.8	10.0	608	7.6	16.0	727	6.0	35.0
551	8.0	32.0	611	10.0	16.2	739	6.8	14.5
559	8.0	29.0	613	8.0	38.0	740	6.8	23.0
561	7.6	23.0	614	7.2	25.0	742	8.4	22.5
563	9.2	27.0	617	6.0	20.0	743	8.4	32.7
567	4.8	22.5	618	8.8	32.0	744	9.2	22.5
568	9.6	04.0	624	8.8	14.6	745	9.6	36.5
576	9.2	30.5	625	9.1	43.7	746	8.0	27.6
577	8.0	33.7	626	9.6	50.0	747	6.8	27.5
580	7.2	34.0	631	4.0	23.7	748	8.0	33.2
581	6.8	35.0	632	5.6	22.0	N-2-4-1	8.0	24.4

Total 60 accessions including 7 from NHRDF and check were screened for SLB during *rabi* 2000-01 (Table 15). The intensity of disease was very low i.e. ranged from 4.00 to 12.2% Minimum yield was 4.0 t/ha in acc no 568 and maximum yield was 43.7 t/ha in acc no 625.

Advance garlic germplasm (*Rabi*) :

Some garlic germplasm lines screened for disease resistance in previous year were again planted for screening in 2 m x 1 m area. Planting was done as on 28.10.2000 in 1 m^2 area and harvested on 21.03.2001 (Table 16)

Table 16: Screening of advance garlic germplasm against SLB

Acc No	Disease intensity (%)	Yield (t/ha)
61	7.2	13.7
32	9.2	11.8
55	9.6	11.0
66	7.2	7.6
43	5.8	10.1
112	6.0	3.8
183	8.4	17.1
68	6.8	14.8
59	9.6	13.2
175	8.6	9.6
G-41	8.0	16.3
GG-3	8.4	5.8

Minimum disease intensity (5.8 %) was recorded in acc no 43 and maximum (9.6 %) in acc no 55 and 59. Overall disease intensity was less than 10 %. The yield was maximum (17.1 t/ha) in acc no 183 and (16.3 t/ha) in G-41. The minimum yield (3.8 t/ha) was recorded in acc no 112. .

Garlic germplasm *rabi* 2000-01

Garlic germplasm was sown on 02.11.2000 in plot size of 1 m x 1 m and was harvested on 17.03.2001.

Total 115 accession of garlic were screened for disease intensity (SLB). Minimum disease intensity (4.8%) was recorded in acc No. 163 and maximum (14%) in acc. No. 323. Overall disease intensity was less than 10 %. The maximum yield (18 t/ha) was recorded in acc.no.263. (Table 17)

Table 17: Screening of garlic germplasm against SLB during *rabi* season

Acc. No	Disease Intensity (%)	Yield (t/ha)	Acc. No	Disease intensity (%)	Yield (t/ha)	Acc. No.	Disease intensity (%)	Yield (t/ha)
05	5.40	8.30	115	12.00	9.00	283	12.00	5.20
06	7.60	5.50	117	9.20	10.35	284	9.60	7.10
11	9.60	5.40	118	10.80	6.25	285	9.60	6.05
17	9.60	5.95	144	8.40	10.55	286	9.30	2.80
18	8.80	7.50	148	5.60	6.35	287	6.40	5.85
22	8.00	8.40	152	6.00	4.25	288	9.60	10.90
31	9.20	6.80	153	9.20	7.75	289	12.00	6.80
32	8.80	7.80	155	5.60	4.75	292	8.50	8.30
34	8.00	4.85	159	8.80	5.94	293	7.20	8.15
37	12.00	10.20	161	10.40	7.70	294	10.80	7.00
40	8.80	5.65	162	10.40	5.70	295	9.60	8.10
43	9.20	6.25	163	4.80	9.85	296	7.20	1.15
44	11.20	9.70	174	8.00	9.20	297	8.80	10.85
46	9.40	8.15	175	8.40	6.25	300	8.80	5.25
48	6.80	8.50	176	7.20	7.60	301	6.40	3.40
49	10.00	11.30	177	8.50	8.55	302	10.80	7.85
50	8.40	11.10	183	9.60	16.20	303	8.00	8.30
51	7.60	10.55	185	12.00	1.70	304	8.40	4.27
53	8.80	14.20	188	5.60	5.05	305	9.60	8.4
55	20.40	8.10	194	5.20	2.96	310	6.00	5.20
59	8.00	12.10	200	11.60	7.00	313	8.80	4.50
63	4.80	6.95	203	9.20	8.50	314	10.00	11.80
68	9.60	8.60	206	5.60	6.20	315	11.20	8.00
72	9.60	8.60	217	11.20	1160	318	8.00	6.80
73	10.40	7.60	220	8.80	5.17	319	9.20	5.00
74	8.80	9.80	221	8.30	13.80	320	7.60	10.47
80	9.20	2.00	225	9.60	10.10	322	10.40	5.65
87	9.60	8.00	229	9.60	10.70	323	14.00	8.00
89	9.60	4.50	237	11.60	11.65	324	8.80	7.30
92	5.80	5.30	257	7.60	9.40	329	8.40	7.80
95	7.60	4.70	260	5.60	10.85	330	8.00	7.10
96	12.80	6.5	263	7.60	18.00	331	12.00	8.35
98	12.00	7.40	274	7.60	9.10	383	12.80	8.90
100	8.80	8.07	275	11.20	5.90	515	8.40	6.60
109	9.20	9.10	276	7.20	7.45	GG-3	8.00	8.10
110	7.60	2.90	279	10.0	10.30	G-41	9.20	17.30
111	8.80	5.40	280	10.0	4.90	335	6.80	8.75
114	11.20	4.6	281	8.80	10.20	GG-2	11.20	6.85

ONION HYBRIDS – Heterosis Breeding Programme in Short Day Tropical Onion (*Allium cepa* L.)

Exotic Hybrids Evaluation

In *rangda* season, 27 exotic hybrids collected from various sources (Table 18.1) were tested for their superiority over the open pollinated locally adapted commercial varieties. The experiment was laid out in a randomized block design with two replications and plot size was 3m x 2m. Planting was done on 19 Sept. 2000 and harvesting on 8 Jan 2001. Among the hybrids studied (Table 18.2), Rio Raji Red (52 t/ha) recorded significantly higher yield than the check variety ADR (30.4 t/ha) and N-2-4-1 (33.1 t/ha). No variety was found superior than the check variety B 780 (37.1 t/ha). For TSS, exotic hybrids were not found to be superior than the check varieties. This may be due to the reason that the exotic varieties are non pungent and mostly yellow in colour.

In *rabi* season, 29 hybrids (Table 19) were evaluated against the check varieties N-2-4-1, Arka Niketan, B 780 and ALR in a randomized block design of two replications with an individual plot size of 3m x 2m area. Planting was done on 24 Nov 2001 and harvested on 3 Mar, 2001. In terms of marketable yield, HN 9539 (100.4 t/ha) was found to be significantly superior than the check varieties B 780 (60t/ha), ALR (54.8t/ha), N-2-4-1 (66.3t/ha) and Arka Niketan (48.6t/ha). Cadillac (94.8t/ha), Cyclone (94t/ha), DPS 1029 (93.1t/ha), DPS 1024 (94.3t/ha) performed best over B 780, ALR and Arka Niketan. Linda Vista (87.8t/ha) performed superior over ALR and Arka Niketan.

Though most of the exotic hybrids were not found to be superior than the check varieties in terms of yield and TSS but the uniform maturity in both *rangda* and *rabi* season , colour, size and shape along with 100 % neck fall makes it an attractive proposition for future research.

Table 18.1 : Details of evaluated hybrids / varieties from various organizations

Acc. Name	Colour	Source	Country
DPSX 1029	Yellow	D Palmer Seeds Co. Inc.	USA
DPS 1008	Yellow	D Palmer Seeds	USA
DPS 1009	Yellow	D Palmer Seeds	USA
DPS 1047	Yellow	D Palmer Seeds	USA
DPSX 1013	Yellow	D Palmer Seeds	USA
DPS 1024	Yellow	D Palmer Seeds	USA
DPS 1034	Yellow	D Palmer Seeds	USA
DPS 1031	Yellow	D Palmer Seeds	USA
DPS 4310	Red	D Palmer Seeds	USA
Santiago	Dark Red	Nunhems Proagro Seeds Pvt. Ltd	India
HN 9633	Red	Nunhems Proagro Seeds Pvt. Ltd	India
HN-9539	Red	Nunhems Proagro Seeds Pvt. Ltd	India
HN-9730	Dark Red	Nunhems Proagro Seeds Pvt. Ltd	India
HN-9733	Dark Red	Nunhems Proagro Seeds Pvt. Ltd	India
HN-9735	Dark Red	Nunhems Proagro Seeds Pvt. Ltd	India
HN–9935	Light Red	Nunhems Proagro Seeds Pvt. Ltd	India
Hybrid 3404	Dark Red	Nunhems Proagro Seeds Pvt. Ltd	India
Hybrid 3667	Light Red	Nunhems Proagro Seeds Pvt. Ltd	India
Red Creole	Red	US AgriSeeds	USA
RCS 3404	Dark Red	Rio Colorado Seeds Inc.	USA
Rio Raji Red	Red	Rio Colorado Seeds Inc.	USA
Cougar	Yellow	Seminis Vegetable Seeds	USA
Twister	Yellow	Seminis Vegetable Seeds	USA
Mercedes	Yellow	Seminis Vegetable Seeds	USA
Cyclone	Yellow	Seminis Vegetable Seeds	USA
Linda Vista	Yellow	Seminis Vegetable Seeds	USA
Cadillac	Yellow	Seminis Vegetable Seeds	USA

Table 18.2 : Evaluation of exotic hybrids/ varieties during *rangda*, 2000

Acc. No.	Pl. Ht. (cm)	NOL	PD (cm)	ED (cm)	NT (cm)	TSS (°B)	Mkt. yield (t/ha)	DTM	Bulb Colour
RCS 3404	50.81	7.4	5.74	4.67	0.65	9.53	34.6	106	DR
HN-9539	60.95	6.7	6.35	5.19	0.83	9.64	35.3	111	LR
Hybrid 3667	54.10	7.5	6.21	5.12	0.92	9.98	36.1	111	MR
Santiago	49.03	6.9	5.51	5.05	0.38	9.62	22.8	120	DR
Hybrid 3404	51.80	6.5	5.85	5.29	0.70	9.10	36.6	120	R
Mercedes	40.00	6.1	5.82	4.61	0.34	8.14	22.9	106	Y
Twister	51.50	7.4	5.94	4.88	0.45	7.90	35.1	106	Y
DPS 1009	43.25	6.2	6.05	5.06	0.48	7.86	23.9	106	Y
DPS 1008	45.35	7.5	7.02	5.29	0.70	7.55	31.1	111	Y
DPS 1029	49.55	7.2	6.69	4.94	1.25	8.40	29.8	111	Y
Cougar	43.65	7.6	6.30	5.12	0.61	8.38	22.0	106	Y
DPS 1034	50.50	6.6	7.01	5.04	0.69	8.36	25.9	106	Y
DPS 1024	46.35	6.3	5.23	5.69	0.43	8.26	20.3	106	Y
DPSX 1013	44.40	6.6	6.03	5.10	0.53	7.94	25.3	106	Y
DPS 1047	45.00	7.0	6.66	4.70	0.71	8.76	27.1	106	Y
DPS 4310	45.80	9.1	4.01	4.21	0.29	11.72	11.9	120	R
HN - 9935	46.50	7.7	4.36	4.76	0.29	9.70	27.3	120	MR
HN-9735	51.45	8.6	4.45	4.69	0.33	13.16	28.0	120	MR
HN-9733	52.75	8.5	4.41	4.45	0.32	11.48	18.5	120	R
DPS 1031	40.95	4.7	6.41	4.37	0.37	9.38	5.1	106	Y
HN-9730	51.15	6.3	4.50	4.34	0.49	9.22	28.9	111	DR
Red Creole	52.80	8.5	4.19	4.18	0.43	11.40	17.4	120	R
HN 9633	49.60	8.1	3.92	3.75	0.31	11.44	16.9	120	DR
Rio Raji Red	54.25	7.9	5.31	5.05	0.75	8.36	52.0[2,3]	120	DR
Cadillac	50.10	5.9	6.31	4.80	0.49	7.07	36.6	106	Y
Linda Vista	52.10	7.7	6.29	5.50	0.64	8.50	47.8[2]	106	Y
Cyclone	52.35	7.2	6.40	5.09	0.37	8.64	46.4[2]	106	Y
B 780[1]	54.45	9.0	5.44	5.40	0.64	11.28	37.1	111	R
ADR[2]	52.25	9.7	4.70	5.42	0.57	12.28	30.4	106	DR
N-2-4-1[3]	53.90	8.0	4.57	4.52	0.31	12.80	33.1	120	LR
CD (0.05)						**3.09**	**15.5**		

Table 19: Evaluation of exotic hybrids/ varieties during *rabi* 2000

Acc.no.	Pl. Ht (cm)	NOL	PD (cm)	ED (cm)	NT (cm)	TSS (°B)	Mkt. yield (t/ha)	Doubles (%)	Bolters (%)	DTM	Bulb Colour
Twister	52.1	8.5	6.75	5.85	0.45	7.7	78.8	11	0	105	Y
DPS-1037	53.4	8.8	5.95	6.00	1.40	8.6	69.4	14	0	109	Y
Couger	53.3	9.0	7.40	6.80	0.88	9.0	76.8	1	0	98	Y
Cyclone	52.6	8.6	6.95	6.40	0.65	8.9	94.0	3	0	98	Y
Mercedes	53.6	8.5	6.20	5.60	0.60	8.8	77.8	1	0	98	Y
Hy 9935	50.4	8.7	4.60	5.80	0.85	10.7	68.0	1	0	109	MR
Red Creole	52.4	8.9	4.90	5.75	1.15	10.2	24.0	40	0	109	R
DPS-1047	53.0	8.5	7.65	5.80	0.65	9.4	41.9	35	0	105	Y
DPS-1008	52.8	8.9	7.30	5.80	0.65	8.1	69.4	13	0	105	Y
Linda Vista	52.2	9.0	7.30	5.85	0.60	9.1	87.8	7	0	105	Y
RCS-3404	52.9	8.6	6.05	6.60	0.80	8.7	92.3	3	0	109	DR
DPS-1043	53.1	8.5	7.60	6.05	0.65	8.6	75.1	0	0	105	Y
Cadillac	51.4	8.6	7.25	6.80	0.70	7.8	94.8	1	0	98	Y
Hy-Nun-9735	52.3	9.1	4.85	5.95	0.48	10.1	70.0	2	0	109	MR
Hy-Nun-9633	51.4	8.2	4.55	5.60	0.85	11.6	37.0	2	2	109	DR
Hy-3404	52.6	8.9	6.20	6.05	0.80	9.0	84.5	6	0	109	R
Hy-Nun-9730	51.7	8.4	4.90	6.10	0.58	10.2	84.3	1	0	109	DR
Hy-Nun-9539	53.2	8.8	6.75	6.50	0.75	9.0	100.4	0	0	105	LR
DPSX-1013	51.8	9.0	6.30	6.00	0.55	9.0	55.6	23	0	98	Y
DPS-1024	53.4	9.4	5.15	6.55	0.45	8.8	94.3	7	0	105	Y
DPS-1029	53.8	8.8	6.65	6.65	0.95	8.8	93.1	10	0	109	Y
DPS-1034	51.7	9.4	7.95	6.35	0.55	8.8	82.6	8	0	98	Y
DPS-4310	49.4	8.9	5.25	5.85	0.85	9.7	24.9	34	0	109	R
DPS-1009	54.3	9.2	6.55	6.15	0.55	8.7	83.3	12	0	98	Y
Hy-Nun-9733	54.8	9.2	4.90	6.00	0.95	11.7	65.9	2	0	109	R
Santiago	54.7	9.3	6.35	6.80	0.90	8.5	69.4	5	0	109	DR
DPS-1031	53.6	8.6	6.65	6.25	0.55	8.5	71.6	10	0	98	Y
DPS-2023	54.5	9.0	6.75	6.00	0.90	9.9	59.8	7	0	105	W
Hy 3667	54.5	8.7	6.40	5.70	0.75	9.0	74.5	1	0	105	MR
B-780	55.5	9.4	5.00	6.25	0.75	11.5	60.0	4	1	105	R
ALR	55.1	8.8	4.80	5.95	1.01	11.4	54.8	12	2	109	LR
N-2-4-1	52.4	8.8	4.85	6.00	1.35	12.0	66.3	8	9	109	LR
A.Niketan	54.7	9.1	5.20	6.10	0.90	12.4	48.6	3	26	109	R
CD (0.05)						**2.3**	**32.94**				

Development of Inbred Lines

Twenty inbred lines viz., 271, 283, 546, 553, 571, 592, 593, 594, 595, 597, 600, 614, 635, 644, 646, 650, 651, 657, 670 and 671, selected on the basis of horticultural traits were developed during *rabi* 1999-00 and planted during *rangda* 2000 to obtain first generation inbred lines. The bulbs obtained have been again planted in Feb, 2001 to generate second generation inbreds. Seeds have been obtained and the inbreds will be evaluated to check the level of inbreeding depression in *rabi* 2001.

Heterosis Breeding

In line x tester programme, two male sterile lines MS 48A and MS 65 A were crossed with 42 selected varieties and germplasm lines. The seeds were obtained from 36 crosses with MS 48A and from 37 crosses with MS 65A . The material so obtained will be evaluated for heterosis during next *rangda* and *rabi* season.

Development of Purelines

In pureline development programme, single bulbs of 9 commercial varieties viz., ALR, Phule Safed, Arka Kalyan, B 780, Punjab Naroha, N-2-4-1 and Arka Niketan and 14 exotic hybrids have been planted to obtain purelines. Hybrids did not flower at all and selfed seeds of commercial varieties has been obtained.

In addition to this, a marker line with glossy leaves in shallot has been selected. It is evident from the literature that glossy leaves (without wax) trait is linked with thrips resistance. Next season, this line will be valuated for thrips resistance and if successful crosses with the onion germplasm and commercial lines will be made. Also a male sterile line has been identified. The line was found to have 100% non viable pollen under microscopic studies. This line was crossed with maintainer line of MS 48A to assess its sterility status in the next generation.

Varietal Evaluation

Performance of onion varieties during *kharif* season

Experiment was conducted during *kharif* season, 2000 with four varieties to study the performance of onion varieties under western Maharastra conditions. The trial was laid out in a randomized block design with five replications. The plot size was 3m x 2m.The results revealed that, in general, yield level was very low as the late *kharif* rains affected the crop more severely. Among all the varieties evaluated, performance of Arka Kalyan was found better than other varieties followed by B-780. The highest yield was recorded in Arka Kalyan (21.6t/ha) in respect of marketable bulbs where as percentage of twin bulbs were minimum (Table 20)

The data regarding three years performance presented in Table 21 indicated that Arka Kalyan recorded the highest marketable bulb yield of 13.8 t / ha which was closely followed by Baswant-780 (13.5t/ ha.). Both the varieties had very good attractive red colour, which remained for four months period

Table 20: Performance of onion varieties during *kharif* season – 2000

Varieties	Mkt. yield (t/ha)	Percentage grade of bulbs A	B	C	Doubles (%)	ED (cm)	PD (cm)	Average Wt. bulb (g)	TSS (°B)	Bulb Colour
B-780	18.6	15.2	58.9	25.1	5.1	0.80	5.9	52.7	13.1	R
N-53	6.40	24.4	35.9	27.8	4.4	11.9	3.9	44.3	12.5	R
ADR	14.7	12.3	36.6	27.8	4.7	23.3	5.0	47.6	12.9	DR
Arka Kalayan	21.6	25.1	47.6	25.1	5.3	2.2	6.1	54.9	12.7	R
CD (0.05)	1.5									

Table 21: Average performance of onion varieties during *kharif* season over last three years (1998-2000)

Varieties	Mkt. yield (t/ha)	Percentage grade of bulbs A	B	C	Doubles (%)	ED (cm)	PD (cm)	TSS (°B)
B 780	13.5	17.0	46.2	31.4	4.72	5.50	5.14	11.5
N-53	7.49	24.0	31.9	30.2	4.45	14.1	4.29	10.8
ADR	9.77	13.0	34.2	30.6	4.19	22.3	4.43	11.7
Arka Kalyan	13.8	22.0	38.8	32.5	4.79	6.7	5.40	11.2

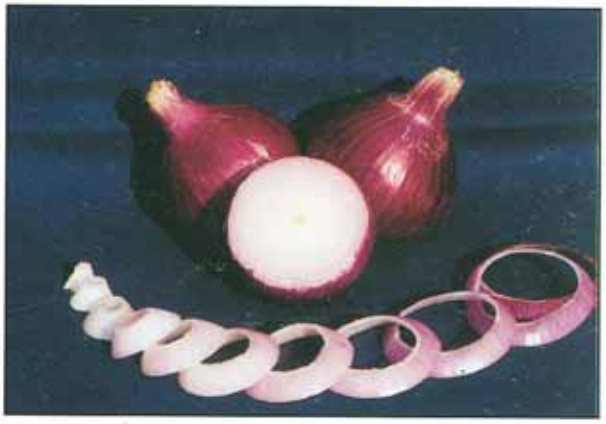
Evaluation of onion varieties for late *kharif* season under different dates of planting

For *kharif* and *rabi* season there are well identified varieties for cultivation. But in late *kharif* or *rangda* season very little information is available as to which variety is most suitable. A comprehensive trial was therefore planned with varying dates of planting comprising of released and most adapted varieties usually being used in *kharif* as well as *rabi* season so that a proper combination of variety and time of planting can be identified.

Seeds of different varieties were sown at fortnightly intervals on four dates starting from the first week of August to second week of September. Correspondingly, seedlings were transplanted after attaining proper stage. Irrespective of varieties, higher yield was recorded when sowing was done during first week of September and subsequent transplanting was done during second week of October. In early dates of planting, poor yield was recorded mainly due to occurrance of more bolters and twins (Table.22.1 – 22.4). The low temperature during November to January correspond to the stages of bulb initiation and development which transform plant from vegetative phase to reproductive phase, thus resulting in direct and pre mature bolting. Among the various varieties tried under different dates of plantings, the performance and mean yield of Baswant - 780 was superior over other varieties and it recorded the highest yield (48.7t/ha) followed by Arka Niketan (37.3 t/ha.)

The mean yield performance over last three years (Table 23) indicated consistent superiority of variety Baswant–780.Among different dates, seed

sowing in first week of September and subsequent transplanting in second week of October recorded the highest yield with Baswant-780 (30.7 to 48.7 t/ha.).The data regarding percentage of various grades of bulb, bolters and doubles are presented in table 24. It is revealed from the data that the highest A grade bulbs were recorded in Baswant-780 . Among different dates, third date of planting recorded the highest percentage of A grade bulbs(59.5%) while the bolters and twins were less.



Baswant - 780

Table : 22. Performance of onion varieties during *rangda* season

Table 22.1: (I date of planting)

Varieties	ED (cm)	PD (cm)	Average weight of bulb (g)	TSS (°B)	A grade (%)	B grade (%)	C grade (%)	Bolters (%)	Doubles (%)	Mkt. Yield (t/ha.)
B-780	5.4	4.4	55.8	12.3	25.2	52.8	14.7	0.00	7.40	30.0
N-53	4.8	3.9	52.7	10.9	20.2	32.3	19.4	25.9	2.50	26.5
ADR	4.7	4.3	45.5	11.2	19.5	29.2	30.6	12.7	8.00	23.3
A.Kalyan	5.1	4.7	49.0	11.4	20.0	28.8	16.0	28.0	7.2	21.6
A.Niketan	5.0	4.9	51.0	13.7	18.4	36.8	33.1	5.2	6.5	25.6
PSafed	4.7	4.4	44.5	13.2	16.2	27.4	10.0	19.1	27.3	19.5
ALR	5.2	4.7	50.3	13.4	20.3	29.3	36.6	3.25	10.7	23.8
N-2-4-1	4.9	4.5	47.2	12.2	25.2	36.2	25.2	9.5	3.9	21.5
CD (0.05)	1.84									

Table 22.2: (II date of planting)

Varieties	ED (cm)	PD (cm)	Average weight of bulb (g)	TSS (°B)	A grade (%)	B grade (%)	C grade (%)	Bolters (%)	Doubles (%)	Mkt. Yield (t/ha.)
B-780	6.3	4.5	54.3	13.4	23.1	26.0	27.0	5.0	18.9	29.0
N-53	5.1	4.0	39.5	14.0	31.0	17.7	13.3	2.7	35.4	19.5
ADR	4.8	5.0	43.5	13.1	17.7	27.7	26.1	3.40	25.2	22.5
A.Kalyan	5.8	4.5	42.0	14.2	26.7	31.8	15.9	9.8	8.0	24.2
A.Niketan	5.5	5.2	51.2	14.4	10.3	15.4	46.2	14.5	13.7	26.0
PSafed	4.5	4.3	44.7	14.2	13.0	18.7	12.2	11.4	44.7	25.8
ALR	5.7	4.8	49.5	13.7	21.4	25.3	30.0	10.0	13.3	27.8
N-2-4-1	5.0	4.6	41.3	14.4	17.5	21.1	25.6	12.0	20.0	21.3
CD (0.05)	2.27									

Table 22.3 : (III date of planting)

Varieties	ED (cm)	PD (cm)	Average weight of bulb (g)	TSS (°B)	A grade (%)	B grade (%)	C grade (%)	Bolters (%)	Doubles (%)	Mkt. Yield (t/ha.)
B-780	6.1	5.3	67.4	13.1	75.3	12.4	0.00	12.4	3.9	48.7
N-53	5.1	4.7	54.3	11.5	45.4	17.3	10.5	16.8	10.0	26.9
ADR	4.9	4.5	55.2	12.5	51.0	15.1	8.5	10.0	15.4	27.5
A.Kalyan	5.5	5.1	58.5	13.6	53.4	13.8	14.1	12.7	6.0	32.9
A.Niketan	5.7	5.0	63.2	14.3	48.9	11.0	6.90	26.2	6.90	37.3
PSafed	5.4	5.7	60.5	13.1	53.9	14.5	12.2	11.5	14.5	34.2
ALR	5.3	5.0	46.6	12.8	47.3	14.5	12.2	11.5	14.5	26.7
N-2-4-1	4.9	5.4	52.6	13.0	32.3	10.5	7.3	17.7	32.3	31.7
CD (0.05)	4.38									

Table 22.4 : (IV date of planting)

Varieties	ED (cm)	PD (cm)	Average weight of bulb (g)	TSS (°B)	A grade (%)	B grade (%)	C grade (%)	Bolters (%)	Doubles (%)	Mkt. Yield (t/ha.)
B-780	5.7	5.2	60.0	13.7	48.9	26.3	3.00	3.00	18.8	29.2
N-53	4.7	4.5	45.2	12.5	35.2	19.5	8.5	10.0	26.8	23.5
ADR	5.0	4.9	51.5	12.6	39.4	22.5	7.0	11.1	20.0	26.7
A.Kalyan	5.2	5.6	58.5	14.1	51.3	27.5	6.1	5.1	10.0	29.7
A.Niketan	5.3	4.7	57.0	14.0	32.5	11.9	4.80	2.9	22.2	28.5
PSafed	4.9	4.2	55.0	13.1	32.3	17.4	-	37.9	12.1	22.8
ALR	5.1	4.0	42.5	12.5	37.1	17.5	7.7	15.7	27.0	23.6
N-2-4-1	4.9	5.1	45.5	13.5	32.4	32.4	8.8	35.2	17.6	25.9
CD (0.05)	2.43									

Table 23 : Mean yield performance of onion varieties during *rangda* season for the last three years

Varieties	I date of Planting				II date of Planting				III date of Planting				IV date of Planting			
	98-99	99-00	00-01	Mean	98-99	99-00	00-01	Mean	98-99	99-00	00-01	Mean	98-99	99-00	00-01	Mean
B-780	45.6	22.9	30.0	32.8	34.3	30.2	29.0	31.2	34.3	30.7	48.7	37.9	33.5	22.7	31.3	29.2
N-53	32.9	-	26.5	29.7	-	-	19.5	19.6	-	-	26.9	26.9	-	-	23.5	23.5
ADR	23.1	-	23.3	23.2	11.8	-	22.5	17.1	28.2	-	27.5	27.9	26.7	-	26.7	26.7
A.Kalyan	27.6	-	21.6	24.6	18.7	-	24.2	21.5	36.6	-	32.9	34.7	33.5	-	25.9	29.7
A.Niketan	19.4	13.9	25.6	19.6	8.91	15.6	26.0	16.9	41.8	26.1	37.3	35.1	37.9	16.8	30.8	28.5
P.Safed	-	12.0	19.5	15.8	14.7	12.9	25.8	17.8	28.6	19.4	34.2	27.4	27.1	13.6	27.8	22.8
ALR	27.2	16.7	23.8	22.6	29.2	12.6	28.8	23.5	32.4	28.5	26.7	29.2	31.1	15.3	24.3	23.6
N-2-4-1	-	23.7	21.5	22.6	24.2	19.4	27.8	21.6	36.4	22.3	31.7	30.1	19.6	-	32.1	25.9

Table 24 : Average performance of onion varieties in respect of marketable grades during *rangda* season over the last three years

Varieties	I date of Planting					II date of Planting					III date of Planting					IV date of Planting				
	AGB (%)	BGB (%)	CGB (%)	B (%)	D (%)	AGB (%)	BGB (%)	CGB (%)	B (%)	D (%)	AGB (%)	BGB (%)	CGB (%)	B (%)	D (%)	AGB (%)	BGB (%)	CGB (%)	B (%)	D (%)
B-780	34.3	40.9	13.0	2.4	9.7	19.5	19.1	23.4	20.9	17.2	59.5	17.2	9.6	9.1	7.73	46.3	25.4	6.53	8.40	13.4
N-53	37.5	21.6	15.7	25.7	2.4	31.0	17.7	13.3	2.7	35.4	45.4	17.3	10.5	16.8	10.0	35.2	19.5	8.5	10.0	26.8
ADR	30.4	20.9	13.7	22.4	9.1	18.2	16.3	18.2	36.4	18.2	55.2	12.9	8.5	18.1	12.7	35.4	8.95	7.30	23.1	19.0
A.Kalyan	33.5	20.1	11.2	29.9	5.5	22.5	15.1	16.2	37.5	10.7	57.0	12.1	9.2	18.1	3.7	42.7	15.6	10.1	17.4	14.9
A.Niketan	27.3	23.5	23.9	20.1	5.3	19.5	19.1	23.4	20.9	17.2	50.4	12.0	8.73	20.1	8.7	40.5	18.0	6.4	9.63	16.9
P.Safed	17.4	25.9	12.5	11.8	32.4	16.8	12.5	20.3	28.6	32.6	43.0	13.7	12.6	14.4	18.8	35.7	13.9	10.4	27.7	17.6
ALR	31.7	22.7	25.0	10.7	9.90	22.6	18.2	22.0	13.3	13.1	45.8	16.8	14.3	12.9	13.3	35.1	20.1	12.1	15.5	19.3
N-2-4-1	35.5	26.1	20.0	12.5	6.56	23.4	15.2	30.0	21.1	10.5	43.0	15.9	7.49	13.1	20.6	35.7	22.1	10.2	26.2	14.6

Performance of onion varieties during *rabi* season

For studying the performance of different onion varieties under western Maharastra conditions, six released varieties were planted during *rabi* season. The trial was laid out in a randomized block design with four replications. The plot size was 3 m x 2 m. Among the varieties evaluated, Arka Niketan recorded the highest yield of 49.4 t/ha which was on par with N-2-4-1 (46.8 t/ha) and ALR (46.2 t/ha).The percentage of A grade bulbs was also higher in these varieties. Baswant –780 recorded very low per cent of bolters (7.5) and twins (4.0) compared to other varieties evaluated. Higher TSS was also observed in Arka Niketan (14.3°B) (Table 25).

The data regarding three years perfor-mance is presented in table 26, which indicates that variety N-2-4-1 was the consistently higher yielder which was closely followed by Arka Niketan.The qualitative performance (Table 27) also supported the superiority of these varieties in terms of higher percentage of A grade bulbs, bulb weight and diameter.

Table 25 : Performance of onion varieties for yield and yield characters during *rabi* season 2000-2001

Varieties	Mkt. Yield (t/ha)	AGB (%)	BGB (%)	CGB (%)	Bolters (%)	Doubles (%)	ED (cm)	PD (cm)	Average wt. of bulb (gm)	TSS (°B)
ALR	46.2	42.3	33.2	6.7	10.2	7.6	5.4	4.7	52.8	13.1
Arka Niketan	49.4	52.1	22.8	11.8	8.0	5.3	5.7	4.4	56.9	14.3
N-2-4-1	46.8	50.7	25.2	7.9	10.2	6.0	5.6	4.2	55.7	13.6
B-780	45.2	50.4	24.6	13.5	7.5	4.0	5.2	4.5	54.3	14.2
Phule Safed	26.8	36.2	28.5	10.7	10.1	14.5	4.9	4.1	46.4	12.9
CD (0.05)	**4.11**									

Table 26 : Performance of onion varieties during *rabi* season

Varieties	Marketable Yield (t/ha.)			Mean
	1998-1999	1999-2000	2000-2001	
B-780	27.03	26.50	45.24	32.91
N-2-4-1	30.69	26.53	46.81	34.68
ALR	30.82	17.84	46.22	31.63
P.Suvarna	-	15.72	27.15	21.44
A.Niketan	27.05	22.90	49.41	33.12
P.Safed	26.64	19.41	26.78	24.28
CD (0.05)	3.86	1.56	4.11	-

Table 27: Performance of varieties in respect of marketable grades during *rabi* season over the last three years

Varieties	1998-1999					1999-2000					2000-2001				
	AGB (%)	BGB (%)	CGB (%)	Bolters (%)	Doubles (%)	AGB (%)	BGB (%)	CGB (%)	Bolters (%)	Doubles (%)	AGB (%)	BGB (%)	CGB (%)	Bolters (%)	Doubles (%)
N-2-4-1	40.0	48.04	8.95	-	3.01	40.8	23.7	11.2	17.3	7.0	50.7	25.2	7.9	10.2	6.0
PSafed	26.5	50.5	6.19	-	6.88	33.6	18.8	9.7	11.6	26.3	36.2	28.5	10.7	10.1	14.5
ALR	45.3	40.6	3.31	-	10.7	36.2	13.1	17.2	25.9	7.6	42.3	33.2	6.7	10.2	7.6
A.Niketan	29.5	55.2	8.35	-	7.02	50.0	23.5	6.2	15.2	12.7	52.1	22.8	11.8	8.0	5.3
B_780	31.5	52.8	14.7	-	0.98	51.5	23.5	15.8	5.8	3.5	50.4	24.8	13.5	7.5	4.0
PSuvarna	-	-	-	-	-	22.9	22.3	13.7	13.7	15.9	-	-	-	-	-

Evaluation of onion varieties during *rabi* season (AICVIP)

Six varieties received under AICVIP were evaluated for yield and other characters. None of the new entries could surpass the checks ie.Arka Niketan and ALR. (Table 28 & 29)

Table 28 : Evaluation onion varieties for yield characters during *rabi* season

Varieties	Mkt. bulb Yield (t/ha)	A grade bulb (%)	B grade bulb (%)	C grade bulb (%)	Bolters (%)	Doubles (%)	ED (cm)	PD (cm)	Average Wt of Bulb (g.)
RO-1	28.3	22.4	16.2	21.8	15.6	24.0	3.90	5.08	43.5
PKV-Sln.	24.4	20.5	29.1	18.4	13.9	18.1	3.55	4.95	35.7
NHRDF(W)	21.5	21.3	24.6	20.9	16.9	16.3	3.70	4.56	34.2
PRO-6	21.1	15.6	19.8	25.9	9.5	29.2	3.23	4.00	31.4
Arka Niketan	40.4	36.1	35.7	6.9	14.8	6.56	5.03	6.03	59.8
ALR	31.8	33.4	30.9	13.5	7.70	14.5	4.33	5.20	55.6
CD (0.05)	3.70								

Table 29 : Evaluation of onion varieties for growth characters and TSS during *rabi* season

Varieties	Colour	Plant Ht. (cm.)	NOL	NT (cm.)	TSS(° B)
RO-1	Y	45.9	8.00	0.55	12.4
PKV-Sln.	W	40.8	9.00	0.70	13.0
NHRDF	W	49.0	10.3	0.77	13.6
PRO-6	LR	44.3	8.33	0.60	12.7
Arka Niketan	LR	50.9	9.80	0.45	13.0
ALR	LR	48.4	9.80	0.58	12.7

ALLIUM BIOTECHNOLOGY

Allium inbreds : *In vitro* haploid production in onion (*Allium cepa* L.)

Different bud sizes of var. N-2-4-1 were collected and fixed at different times *viz.*, 11.30 am, 11.45 am and 12.00 noon. The buds were fixed in Carnoy's fluid (3 alcohol : 1 acetic acid) and cytologically analysed. Buds of 3 – 4 mm size showed uninucleate condition of pollen and hence were used for further inoculation.Two different media has been tried so far – MS and BDS. Different concentrations of the plant growth regulators viz., BA, Kinetin, TDZ, IAA, IBA, 2,4 – D, NAA, GA_3 and Picloram have been tried alone and in combination for inducing androgenic and gynogenic response from different explants *viz.*, anthers, ovary and immature flower buds of var. N-2-4-1 during first year (in MS medium) and Arka Niketan, Arka Bindu, ALR, B-780, N-2-4-1 and Phule Safed (in both MS and BDS media) during 2000-01.

Most of the combinations using BA and Kin alone and combinations having different concentrations showed callusing from flower buds after 1 month of culture in MS media. (Table 30). Upon subculture to the same media, rate of callusing increased. Only in higher concentrations of BA (10.0 – 20.0) and

Kin (5. 0 – 6.0), shoot formation was observed after the second subculture. To increase the rate of shoot regeneration, IAA and Picloram was tried but no response was obtained. 5 mg/l Kin was giving 4-5 shoots. Further the same combination gave shoots directly from the ovary. After root induction, the roots are to be studied to assess their ploidy level. In 10 mg/l BA, 6-7 shoots had formed, but further elongation was not there. Even after addition of GA_3, no difference was seen (Table 31). In anther culture, no response was obtained from any of the combinations tried in neither MS medium nor in BDS medium.

Table 30 : Effect of different cytokinins on androgenesis and gynogenesis in onion var. N-2-4-1

Explant	PGRs (mg/l)		Result
	BA	Kin	
Flower buds	1.0	-	Callus initiation after 1 month
	1.5	-	Callus initiation after 1 month
	2.0	-	Callus initiation after 1 month
	3.0	-	Callus initiation after 1 month
	5.0	-	Callus initiation after 1 month
	10.0	-	Callus initiation after 1 month
	12.0	-	-
	15.0	-	-
	17.0	-	-
	20.0	-	-
	-	0.5	-
	-	1.0	-
	-	1.5	-
	-	2.0	-
	-	4.0	Callus initiation after 1 month
	-	5.0	Callus initiation after 1 month
	-	6.0	Callus initiation after 1 month
	-	10.0	Callus initiation after 1 month
	-	20.0	Callus initiation after 1 month

Further, BDS media is being tried and explants from different varieties *viz.*, Arka Niketan, Arka Bindu, ALR, Phule Safed, etc., are being studied. Some concentrations of 2,4 – D are showing promise.

Table 31 : Effect of different cytokinins and auxins on callus regeneration in onion var. N-2-4-1

Explant	PGRs (mg./l)					Result		
	BA	Kin	Picloram	IAA	IBA	NAA	GA_3	
	10.0	-	-	-	-	-	-	6-7 shoots
	12.0	-	-	-	-	-	-	3-4 shoots
Flower	15.0	-	-	-	-	-	-	2-3 shoots
bud	17.0	-	-	-	-	-	-	2-3 shoots
callus	20.0	-	-	-	-	-	-	2-3 shoots
	10.0	0.7	-	-	-	-		-
	10.0	-	-	-	-	0.5	-	No regeneration
	10.0	-	-	-	-	1.0	-	No regeneration
	-	5.0	-	-	-	-	0.5	6-7 shoots
	-	5.0	-	-	-	-	0.7	1-2 shoots
	-	5.0	-	-	-	-	1.0	-
	-	5.0	-	-	-	-	-	4-5 shoots
	-	6.0	-	-	-	-	-	1-2 shoots
	-	10.0	-	-	-	-	-	Green protuberances,No shoots
	-	20.0	-	-	-	-	-	-
	-	5.0	-	0.5	-	-	-	-
	-	5.0	-	1.0	-	-	-	-

Studies on Somaclonal Variation in Garlic (*Allium sativum* L.)

MS media was tried to induce callusing in garlic var. G – 41. Cloves were treated with 10% labolene for 15 min. and washed under running tap water for one hour. Surface sterilization was done using 70% alcohol for 30 seconds followed by 0.5 % NaClO for 15 min. The sterilized explants were washed 4 to 5 times with sterile distilled water and inoculated. Different concentrations of the following plant growth regulators (BA, Kinetin, TDZ, IAA, IBA, 2,4 – D, NAA) have been tried alone and in combination for inducing callusing from different explants *viz.*, leaf, basal plate, cloves and roots.

Though different combinations and concentrations of plant growth regulators were used alone and in combination, callusing could be achieved so far from only one combination of NAA and BA (NAA 1 mg/l and BA 15 mg/l) (Table 32). Variation of this combination and others will be tried to attain high rate of callusing for the induction of somaclones.

Table 32 : Effect of NAA with BA and Kinetin on callus induction in garlic

Explant	PGRs (mg/l)			Result
	BA	Kin	NAA	
	1.0	-	1.0	Single shoot (BP)
Basal Plate	3.0	-	1.0	Single shoot (BP)
Cut in half,	5.0	-	1.0	Single shoot (BP)
Leaf and	7.0	-	1.0	Single shoot (BP)
Root	10.0	-	1.0	Single shoot (BP)
	15.0	-	1.0	Single shoot (BP) Creamy compact callus after 15 days (R)
	1.0	1.0	1.0	Single shoot (BP)
	1.0	1.5	1.0	Single shoot (BP)
	1.5	1.0	1.0	Single shoot (BP)
	2.0	2.0	1.0	Single shoot (BP)

CROP PRODUCTION

Studies on Onion Based Cropping Systems

Studies on sequential cropping of well delineated agro ecological zone would help for optimization of nutrient inputs thereby minimizing the external inputs. However, the available information on similar aspects in onion is meager. Hence it is important to study the onion based cropping systems to get higher yield and net profit.

The investigation was carried out during *kharif* , late *kharif (rangda)* and *rabi* season, 2000-2001 and laid out in randomized block design having 11 cropping sequences with three replications. The plot size was 10m X 10 m. Among the various cropping sequences evaluated (Table 33), aster in *kharif* season followed by onion in *rabi* season recorded the highest C:B ratio of 1:2.2 followed by bajra - onion sequence(1:2.08).but legume based cropping patterns like preceding crop of groundnut followed by onion, and soybean – onion sequences noticed the highest onion yield of 27.2 and 26.9 t/ha , respectively.

Based on the results, the most profitable on-

ion based cropping system was aster (*kharif*) - onion (*rabi*) followed by bajra (*kharif*) - onion (*rabi*). Further studies on the uptake of plant and soil nutrients and it's correlation with yield and yield characters are to be evaluated consecutively for three or more years to study the effect of different sequences on soil fertility status and other properties also.

Treatment Details

Cropping Sequences	Summer (Feb-May)	*Kharif* (June-Sept)	*Rangda* (Sept.-Feb)	*Rabi* (Nov-April)
1		Aster		Onion(N-2-4-1)
2		Marigold		Onion(N-2-4-1)
3		Potato		Wheat
4		Potato		Onion(N-2-4-1)
5		Groundnut		Onion (N-2-4-1)
6		Soyabean		Onion(N-2-4-1)
7		Bajra	-	Wheat
8		Bajra		Onion(N-2-4-1)
9		Onion (B-780)		Wheat
10	Groundnut		Onion (B.780)	
11	Cucumber		Onion (B.780)	

Onion based cropping sequence

Drip irrigation in garlic

Table 33: Comparative Yield Performance (t/ha.), Total returns and Cost – Benefit ratio of Onion based Cropping Systems

Sequences	Summer season	*Kharif* season yield (t/ha)	Late *Kharif* yield (t/ha)	*Rabi* season yield (t/ha)	Cost of Production (Rs./ha.)	Gross Income (Rs./ha)	Total Returns (Rs./ha.)	C:B Ratio
S1	-	*Aster-270000 bundles	-	Onion-26.5	67910	147250	79340	1:2.20
S2	-	Marigold-11.3	-	Onion-25.6	58035	119825	61790	1:2.06
S3	-	Potato 22.3	-	Wheat 3.9	48580	100650	52070	1:2.07
S4	-	Potato 21.2	-	Onion 24.9	63290	126000	62710	1:1.99
S5	-	Groundnut 2.00	-	Onion 27.2	26200	51000	24900	1:1.95
S6	-	Soyabean 2.50	-	Onion 26.9	40910	76537	42390	1:2.08
S7	-	Bajra 2.50	-	Wheat 4.10	41610	84000	42390	1:1.87
S8	-	Bajra 2.57		Onion 23.9	45050	90550	45500	1:1.93
S9	-	Onion 18.0	-	Wheat 4.30	45170	87175	42005	1:1.93
S10	Groundnut 4.92	-	Onion 25.2	-	65150	131830	66680	1:2.02
S11	Cucumber 13.3		Onion 24.7	-	49780	101650	51870	1:2.04

*No.of flowers/bundle of Aster - 12

Irrigation Studies In Onion and Garlic

The investigation was carried out on garlic variety G-41 and onion var. N-2-4-1 during *rabi* season 2000-2001 in randomized block design with three replications. The plant spacing of 10 x 15 cm was maintained in a plot size of 1.2 m x 40 m. The treatments consisted of drip irrigation and sprinkler irrigation at 50, 75 & 100 % PE along with surface irrigation @ 7 ha/cm depth at 50 mm CPE as a control.

The results of the study indicated that there was significant effect on marketable yield of onion and garlic bulbs due to different methods and levels of irrigation. Among the various treatments T-3 (drip irrigation-100% PE) recorded the highest yield in both the crops. (onion- 46.7 t/ha & garlic-14.8 t/ha). The yield increase over surface was 31.5% in onion and 14.8 % in garlic (Table 34.1 & 34.2).

Among the irrigation methods and different levels tested, the drip irrigation at 100% PE recorded the highest yield in both onion and garlic followed by 75% PE of the same system. The percentage of A grade bulbs was higher in drip irrigation than other systems in both the crops. In best treatment (T3-Drip at 100 % PE) the water saving was 45.5 % in onion and 44% in garlic over surface irrigation. The highest water use efficiency was observed at 50% PE in both drip and sprinkler irrigation but there was marked reduction in yield (Table 34.3& 34.4).

Table 34.1 : Effect of different irrigation methods and levels on yield and yield contributing characters of onion var. N-2-4-1

Treatments	Mkt. Yield (t/ha)	A grade (%)	B grade (%)	C grade (%)	Bolters (%)	Doubles (%)	ED (cm)	PD (cm)	Average weight of bulb (g)	No. of roots	Root Length (cm)
T1	29.0	41.0	30.7	18.4	7.3	2.6	5.12	4.37	56.3	39	6.6
T2	39.5	53.0	20.1	3.9	19.1	3.9	5.70	5.0	62.0	45	5.9
T3	46.7	61.9	14.8	3.2	14.4	5.7	6.3	5.6	69.5	53	5.7
T4	25.3	38.3	31.8	6.8	17.7	5.4	5.3	4.4	59.8	55	11.0
T5	23.8	35.7	35.3	13.4	11.2	4.4	5.1	4.3	47.6	62	9.3
T6	21.2	29.0	37.3	16.6	11.4	5.7	5.5	4.64	45.2	69	6.5
T7	35.5	49.3	15.8	5.5	21.1	8.3	5.51	4.7	68.7	45	6.4
CD (0.05)	2.55										

T1- Drip Irrigation-50% PE; T2-Drip Irrigation-75% PE; T3-Drip Irrigation -100% PE; T4- Sprinkler Irrigation-50% PE; T5- Sprinkler Irrigation-75% PE; T6- Sprinkler Irrigation-100% PE; T7-Surface Irrigation on 50 mm CPE at 7 cm depth

Table 34.2 : Effect of different irrigation methods and levels on yield and yield contributing characters of garlic var.G-41

Treatments	Mkt. Yield (t/ha)	A grade (%)	B grade (%)	C grade (%)	ED (cm)	PD (cm)	Average weight of bulb (g)	No. of cloves / bulb	No. of roots	Root length (cm)
T1	10.1	54.1	37.0	8.9	3.27	3.11	27.5	17.0	59.4	9.73
T2	13.5	63.3	32.5	4.2	3.89	3.67	31.2	21.0	70.0	8.77
T3	14.8	65.7	30.9	3.4	4.30	3.50	35.6	27.0	75.8	8.03
T4	9.31	33.5	45.9	20.6	2.91	2.63	22.2	14.0	43.3	9.26
T5	11.4	46.8	43.2	10.0	3.22	3.24	29.7	19.0	66.4	8.81
T6	12.8	54.1	38.4	7.5	3.49	3.42	34.7	25.0	72.2	8.35
T7	11.9	55.6	32.1	12.3	3.14	3.26	30.2	22.0	69.5	7.91
CD (0.05)	1.2									

T1- Drip Irrigation-50% PE; T2-Drip Irrigation-75% PE; T3-Drip Irrigation -100% PE; T4- Sprinkler Irrigation-50% PE; T5- Sprinkler Irrigation-75% PE; T6- Sprinkler Irrigation-100% PE; T7-Surface Irrigation on 50 mm CPE at 7 cm depth

Table 34.3 : Water use efficiency of different irrigation systems in onion var. N-2-4-1

Particulars	Drip irrigation			Sprinkler Irrigation			Surface Irrigation on 50 mm CPE at 7 cm depth
	50%	75%	100%	50%	75%	100%	
Water applied (cm)	21.0	31.5	42.0	24.8	37.2	49.5	77.0
Water saving (%)	72.7	59.0	45.5	67.8	51.7	46.8	-
Yield (t/ha.)	29.0	39.5	46.5	25.6	23.8	21.2	35.5
Yield Increase (%)	-18.4	11.1	31.5	-29.9	-32.9	-40.4	-
A grade bulbs (%)	41.0	53.0	61.9	38.3	35.7	29.0	49.3
Water use efficiency (kg/ha.cm)	1380.4	1252.7	1111.6	1019.0	640.9	427.9	461.3

Table 34.4 : Water use efficiency of different irrigation systems in garlic var.G-41

Particulars	Drip irrigation			Sprinkler Irrigation			Surface Irrigation on 50 mm CPE at 7 cm depth
	50%	75%	100%	50%	75%	100%	
Water applied (cm)	23.5	35.4	47.2	24.9	37.4	49.8	84.0
Water saving (%)	72.0	58.0	44.0	70.0	55.0	41.0	-
Yield (t/ha.)	10.1	13.3	14.8	9.31	11.4	12.8	11.9
Yield Increase (%)	-18.0	10.2	19.5	-27.8	4.7	7.2	-
A grade bulbs (%)	54.1	63.3	65.7	33.5	46.8	60.1	55.6
Water use efficiency (kg/ha.cm)	431.1	374.3	313.1	318.0	304.0	257.4	14.0

Studies on Transplanting vs Direct seeding in Onion Var. N-2-4-1

The present investigation was carried out in onion var. N-2-4-1 during *rabi* season 2000-2001 with three treatments. Among the treatments, transplanting method recorded significantly highest yield of 37.7 t/ha. followed by direct sowing by row sowing method (29.9 t/ha.).The increased yield may be due to higher per cent of A grade bulbs. The lowest yield (25.4t/ha) was recorded in direct sowing by broad casting method. There was no much difference between plant height, number of leaves and neck thickness among the treatments. There was better uniformity of bulbs in transplanting method (Table 35).

Table 35: Effect of transplanting vs direct sowing on yield and yield parameters of onion var.N-2-4-1

Treatments	Mkt. Yield Yield (t/ha)	A grade (%)	B grade (%)	C grade (%)	Bolters (%)	Doubles (%)	Average Wt. of bulb (g)	ED (cm.)	PD (cm)
T1	37.7	47.6	26.4	18.7	2.0	5.3	65.9	5.9	4.7
T2	25.9	24.2	27.3	43.4	2.1	3.0	48.3	5.0	4.1
T3	29.9	19.3	35.3	36.1	2.3	7.4	59.5	5.7	s4.5
CD (0.05)	3.9								

T1-Transplanting Method ; T2-Direct seeding by Broad casting ; T3-Direct seeding by Row sowing

Effect of mother clove size on growth and yield of garlic var.G-41

A field trial was conducted to study the effect of mother clove size on growth and yield of garlic var.G-41. The trial was laid out in a randomized block design with seven replications. The plot size was 3 m. x 2 m. and treatments comprised of three sizes of mother cloves (0.4 to 0.5g, 0.8 to 1.0 and 1.4 to 1.6g).Among the treatments, mother clove size of 1.4 to 1.6g recorded the highest plant height and more number of leaves per plant. For yield also, the same treatment gave significantly the highest yield at 11.4 t/ha followed by 0.8 to 1.0g mother cloves (9.44 t/ha) (Table 36). The increased yield was mostly due to good percentage of field establishment, more number of bigger bulbs and bigger cloves.

Table 36: Effect mother clove size on yield and yield characters of garlic var. G-41

Treatments	Mkt. Yield Yield (t/ha)	A grade (%)	B grade (%)	C grade (%)	Average wt. of bulb (g)	ED (cm.)	PD (cm)	No. of cloves/ bulb
T1	8.81	43.6	25.1	31.3	18.5	3.17	2.67	18.5
T2	9.44	47.4	30.5	22.1	22.9	3.24	2.73	22.9
T3	11.4	52.8	35.8	11.4	28.4	3.42	2.98	28.4
CD (0.05)	1.27							

T1- 0.4 to 0.5g ; T2- 0.8 to 1.0 g; T3- 1.4 to 1.5 g

Characterization of soils of NRC for Onion and Garlic farm, Rajgurunagar, for fertility parameters.

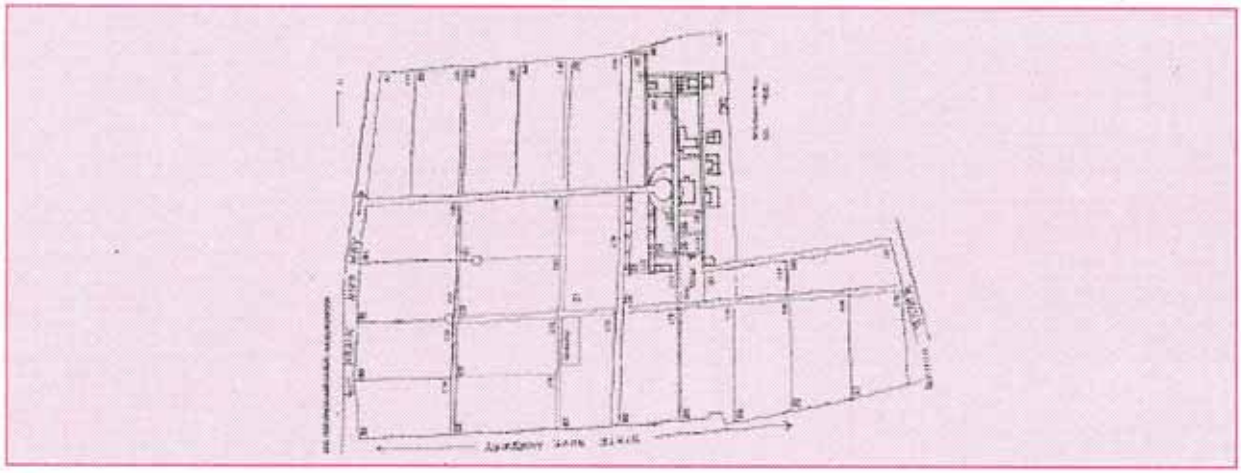
Brief description:

The area of research farm is 46.85 acres. The land has been divided into 21 blocks considering the convenience for easy field operations and slope. The detail layout of different blocks and their respective areas is shown in Figure-1. The land is gradually sloping downwards from west to east and along this slope the depth of the soil is gradually decreasing. The soils of the centre are black, clayey which could be classified into the Vertisol Order and hence the dominant feature of developing wide and deep

cracks during summer. The depth of soil is shallow and quite stony in D1 and D8 blocks.

Methodology:

The soil sampling for 21 blocks was conducted during the year 1999 for the assessment of the fertility status (major and minor elements). Sampling was done in zig- zag manner and 30 sample units were collected for each block. The sampling depth was 0-15 cm. Composite sample was also prepared for each block in order to make the chemical analyses of soils for major and minor nutrients. Standard procedures and methods were adopted. The total and available nitrogen was analyzed using the Kjeldahl unit of Pelican Equipment make. Available potassium was estimated through a microprocessor based flame photometer, Chemito 1020 model. Available phosphorus and sulphur were analyzed through UV- Visible spectrometer of Unicam make. All the DTPA extractable micronutrients (Fe, Mc, Zn and Cu) were analyzed using Atomic absorption spectrometer SpectrAA, 55B model of Varian make. The results pertaining to the fertility parameters are presented in table 37.



Soil Reaction:

The pH of the soils of different blocks (21) was analyzed in 1: 2.5 soil to water ratio. The pH values for the soils varied from 7.38 as normal in D8-Block to slightly alkaline i.e. 8.22 in C4- Block. The pH of blocks B4, C4 and E3 was found to be near 8.00 and rest of the blocks was having pH values below 8.00.

Salinity (Electrical conductivity):

All the soil blocks of farm showed low salinity status, which is a healthy parameter for growing vegetables. The Lowest salinity value was recorded in D8 Block (11.1 mS/cm) and highest of 21.1 mS/cm in E4 Block. In general, soils having EC value greater than 2.0 dS/cm will pose the salinity threat to vegetables crops.

Organic carbon:

Soils usually having organic carbon below 0.5 per cent are classified as poor in fertility status. Most of the blocks of the centre were found to have organic carbon levels above 0.5 per cent. Blocks E1, E2 and E7 had values slightly greater than 0.5 percent value but were substantially low. This parameter is highly oxidizable and will decrease over a period of time if not managed through organic matter addition.

Available nitrogen in soil undergoes rapid changes and it varies with time. It is highly influenced

by the native microbial population and organic matter content. The results in Table 38 showed that all the blocks of this centre showed low in the available nitrogen except D7 block, which had 288 kg N/ha. All the blocks had available phosphorus in high range (>25 kg P/ha). In case of available Potash, all the blocks were high (>280 kg K/ha), except A4, D1 and D7 which had medium values for K (between 110-280 kg K/ha).

Table 37 : Chemical properties of different soil blocks of NRCOG, Rajgurunagar

Properties	Soil pH		Salinity (mS/cm)		O. C	O.M
Block	Composite	Range	Composite	Range	(%)	(g/kg Soil)
A1	7.89	7.80 : 7.91	18.6	18.0 : 18.7	0.70	12.0
A2	7.96	7.90 : 7.96	20.2	19.7 : 20.2	0.64	11.0
A3	7.85	7.81 : 7.90	17.4	17.4 : 17.7	0.64	11.0
A4	7.64	7.60 : 7.67	20.0	20.0 : 20.2	0.68	11.7
B1	7.54	7.51 : 7.54	13.1	13.0 : 13.3	0.70	12.0
B2	7.51	7.51 : 7.60	14.6	14.3 : 14.7	0.62	10.6
B3	7.84	7.80 : 7.85	14.9	14.7 : 15.1	0.65	11.2
B4	8.00	8.00 : 8.20	14.1	14.0 : 14.6	0.65	11.2
C1	7.81	7.80 : 7.88	15.1	15.0 : 15.4	0.60	10.3
C2	7.80	7.80 : 7.82	20.1	20.0 : 20.4	0.77	13.2
C3	7.83	7.80 : 7.83	18.5	18.4 : 18.7	0.72	12.4
C4	8.00	8.00 : 8.22	13.7	13.7 : 13.9	0.70	12.0
D1	7.59	7.55 : 7.59	13.0	13.0 : 13.3	0.60	10.3
D7	7.65	7.60 : 7.65	12.3	11.8 : 12.3	0.62	10.6
D8	7.41	7.38 : 7.42	11.2	11.1 : 11.3	0.65	11.2
E1	7.56	7.56 : 7.80	20.1	20.1 : 20.4	0.52	8.9
E2	7.54	7.53 : 7.57	17.0	17.0 : 17.4	0.52	8.9
E3	7.95	7.94 : 8.00	13.2	13.0 : 13.4	0.60	10.3
E4	7.76	7.71 : 7.76	20.0	20.0 : 21.1	0.67	11.5
E5	7.67	7.67 : 7.70	17.0	16.8 : 17.1	0.57	9.8
E6	7.73	7.72 : 7.80	15.4	15.1 : 15.5	0.60	10.3

Index for organic carbon content in soil : OC - Organic Carbon, OM – Organic Matter Category OC (%) : Low < 0.50, Medium : 0.50 - 0.7; High : > 0.75

Table 38 : Available Nutrient Status of different soil blocks of NRCOG

Parameters Block	Total Nitrogen (%)	Available Nitrogen (kg/ha)	Available Phosphorus (kg/ha)	Exchangeable Potassium (kg/ha)	Water Soluble (Kg/ha)
A1	0.060	248.71	50.40	407.00	32.5
A2	0.055	222.53	49.28	399.66	22.4
A3	0.058	235.62	38.08	350.53	23.5
A4	0.054	170.17	52.60	243.1	21.3
B1	0.060	222.53	69.40	306.20	20.1
B2	0.058	222.53	68.30	322.60	16.8
B3	0.056	222.53	26.80	321.20	16.8
B4	0.056	222.53	22.40	309.10	16.8
C1	0.056	170.12	48.16	289.66	12.3
C2	0.066	235.62	52.64	463.10	25.7
C3	0.062	222.53	50.40	492.43	25.7
C4	0.060	170.17	24.64	415.43	19.0
D1	0.051	235.62	47.04	253.00	11.2
D7	0.058	287.98	47.04	278.66	13.4
D8	0.056	170.17	48.16	370.33	14.5
E1	0.045	170.17	39.20	320.10	16.8
E2	0.045	222.53	40.32	382.43	20.1
E3	0.051	235.62	50.40	436.33	35.8
E4	0.057	274.87	52.64	467.86	31.3
E5	0.057	222.53	44.86	363.00	13.4
E6	0.051	222.53	39.20	381.33	19.0

Rating:	Low	Medium	High
Av. Nitrogen (kg/ha):	< 280	280 - 560	> 560
Av. P (kg/ha)	*< 10*	*10 - 25*	*> 25*
Av. K (Kg/ha)	*< 110*	*110 - 280*	*> 280*

Results depicted in the Table 39 revealed that the chemical analysis for available sulphur content in all the soil blocks are low (< 10 ppm). In case of DTPA extractable micronutrients the zinc content in B3, E1 and E6 was below the critical level (<0.5 ppm). Rest of the blocks had zinc content below 1.0 ppm, except the blocks A1 and A2 which had 1.33 and 1.00 ppm respectively. However, it was found that all the soil blocks were sufficient (values are greater than the critical index values) in the DTPA extractable iron, manganese and copper nutrients.

Table 39. Status of available sulphur and DTPA extractable micronutrients of different soil Blocks of NRCOG, Rajgurunagar

Parameters Block	Av. 'S' (ppm)	Iron (Fe) (ppm)	Zinc (Zn) (ppm)	Mang. (Mn) (ppm)	Copper (Cu) (ppm)
A1	5.79	8.25	1.33	12.37	5.28
A2	7.95	9.43	1.00	8.79	4.48
A3	5.13	10.10	0.54	14.80	3.95
A4	2.94	13.01	0.57	17.36	3.84
B1	1.85	12.24	0.93	23.71	4.94
B2	2.97	12.51	0.87	25.54	5.00
B3	1.84	11.09	0.48	12.34	4.25
B4	5.20	10.43	0.53	10.72	3.99
C1	2.60	10.35	0.73	13.06	4.03
C2	5.17	9.42	0.57	13.10	4.19
C3	5.17	10.25	0.52	13.44	3.62
C4	4.10	10.16	0.63	7.71	3.60
D1	1.91	13.44	0.74	17.34	4.17
D7	3.00	13.02	0.94	17.35	5.08
D8	3.88	14.75	0.75	22.16	5.15
E1	4.41	12.04	0.48	23.77	4.10
E2	4.88	6.92	0.59	25.71	4.24
E3	5.23	10.42	0.62	11.77	3.60
E4	5.96	9.05	0.74	18.02	4.39
E5	4.78	12.10	0.73	23.44	4.79
E6	3.44	10.69	0.48	20.22	3.96
Critical Limit	**10.0***	**4.5***	**0.5***	**1.0***	**0.2***

* Indicate the critical limit for the respective nutrients, below which the soils are deficient.

Nutritional effect of Potassium and Sulphur on the yield and quality, uptake and storability of onion and garlic.

A study to investigate the effect of potassium and sulphur on the growth, yield and quality of onion and garlic crop was taken up in the black soils of the centre having medium to high available potash and low sulphur content. Two sources of potassium namely KCl and K_2SO_4 were selected and applied at different rates (50, 75 and 100 kg K/ha) with different methods of application (whole as basal, half as basal and other half as one split and lastly 1/3rd as basal, other two parts in two splits). The seedlings of onion were transplanted on 4-12-2000 and garlic was planted on 7-11-2000. Both the crops were harvested upon attaining maturity (onion: 5-4-2001 and garlic: 20-3-2001.The experimental results of the trials conducted during *rabi* 2000-2001 on potassium and sulphur nutritional effects on marketable yield (Mkt.Y), TSS, Equatorial diameter(ED), Polar diameter(PD), Neck Thickness(NT), Number of cloves(NOC), Average bulb weight(ABW), percent A, B, & C grade bulbs, Doubles(D) and Bolters (Blt) for onion and garlic crops are presented below. The marketable yield of onion bulbs consisted of A+B+C grade bulbs. A grade = Equatorial Dia. (ED) > 5.5 cm; B grade = ED is 4.0 to 5.5 cm C grade = ED< 4.0 cm.

The effect of K_2SO_4 was significant on the marketable yield of onion bulbs over KCl application. Between the levels, it was seen that split application of all the three rates had less influence on yield in comparison to the same rates when applied in splits. Among different rates of K fertilizer, application of 100 kg/ha as basal and two splits had superior effect on the marketable yield. It was interesting to note was that application of K @ 50 kg/ha as basal and one split gave on par yield to that of higher rate and other methods of application. However, this trend has to be further tested repeatedly. Effect of neither the K sources nor their levels had significant effect on the TSS of the bulbs (Table 39.1).

Table 39.1 Effect of sources of K and their levels on the Marketable Yield (t/ha) and TSS (°B) of onion bulbs (var. N-2-4-1), during *rabi* 2000-2001

K-Levels	K sources					
	KCl		K_2SO_4		Mean	
	Mkt. Yield (t/ha)	TSS (°B)	MktYield (t/ha)	TSS (°B)	Mkt. Yield (t/ha)	TSS (°B)
50 (basal)	40.45	12.60	38.67	13.26	39.66	12.93
50 (1/2basal +1 split)	42.68	12.26	47.69	13.26	45.18	12.53
75 (basal)	44.94	12.66	42.85	12.80	43.90	13.06
75 (1/2basal + 1split)	44.91	12.13	43.02	13.46	43.97	12.50
75 (1/3basal +2 split)	42.17	13.26	44.22	12.86	43.19	12.80
100 (basal)	40.38	13.93	43.93	12.33	42.15	13.53
100 (1/2basal + 1 split)	42.00	12.66	47.31	13.13	45.08	12.93
100 (1/3basal + 2 split)	43.71	13.86	48.16	13.20	45.93	13.93
Mean	42.66	12.92	44.48	13.13		

CD (0.05)	Mkt.Yield (t/ha)	TSS (°B)
K Sources :	1.53	NS
K- Levels :	3.06	NS
KS x KL :	4.32	NS

Table 39.2 Effect of sources of K and their levels on different per cent grades of onion bulbs (var. N-2-4-1) during *rabi* 2000-2001

K-Levels	K Sources														
	KCl					K_2SO_4					Mean				
	A	B	C	D	Blt	A	B	C	D	Blt	A	B	C	D	Blt
50 (basal)	57	26	6	7	4	61	21	3	8	5	59	23	4	7	4
50 (1/2basal +1 split)	61	21	4	10	5	60	23	2	11	5	60	22	3	10	5
75 (basal)	60	23	3	7	6	63	22	3	8	4	61	22	3	7	5
75 (1/2basal + 1split)	63	23	3	4	6	57	22	3	10	7	60	22	3	7	6
75 (1/3basal +2 split)	57	27	4	8	5	66	19	3	7	5	61	23	3	7	5
100 (basal)	60	23	3	6	7	58	21	3	10	8	59	22	3	8	7
100 (1/2basal + 1 split)	59	22	2	9	7	56	26	2	8	8	57	24	2	8	7
100 (1/3basal + 2 split)	61	22	2	8	6	61	21	3	9	7	61	21	2	8	6
Mean	59	23	3	7	5	60	22	3	9	6					

The data presented in Table 39.2 shows the mean values of per cent grades of bulbs obtained due to the application of KCl and K_2SO_4 at different rates. Application of potassium either as KCL or K_2SO_4 recorded highest 'A' grade bulbs followed by B grade. Similar trend was noticed for the different rates of K application.

The onion bulb quality parameters namely, equatorial diameter, polar diameter and neck thickness were found to be less influenced by either of the treatments.

Table 39.3 : Effect of sources of K and their levels on the marketable yield (t/ha) and average bulb weight (g) of garlic bulbs (var. G-41), during *rabi* 2000-2001

(——— —K-Sources———)

K- Levels (kg/ha)	KCl		K_2SO_4		Mean	
	Mkt. Yield (t/ha)	Av.Bulb Wt (g)	Mkt. Yield (t/ha)	Av.Bulb Wt (g)	Mkt. Yield (t/ha)	Av.Bulb Wt (g)
50 (basal)	6.35	24.66	9.65	27.00	8.00	25.83
50 (1/2basal +1 split)	8.49	22.00	11.66	26.66	10.07	24.33
75 (basal)	8.42	25.66	10.10	24.00	9.26	24.83
75 (1/2basal + 1split)	8.71	22.66	11.93	25.00	10.32	23.83
75 (1/3basal +2 split)	9.95	20.33	12.62	26.33	11.28	23.33
100 (basal)	10.24	23.66	10.99	30.00	10.61	26.83
100 (1/2basal + 1 split)	9.34	21.66	12.82	30.66	11.08	26.16
100 (1/3basal + 2 split)	10.34	25.66	11.66	26.33	11.00	26.00
Mean	8.88	23.29	11.37	27.00		

CD (0.05)	K Sources	K- Levels	KS x KL
Mkt. Yield :	0.89	1.79	NS
Av. bulb Wt. :	2.93	NS	NS

Table 39.4 : Effect of sources of K and their levels on bulb diameters and number of cloves of garlic bulbs (var. G-41)

K-Levels	K sources								
	KCl			K_2SO_4			Mean		
	ED	PD	NOC	ED	PD	NOC	ED	PD	NOC
	(— cm —)			(— cm —)			(— cm —)		
50 (basal)	3.4	2.9	20	3.4	2.9	17	3.4	2.9	18
50 (1/2basal +1 split)	3.2	2.8	18	3.4	2.8	18	3.3	2.8	18
75 (basal)	3.2	2.6	18	3.2	2.7	18	3.2	2.7	18
75 (1/2basal + 1split)	3.1	2.7	15	3.3	2.8	18	3.2	2.8	16
75 (1/3basal +2 split)	3.2	2.7	18	3.4	3.0	19	3.3	2.8	19
100 (basal)	3.3	2.8	18	3.7	2.8	21	3.5	2.8	19
100 (1/2basal + 1 split)	3.1	2.6	14	3.3	2.8	18	3.2	2.7	16
100 (1/3basal + 2 split)	3.4	2.9	18	3.4	2.9	18	3.4	2.9	18
Mean	3.2	2.8	17	3.4	2.8	18			

CD (0.05)	(ED)	(PD)	(NOC)
K Sources:	0.1	NS	NS
K- Levels:	NS	NS	NS
KS x KL:	NS	NS	NS

It is seen from the results presented in Table 39.3 that K_2SO_4 had significant influence on the marketable yield of garlic bulbs in comparison to KCl. This could be due to the 'S' content in the material. The rate 75 kg K/ha (1/3 basal + two splits) gave the highest yield value. The above value was on par with other higher rates of application. The response of interaction on yield was non significant. Significant effect of K_2SO_4 on the average bulb weight of garlic was seen when compared with KCl. Effect of K levels and interaction were found to be non significant.

Equatorial diameter of garlic bulbs differed significantly due to the application of K_2SO_4 (3.4 cm) over KCl with 3.2 cm. However, the influence of levels of K and the interaction (K- sources and levels) was found to be non-significant. The effect of all the above treatments was non-significant on the polar diameter and number of cloves per bulb (Table 39.4).

Effect of foliar application of micronutrients on the yield and quality of onion and garlic.

A field experiment was conducted in the *rabi* season during 2000-2001 to study the effect of foliar application of micronutrients on the yield, quality and growth of onion and garlic bulbs. The onion seedlings were transplanted on 4-12-2000 and garlic cloves were planted on 7-11-2000. Both the crops were harvested upon attaining maturity (onion: 5-4-2001 and garlic: 20-3-2001. Micronutrient were applied at two rates; iron (0.5% and 1.0%), manganese, copper and zinc (0.25% and 0.5% each). Foliar application for all the micronutrients was done at 30, 45 and 60 days after transplanting. The results are presented in the table 40.1.

Table 40.1 : Effect of foliar application of micronutrients on the marketable yield (t/ha), TSS (°B), ED (cm), PD (cm) and NT (cm) of onion bulbs, var. N-2-4-1, during *rabi* 2000-2001.

Treatments	Mkt. Yield (t/ha)	TSS (°B)	ED (cm)	PD (cm)	NT (cm)
Fe 0.5%	41.96	13.1	5.4	4.1	1.0
Fe 1.0%	43.44	11.9	5.4	4.2	0.8
Mn 0.25%	46.56	13.8	5.6	4.3	0.8
Mn 0.5%	44.74	14.9	5.6	4.4	0.8
Cu 0.25%	44.23	11.1	5.3	4.4	0.8
Cu 0.5%	44.57	13.4	5.6	4.4	0.8
Zn 0.25%	46.11	13.0	5.6	4.3	0.8
Zn 0.5%	48.58	13.3	5.4	4.3	0.8
Control (NPK)	45.25	13.5	5.6	4.3	0.9
CD (0.05)	NS	1.50	NS	NS	NS

Table 40.2 : Effect of foliar application of micronutrients on the marketable yield (t/ha) and quality parameters of garlic bulbs var.G-41, during *rabi* 2000-2001

Treatments	Mkt. Yield (t/ha)	ED (cm)	PD (cm)	NOC	Average wt. (gm)	A grade (%)
Fe 0.5%	6.65	3.6	3.4	18.0	24.5	46
Fe 1.0%	7.36	3.8	3.5	25.7	26.9	47
Mn 0.25%	7.48	4.0	3.4	22.0	30.7	47
Mn 0.5%	7.97	3.7	3.3	20.0	24.1	55
Cu 0.25%	7.60	3.6	3.3	17.7	23.8	51
Cu 0.5%	8.02	3.8	3.4	21.3	26.1	49
Zn 0.25%	7.85	3.8	3.4	21.7	26.8	54
Zn 0.5%	8.22	3.9	3.3	21.3	26.0	52
Control	7.58	3.5	3.2	19.3	21.6	53
CD (0.05)	NS	NS	NS	NS	NS	

Data pertaining to the effect of foliar application of micronutrient on the marketable bulb yield, TSS, ED, PD, and NT of onion var. N-2-4-1 revealed that three applications of zinc @0.5% showed the highest yield but did not differ significantly over control. Similarly, other micronutrient application had no significant effect on the yield of onion bulbs. However, spraying with manganese @0.5% showed significant effect on the TSS value content of bulbs in comparison to treatments due to Fe and zinc. However, this was found to be on par with control (only NPK). Similar trend in the results due to micronutrient effect on garlic crop was observed (Table 40.2).

Table 40.3 : Effect of foliar application of micronutrients on the per cent grades of onion bulbs, var.N-2-4-1, during *rabi* 2000-2001

Treatments	AGB	BGB	CGB	D	Blt
Fe 0.5%	67	16	4	7	6
Fe 1.0%	65	14	3	11	7
Mn 0.25%	65	12	5	9	8
Mn 0.5%	68	9	2	12	9
Cu 0.25%	67	11	4	13	6
Cu 0.5%	68	11	4	13	6
Zn 0.25%	66	13	3	13	6
Zn 0.5%	70	12	3	9	5
Control	63	13	3	11	9

Mean values of data pertaining to the effect of individual micronutrients on different grades of onion bulbs is shown in Table 40.3. The highest value for A grade (70 %) bulbs was recorded due to zinc application @0.5 %, and this accounted for 11.0 per cent increase in A grade bulbs over control.

Effect of organic manures and fertilizers on the yield and quality of onion and garlic bulbs.

Organic manures play a vital role in maintaining the soil fertility. Combined application of organic manures and the chemical fertilizers can help in improving the nutrient uptake and mitigate the losses of plant nutrients when applied to soil only through fertilizers. Field studies were conducted to evaluate the effect of combined application of different rates of manures and chemical fertilizers on the yield and quality of onion and garlic. The trial for onion was transplanted on 4-12-2000 and garlic was planted on 7-11-2000. Both the crops were harvested upon attaining maturity (onion: 5-4-2001 and garlic: 20-3-2001). The results obtained from the experiments are presented in table 41.1 - 41.5

Table 41.1 Effect of organic manure and fertilizer levels on the marketable yields (t/ha) and TSS (°B) of onion bulb var. N2-4-1, during *rabi* 2000-2001

Fert. Levels (FL)	Organic manure											
	No organic manure		FYM @4t/ha		FYM @8t/ha		Vermicompost @4t/ha		Vermicompost @8t/ha		Mean	
	Yield (t/ha)	TSS (°B)	Yield (t/ha)	TSS (°B)	Yield (t/ha)	TSS (°B)	Yield (t/ha)	TSS (°B)	Yield (t/ha)	TSS (°B)	Yield (t/ha)	TSS (°B)
No Fertilizer	27.67	12.6	35.96	12.2	37.90	13.6	30.65	13.8	41.36	13.3	34.71	13.1
50% RDF*	35.69	13.5	39.84	13.0	45.79	13.9	44.62	12.9	48.69	12.4	42.92	13.1
75% RDF	38.73	12.2	45.37	13.1	44.10	14.1	44.24	12.8	46.37	12.5	43.76	12.9
100% RDF	37.67	13.0	42.05	13.9	50.50	13.7	46.57	13.8	49.44	12.4	45.30	13.4
Mean	34.96	12.8	40.80	13.0	44.57	13.8	41.56	13.3	46.46	12.6		
CD: (0.05)												

RDF = Recommended dose of fertilizer*

	OM	FL	OM x FL
Mkt.yield (t/ha)	6.41	4.39	NS
TSS (°B)	0.90	NS	NS

Application of vermicompost and FYM @ 8 t/ha recorded significantly highest yield than control. However, both were on par with each other. All the levels of chemical fertilizers recorded significantly higher yield than control. Incidentally, all the levels were on par with each other. Although the intervention of organic manures and fertilizers was non-significant, the highest yield (49.44 t/ha) was produced by vermicompost @ 8 t/ha and 100% RDF of chemical fertilizer closely followed by vermicompost @ 8 t/ha and 50% RDF (48.89 t/ha).

The effect of organic manure had no effect on the percentage of A grade bulbs. It is seen from the data presented in the Table 41.2 that there was no difference due to application of either FYM or Vermicompost when compared to control. However, the fertilizer application at all three rates showed greater percentage of A grade bulbs than on no fertilizer treatment.

Table 41.2 : Effect of organic manure and fertilizer levels on different grades of onion bulbs (%), var. N-2-4-1, during *rabi* 2000-2001

ORGANIC MANURE

Fertilizer level	No organic manure					FYM @ 4t/ha					FYM@ 8t/ha					Vermicompost @4t/ha					Vermicompost@8t/ha					Mean				
	A (%)	B (%)	C (%)	D (%)	Blt (%)	A (%)	B (%)	C (%)	D (%)	Blt (%)	A (%)	B (%)	C (%)	D (%)	Blt (%)	A (%)	B (%)	C (%)	D (%)	Blt (%)	A (%)	B (%)	C (%)	D (%)	Blt (%)	A (%)	B (%)	C (%)	D (%)	Blt (%)
No Fertilizer	53	24	8	9	7	58	19	6	6	11	46	24	9	10	12	47	24	11	5	14	55	22	6	5	12	52	22	8	8	11
50 % RDF*	64	18	3	8	8	61	16	2	13	9	62	17	3	9	9	62	16	4	9	8	61	15	4	10	10	62	16	3	10	9
75 % RDF	61	16	4	12	7	60	18	3	12	7	64	16	3	10	7	61	15	3	12	9	63	15	3	13	6	62	16	3	9	7
100 % RDF	61	17	3	14	6	66	13	2	9	10	67	14	2	7	9	62	15	3	13	7	58	16	3	16	7	63	15	2	12	8
Mean	60	15	3	10	7	61	16	3	10	9	60	17	4	9	9	58	17	5	10	9	59	17	4	11	9					

RDF = Recommended dose of fertilizer*

Table 41.3 Effect of organic manure and fertilizer levels on quality parameters (ED, PD and NT) of onion bulbs var. N-2-4-1, during *rabi* 2000-2001

Fertilizer level (FL)	No organic manure			FYM@ 4t/ha			FYM@ 8t/ha			Vermicompost @ 4t/ha			Vermicompost @ 8t/ha			Mean		
	ED	PD (cm)	NT	ED	PD (cm)	NT	ED	PD (cm)	NT	ED	PD (cm)	NT	ED	PD (cm)	NT	ED	PD (cm)	NT
No Fertilizer	5.7	4.3	0.7	5.5	4.5	0.5	5.4	4.5	0.5	5.4	4.4	0.6	5.4	4.2	0.5	5.5	4.4	0.6
50 % RDF*	5.4	4.6	0.5	5.3	4.3	0.5	5.5	4.3	0.5	5.5	4.3	0.5	5.4	4.3	0.6	5.4	4.4	0.5
75 % RDF	5.5	4.4	0.5	5.5	4.4	0.5	5.4	4.4	0.5	5.7	4.3	0.5	5.5	4.2	0.5	5.5	4.4	0.5
100 % RDF	5.5	4.4	0.6	5.5	4.4	0.5	5.4	4.5	0.5	5.6	4.5	0.6	5.4	4.4	0.5	5.5	4.5	0.5
Mean	5.5	4.4	0.6	5.5	4.4	0.5	5.4	4.4	0.5	5.5	4.4	0.5	5.4	4.3	0.5			

**RDF = Recommended dose of fertilizer*

CD (0.05) :	OM	FL	OM x FL
Equatorial Dia (ED) :	NS	NS	NS
Polar Dia (PD) :	NS	NS	NS
Neck Thickness (NT) :	NS	NS	NS

The statistical analyses of data presented in Table 41.3 for the bulb quality parameters, equatorial and polar diameters and neck thickness of onion bulbs showed that the effect of organic manure o[r] fertilizer levels applied alone or in combination ha[d] no significant effect.

Table 41.4 Effect of organic manure and fertilizer levels on bulb diameter and no. of cloves of garlic bulb var. G-41, during *rabi* 2000-2001

Fertilizer level (FL)	No organic manure			FYM@ 4t/ha			FYM@ 8t/ha			Vermicompost @ 4t/ha			Vermicompost @ 8t/ha			Mean		
	ED (cm)	PD (cm)	NOC	ED (cm)	PD (cm)	NOC	ED (cm)	PD (cm)	NOC	ED (cm)	PD (cm)	NOC	ED (cm)	PD (cm)	NOC	ED (cm)	PD (cm)	NOC
No Fertilizer	3.3	2.9	13	3.1	3.0	14	3.3	3.2	14	3.4	3.2	14	3.4	3.2	15	3.3	3.1	14
50 % RDF*	3.4	3.0	17	3.2	2.9	16	3.4	3.0	14	3.5	2.9	17	3.4	3.1	15	3.3	3.0	15
75 % RDF	3.3	3.0	15	3.5	3.3	19	3.5	3.4	16	3.4	3.2	16	3.3	3.1	17	3.4	3.2	16
100 % RDF	3.4	3.1	17	3.5	3.3	17	3.4	3.2	19	3.5	3.1	19	3.2	3.2	15	3.4	3.2	17
Mean	3.3	3.0	15	3.3	3.1	16	3.4	3.2	15	3.4	3.1	16	3.3	3.1	15			

RDF= Recommended dose of fertilizer

CD (0.05):	OM	FL	OM x FL
Equatorial Dia (ED):	NS	NS	NS
Polar Dia (PD):	NS	0.1	NS
No.of Cloves (NOC):	NS	1.6	NS

In case of garlic, the results in Table 41.4 showed that different fertilizer level had significant effect on the polar diameter and on number of cloves of garlic bulb var. G-41. Polar diameter due to fertilizer application @ 75 and 100 % respectively, was significantly greater than 50% RDF application. Whereas, other treatment effects on bulb quality parameters were found to be non-significant.

Table 41.5 : Effect of organic manure and fertilizer levels on the marketable yield of garlic bulbs (t/ha), var. G-41, during *rabi* 2000-2001

(————————Organic manure————————)

Fert. Levels	No OM	FYM (4t/ha)	FYM (8t/ha)	Vermi compost* (4t/ha)	Vermi Compost (8t/ha)	Mean
No Fertilizer	4.01	5.42	6.80	8.78	10.59	7.12
50 % RDF*	4.57	7.54	7.24	10.17	11.66	8.23
75 % RDF	4.76	6.61	10.65	11.82	10.88	8.94
100 % RDF	5.63	7.89	10.17	10.40	10.72	8.96
Mean	4.74	6.86	8.71	10.29	10.96	

**RDF= Recommended dose of fertilizer*

CD : (0.05) OM : 0.93 FL: 0.62 OM x FL : 1.40

The results presented in the Table 41.5 above indicate the significant effects of organic manures, fertilizer levels and their interaction on the marketable yield of garlic bulbs. Application of vermicompost at 4 or 8 t/ha was significant over the Mkt.Y application. Fertilizer application at 75 and 100 % RDF respectively, were found to be superior over 50% RDF and on par to each other. Combined application of vermicompost @ 4t/ha + 75 % RDF gave the highest marketable yield of 11.82 t/ha. These results infer that there is scope for management with lower rates of manure applied with reduced RDF to get the same results due to high application rate of nutrients through fertilizers alone. The results on uptake of nutrients and storage studies are yet to be analyzed and processed.

CROP PROTECTION

Integrated pest Management

Studies on seasonal incidence of onion thrips

D.O.P : from 1 June to 15 Dec, 2000 at 15 day interval

Design : FRBD Plot size: 3 x 1.5 m

Date of planting had significant effect on thrips incidence. It was highest in 15 November planting followed by 1 December planting, whereas lowest infestation was recorded in 15 August planting followed by 1 and 15 October plantings (Table 42.1). Because of bulb rotting lowest yields were obtained in 1.7.2000-1.8.2000 plantings. Bulb rotting was uniform in all the regimes (Table 42.3). There is no yield difference between protected and control plots in 15 September planting, suggesting no need of insecticide spray.

Thrips population reached to maximum

(48.8/plant) in August during *kharif* season and touched the lowest (1.3/plant) in October (Table 43). Thrips started multiplying from December and reached highest (112.0/plant) in February and drastically came down to 14.4/plant during March. Among various weather parameters humidity and rainfall have affected the population, negatively. During the entire period two peaks of thrips population were recorded –one in august and the second in February (Fig.3).Hot and dry climate is congenial for thrips multiplication(Fig.2). No correlation was observed between thrips population and Stemphylium blight, suggesting the role of humidity and rainfall in development and spread of the disease. However, disease intensity was less in insecticide sprayed plots compared to control and even fungicide sprayed plots particularly during *kharif* season (Table 42.2).

The reduction in yield during *rabi*, particularly 15.11.2000 and 1.12.2000 plantings is due to the coincidence of high infestation of thrips (Fig. 4) at bulb initiation, formation and development (45-75 days).Yield loss was up to 50% in 1.11.2000 and 1.12.2000 plantings compared to protected plots. It gives a clue that management of thrips is crucial between bulb initiation and bulb development stages. High population of thrips after 75 days of age did not reduce the yield. This study also suggests that onion plants can tolerate thrips population up to 30/plant without affecting the yield.

Table 42.1 : Effect of date of planting on *thrips* incidence in onion under protected and unprotected regimes during the year 2000

Date (D)	Thrips/plant			Yield (t/ha)		
	Regimes (R)			Regimes (R)		
	Protected	Unprotected	Average	Protected	Unprotected	Average
1.6.2000	3.0	32.5	17.7	15.2	15.2	15.2
15.6.2000	3.5	40.1	21.8	12.3	7.9	10.1
1.7.2000	7.9	32.4	20.1	6.6	2.4	4.5
15.7.2000	6.3	17.0	11.7	6.8	5.7	6.2
1.8.2000	4.2	10.2	7.2	5.6	10.9	8.3
15.8.2000	1.0	5.3	3.1	21.7	23.9	22.8
1.9.2000	0.6	3.4	2.0	34.7	35.1	34.9
15.9.2000	0.4	6.6	3.5	60.6	59.3	59.9
1.10.2000	0.6	14.4	7.5	56.3	47.1	51.7
15.10.2000	1.2	33.4	17.3	54.5	45.9	50.2
1.11.2000	0.8	49.2	25.0	47.5	33.9	40.8
15.11.2000	2.5	91.6	47.0	44.4	22.6	33.5
1.12.2000	5.5	70.8	38.2	44.9	26.3	35.6
15.12.2000	6.8	61.5	33.5	54.8	38.7	46.8
Average (regime)	3.2	33.5		33.3	26.8	
	Date	Regime	D x R	Date	Regime	D x R
S.E.±	0.79	0.30	1.12	0.57	1.22	0.46
C.D (0.05)	2.25	0.76	3.19	3.47	1.17	4.91

Table 42.2: Incidence of thrips and disease (*Stemphylium* blight) intensity in onion planted at different dates under different regimes during *rabi*, 2000

Date of planting (D)	Thrips/plant					Disease intensity (%)				
	Regime (R)					Regime (R)				
	I	F	C	I+F	Avg.	I*	F	C	I+F	Avg.
1.6.2000	3.0	25.9	32.5	4.8	16.6	10.7 (18.98)	14.4 (22.29)	31.7 (34.25)	11.3 (28.30)	17.0 (25.95)
15.6.2000	3.5	30.3	40.1	3.6	19.4	13.1 (20.55)	10.4 (18.80)	15.5 (23.14)	13.1 (21.16)	13.0 (20.91)
1.7.2000	7.9	23.2	32.4	8.4	17.9	20.8 (27.06)	57.1 (49.14)	71.7 (57.75)	24.0 (29.31)	43.4 (40.82)
15.7.2000	6.3	17.7	17.0	6.3	11.8	8.8 (16.98)	47.4 (43.50)	51.5 (44.69)	13.9 (21.77)	30.4 (31.74)
1.8.2000	4.2	11.6	2.6	2.6	7.2	27.7 (31.14)	19.2 (25.68)	61.9 (52.20)	29.3 (32.64)	34.5 (35.41)
15.8.2000	1.0	5.5	5.3	1.8	3.4	29.9 (33.04)	33.9 (35.50)	38.4 (38.24)	17.9 (24.97)	30.0 (32.94)
1.9.2000	0.6	3.2	3.4	0.9	2.0	37.8 (37.34)	28.5 (32.19)	22.9 (28.60)	29.6 (32.89)	29.7 (32.76)
15.9.2000	0.4	3.7	6.6	0.9	2.9	15.7 (23.27)	11.5 (22.46)	17.9 (24.87)	15.5 (23.09)	15.1 (23.42)
1.10.2000	0.6	13.5	14.4	1.1	7.4	9.3 (17.78)	11.7 (20.02)	13.6 (21.36)	11.7 (20.02)	11.6 (19.79)
15.10.2000	1.1	31.0	33.4	1.9	16.9	6.9 (15.26)	16.0 (23.46)	23.7 (29.12)	9.9 (18.29)	14.1 (21.53)
1.11.2000	0.8	38.1	49.2	3.4	22.9	8.5 (16.93)	19.7 (47.04)	24.3 (29.37)	9.1 (17.46)	15.4 (27.70)
15.11.2000	2.5	69.6	91.6	6.3	42.5	8.3 (16.64)	12.3 (20.47)	13.1 (21.15)	9.1 (17.51)	10.7 (18.94)
1.12.2000	5.5	59.1	70.8	9.4	36.2	5.6 (12.61)	14.1 (21.76)	9.9 (18.29)	5.1 (13.62)	8.7 (16.57)
15.12.2000	6.8	53.1	61.5	7.4	32.2	9.6 (18.04)	14.4 (22.14)	13.3 (21.38)	6.7 (14.92)	11.0 (19.12)
Average R	3.2	27.5	33.5	4.2		15.2 (21.83)	22.2 (28.89)	29.2 (31.74)	14.7 (22.57)	
S.E.±	D	R	D x R			D	R	D x R		
	0.99	0.53	1.99			1.26	0.67	2.58		
C.D. (0.05)	2.78	1.48	5.57			3.55	1.90	6.02		

*Values in parentheses are arc-sin transformed

I= Insecticide regime; F= Fungicide regime; C= Control; I+F= Insecticide + Fungicide;

Table 42.3 : Yield and % bulb rotting in different date of planting under different regimes in onion during *rabi*, 2000

Date of planting (D)	Yield t/ha				
	Regime (R)				
	I	F	C	I+F	Avg.
1.6.2000	15.2 (0.00)*	16.0 (0.00)	15.9 (0.00)	20.3 (0.00)	16.9 (0.00)
15.6.2000	12.3 (0.00)	11.7 (0.00)	8.5 (0.00)	11.1 (0.00)	10.9 (0.00)
1.7.2000	6.6 (23.31)	2.8 (7.73)	2.2 (14.19)	7.2 (20.00)	4.7 (16.30)
15.7.2000	6.8 (21.02)	5.3 (27.61)	5.8 (32.49)	5.8 (37.46)	5.9 (29.64)
1.8.2000	5.6 (41.14)	8.6 (29.97)	10.5 (29.25)	9.9 (35.14)	8.7 (33.87)
15.8.2000	21.7 (0.00)	23.4 (0.00)	24.3 (0.00)	24.7 (0.00)	23.5 (0.00)
1.9.2000	34.7 (0.00)	39.5 (0.00)	35.9 (0.00)	41.2 (0.00)	37.8 (0.00)
15.9.2000	60.6 (0.00)	60.7 (0.00)	58.7 (0.00)	62.3 (0.00)	60.6 (0.00)
1.10.2000	56.3 (0.00)	49.3 (0.00)	46.9 (0.00)	50.3 (0.00)	50.7 (0.00)
15.10.2000	54.5 (0.00)	48.2 (0.00)	47.7 (0.00)	63.0 (0.00)	53.3 (0.00)
1.11.2000	47.5 (0.00)	29.1 (0.00)	32.9 (0.00)	42.1 (0.00)	37.9 (0.00)
15.11.2000	44.4 (0.00)	21.1 (0.00)	24.4 (0.00)	50.6 (0.00)	35.2 (0.00)
1.12.2000	44.9 (0.00)	30.9 (0.00)	26.8 (0.00)	41.6 (0.00)	36.0 (0.00)
15.12.2000	54.8 (0.00)	40.3 (0.00)	39.3 (0.00)	46.7 (0.00)	45.3 (0.00)
Average	33.3 (0.00)	27.6 (0.00)	27.1 (0.00)	34.1 (0.00)	
		D	R	D x R	
S.E.±		1.07	0.57	2.15	
C.D(0.05)		3.01	1.44	6.02	

*Values in parentheses are % bulb rotting.

Table 43 : Affect of weather parameters on incidence of thrips and *stemphylium* blight on onion

Month	Thrips/ Plant	Max. temp (°C)	RH (%)	Rainfall (mm)	Disease intensity (%)	Total spore count
June	0.8	31.92	64.4	0	-	-
July	10.2	27.97	69.75	70.2	-	-
August	48.8	29.1	68	82	23.59	3879
September	14.9	30.82	58	77	61.59	6145
October	1.3	33.07	40.25	43.5	49.88	4658
November	3.3	32.22	37.6	7.5	20.39	64
December	27.6	30.15	33.25	0	18.66	0
January	78.9	29.9	36.75	0.4	18.66	0
February	112.0	33.3	19.8	0	11.59	0
March	14.4	34.44	18.41	0	0	0
Corr. coeff.	Thrips	-0.02	-0.37	-0.41	-0.12	-0.20
Corr. coeff	Disease	-0.24	0.62	0.71		
Corr. coeff	Spores	-0.23	0.75	0.92	0.88	

Fig. 2 : Population dynamics of onion thrips during the year 2000 –standard week wise

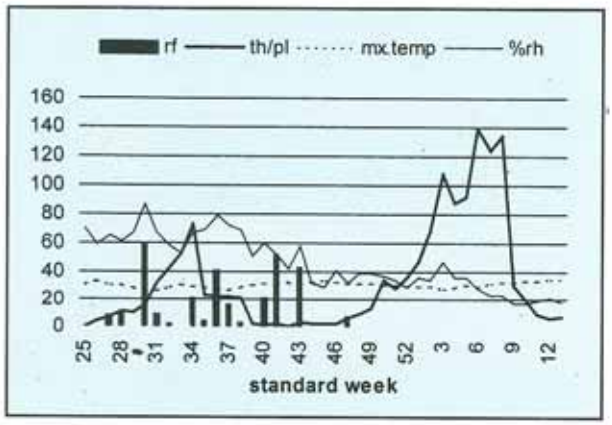


Fig. 3 : Population dynamics of onion thrips during the year 2000– month wise

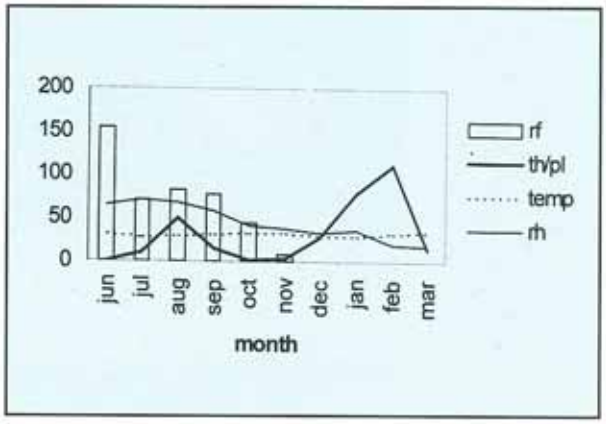
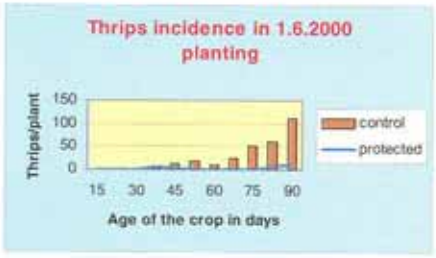
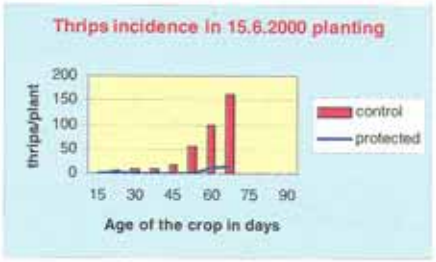
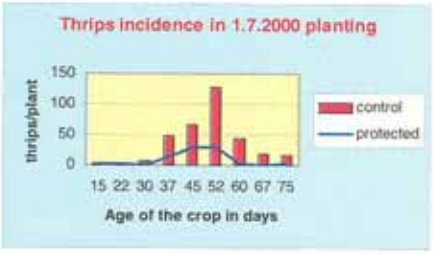
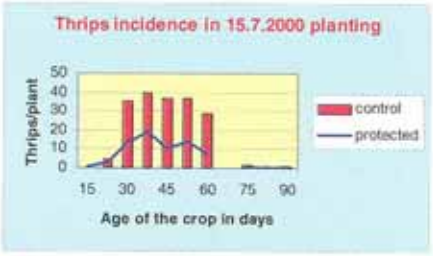


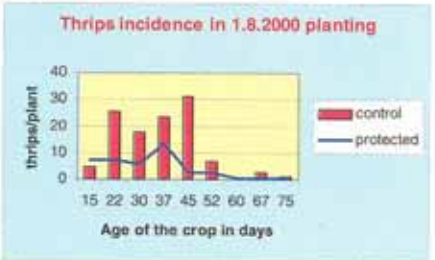
Fig. 4 : Thrips incidence on onion planted on different dates based on the age of the crop during the year 2000-01

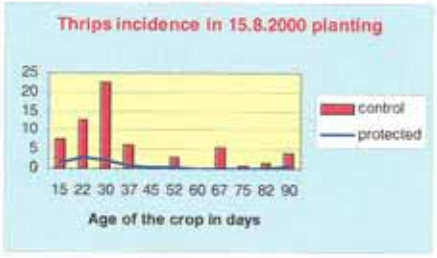


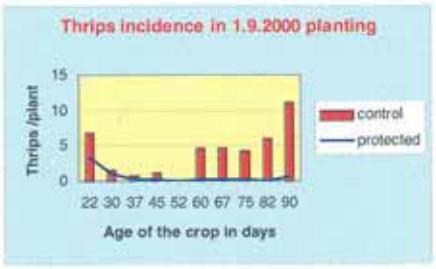


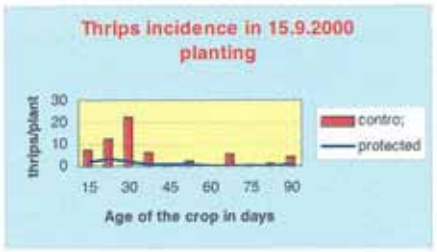


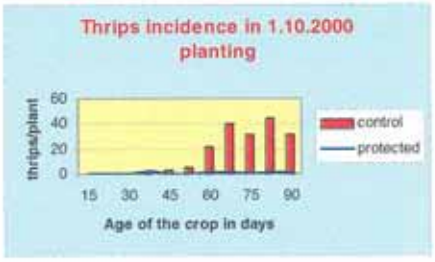




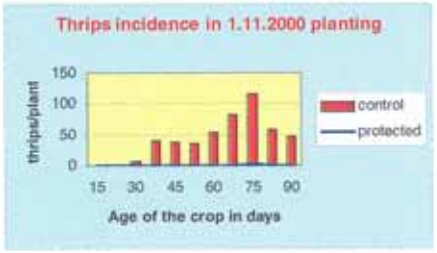


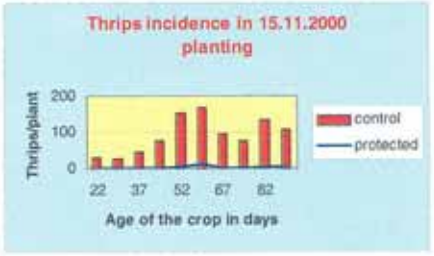

Thrips incidence in 1.9.2000 planting
Thrips /plant
15
10
5
0
22 30 37 45 52 60 67 75 82 90
Age of the crop in days
control
protected

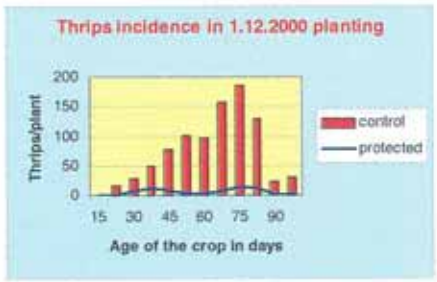

Thrips incidence in 15.9.2000 planting
thrips/plant
30
20
10
0
15 30 45 60 75 90
Age of the crop in days
contro;
protected


Thrips incidence in 1.10.2000 planting
thrips/plant
60
40
20
0
15 30 45 60 75 90
Age of the crop in days
control
protected


Thrips incidence in 15.10.2000 planting
thrips/plant
100
50
0
15 30 45 60 75 90
Age of the crop in days
control
protected


Thrips incidence in 1.11.2000 planting
thrips/plant
150
100
50
0
15 30 45 60 75 90
Age of the crop in days
control
protected


Thrips incidence in 15.11.2000 planting
Thrips/plant
200
100
0
22 37 52 67 82
Age of the crop in days
control
protected


Thrips incidence in 1.12.2000 planting
Thrips/plant
200
150
100
50
0
15 30 45 60 75 90
Age of the crop in days
control
protected


Thrips incidence in 15.12.2000 planting
thrips/plant
200
150
100
50
0
15 30 45 60 75 90
Age of the crop in days
control
protected

Economics in management of thrips

D.O.P: 28.11.2000 D.O.H: 20.3.2001 Variety: N-2-4-1
Design: RBD Plot size: 3 x 2 m

Two sprays of Cypermethrin (60 g ai/ha) were required to maintain 30 thrips /plant in onion. (Table 44.1). Though net income was highest at a population level of 15 thrips /plant that required 4 sprays, C: B ratio was highest at 30 thrips/plant. Based on regression coefficient of 24.88 kg/ha and current market price of Rs.2.50 /kg EIL was worked out at 49.29 thrips/plant. (Table 44.2) The study suggests to make chemical intervention only when thrips reaches 30 / plant.

Table 44.1 : Economic threshold level for onion thrips during *rabi* 2000

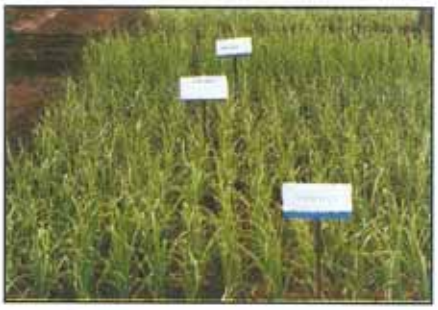
Treatment	Population Level of thrips	No.of Sprays required	Yield t/ha over control	Gross Income (Rs.)	Cost of application (Rs/ha)	Net Income (Rs)	C:B ratio
T1	2	8	18.1	45348	4800	40548	8.45
T2	5	6	20.6	51390	3600	47790	13.28
T3	8	5	20.2	50625	3000	47625	15.88
T4	10	4	21.9	54723	2400	52323	21.80
T5	15	4	22.7	56808	2400	54408	22.67
T6	20	2	16.9	42363	1200	41163	34.30
T7	25	2	19.5	48750	1200	47550	39.63
T8	30	2	19.7	49308	1200	48108	40.09
T9	Check*	4	21.9	54748	2400	52348	21.81

* foliar spray at 15 day interval from 30 days after planting

Table 44.2 : Economic injury level for onion thrips during *rabi* 2000

Season & year threshold	Cost of application in maintaining 30 thrips per plant Per Ha.	Current market price of onion bulbs (Rs/Kg)	Gain	EIL*
Rabi 2000	1200	2.5	480	49.29

* at regression.coeff. 24.88 kg/ha



Onion plots with different population levels of thrips

Effect of certain botanicals on onion thrips

D.O.P. : 28.11.2000 D.O.H: 03.04.2001 Variety: N-2-4-1
Design: RBD Plot size: 3 x 2 m

Different botanicals viz., neem, annona, karanj oil were evaluated for their efficacy against thrips during *rabi*, 2000. Three foliar sprays at 15-day interval were sprayed from 1 month after planting. At 3 days after spray Cypermethrin (60 g ai/ha) recorded significantly lower number of thrips (Table 45) followed by monocrotophos (0.05%). All other treatments were found superior over control. There is a slight increase in efficacy of botanicals at 7 days after spraying. At 14 days after spray also cypermethrin significantly reduced the thrips population, realizing highest yield of 36.1 t/ha, followed by monocrotophos (24.4 t/ha). Botanicals were not effective in management of thrips compared to cypermethrin and monocrotophos.

Table 45 : Efficacy of certain botanicals against onion thrips during *rabi*, 2000

Treatment	Dose	Number of thrips/plant			Yield
	ml/l	3 DAS	7 DAS	14 DAS	t/ha
Nivaar	4	78.5	62.6	88.9	16.4
Nivaar	6	114.5	72.4	124.4	11.8
Neem Azal	2	95.7	74.0	119.9	16.4
Neem Azal	4	99.3	77.1	124.1	11.9
Biofen	5	68.9	61.5	78.5	20.3
Biofen	10	105.6	90.1	139.9	13.3
Karanj oil	10	99.8	96.4	135.8	14.8
Neem oil	10	115.9	74.7	101.9	17.4
Cypermethrin	0.5	3.5	5.2	5.0	36.1
Monocrotophos	1.6	21.0	30.4	37.1	24.4
Control	Nil	150.7	103.3	171.1	12.3
S.E.±		3.00	6.09	8.29	0.783
C.D. (0.05)		6.26	12.72	17.31	1.63

Seedling root dip for management of onion thrips

D.O.P: 28.11.2000 D.O.P: 03.04.2001 Variety: N-2-4-1
Design: RBD Plot size: 3 x 2 m

Seedling root dip was done for 2 hr. with imidacloprid, (0.04%), Carbosulfan (0.025%) and chlorpyriphos (0.02%). Foliar sprays were done from 30 days after planting at 15-day interval for 3 times. Seedling root dip with carbosulfan and imidacloprid was found significantly effective up to 40 days after planting (Table 46). With regard to foliar sprays carbosulfan was significantly superior over other treatments at 40,55 and 70 days after planting. Highest yield (25.8t/ha) was recorded in treatment T6. Marketable yield was low because of high percentage of doubles and bolters.

Table 46 : Effect of seedling root dip on thrips infestation in onion during *rabi* 2000

Treatment	Number of thrips/plant					Overall efficacy of foliar sprays	Overall efficacy	Yield t/ha
	15 DAP	25 DAP	40 DAP	55 DAP	70 DAP			
T1	0.0	6.1	36.9	215.5	47.5	100.0	76.5	15.5
T2	0.1	8.3	32.4	75.4	28.2	45.3	36.1	25.2
T3	0.0	10.4	33.7	76.0	43.5	51.1	40.9	16.6
T4	0.5	6.3	32.6	223.2	44.0	99.9	76.5	16.0
T5	1.2	2.3	15.3	89.4	28.5	44.4	33.9	18.4
T6	0.2	2.5	10.1	14.5	4.3	9.0	7.3	25.8
T7	0.4	15.0	72.5	195.9	56.0	108.1	84.9	12.3
T8	1.5	14.3	44.2	73.1	30.1	49.1	40.4	14.8
T9	1.0	15.0	46.3	119.7	19.0	61.7	50.0	15.6
T10	0.3	26.7	44.0	80.2	40.4	54.9	47.8	17.7
T11	1.6	15.0	42.6	62.2	14.3	39.7	33.5	21.7
T12	1.3	20.3	75.5	255.6	60.2	130.4	102.9	13.3
S.E.±	NS	4.18	6.13	10.14	2.23	4.73	3.70	0.56
C.D.(0.05)	NS	8.65	12.69	21.01	4.62	9.79	7.67	1.16

T1= Seedling root dip (SRD) with imidacloprid(0.04%) for 2 hr. before transplanting; T2=T1+foliar spray with monocorotophos (0.05%) from 30 days after planting (DAP) at 15 day interval; T3= T1+ foliar spray with imidacloprid from 30 DAP at 15 day interval; T4=SRD with Carbosulfan(0.025%); T5=T4+ foliar spray with monocorotophos from 30 DAP at 15 day interval; T6= T4+ foliar spray with carbosulfan(0.05%) from 30 DAP at 15 day interval; T7= SRD with Chlorpyriphos(0.02%); T8=T7+ foliar spray with monocrotophos(0.05%) from 30 DAP at 15day interval; T9=T7+ foliar spray with Chlorpyriphos(0.02%) from 30 DAP at 15 day interval; T10=foliar spray with monocrotophos(0.05%) from 30 DAP at 15 day interval; T11= foliar spray with dimethoate(0.06%) from 30 DAP at 15 day interval; T12= control

Effect of potassium fertilizer on onion thrips

D.O.P: 28.11.2000 D.O.H: 03.04.2001 Variety: N-2-4-1
Design: RBD Plot size: 1 m x 1 m

Potash fertilizer was applied in two forms i.e., KCl, K_2SO_4 ,each at 50, 75 and 100 kg/ha along with regular dose of N&P. The experiment was carried in both field and pots. K- uptake at 45 and 60 days of age was studied in the laboratory. In both field and pot culture potash has shown no effect on thrips at 30,45 and 60 days after planting (Table 47.1). There was no significant difference in yield among the treatments. However, K uptake was highest at 75 kg/ha irrespective of source of K (Table 47.2).

Table 47.1 : Effect of potash fertilizer on thrips incidence in onion during *rabi* 2000

Treatment*	FIELD				POT CULTURE		
	Thrips/plant			Yield (t/ha)	Thrips/plant		
	30DAP	45DAP	60DAP		30 DAP	45DAP	60DAP
T1	48.9	114.7	51.7	31.2	26.2	33.5	36.9
T2	53.4	127.6	50.4	27.8	28.9	30.0	24.2
T3	49.1	123.0	46.7	26.8	42.9	34.3	30.5
T4	44.1	130.1	39.3	30.5	27.7	37.6	25.3
T5	49.1	126.4	51.0	27.3	29.8	43.8	29.3
T6	42.3	138.7	35.6	30.5	29.2	33.2	21.0
T7	47.8	137.0	43.8	29.8	26.6	34.2	37.7
S.E.±	NS	NS	NS	NS	NS	NS	NS
C.D. (0.05)	NS	NS	NS	NS	NS	NS	NS

*T1=NPK50 kg (KCl); T2=NPK75 kg (KCl); T3=NPK100 kg (KCl);T4=NPK50 kg (K_2SO_4) ; T5=NPK75 kg (K_2SO_4) ; T6=NPK100 kg (K_2SO_4) ; T7= Control

Table 47.2: Potassium uptake in onion plant at 45 and 60 DAP during *rabi* 2000

Treatment	K- uptake g/g	
	45 DAP	60 DAP
T1	18.77	19.8
T2	23.50	22.10
T3	20.20	21.93
T4	17.00	18.85
T5	22.47	23.73
T6	19.97	22.63
T7	18.73	19.50
S.E.±	1.16	0.67
	2.54	1.46

Effect of irrigation systems on thrips infestation

D.O.P: 1.12.2000(Onion) D.O.H: 10.4.2001 Variety: N-2-4-1 Plot size: 10 x 1.2 m
D.O.P: 28.10.2000(Garlic) D.O.H: 15.3.2001 Variety : G-41
Design: Split-plot (main plot-irrigation system: sub plot-chemical treatment)

Sprinkler irrigation significantly reduced the thrips population at 30, 45, 60 and 75 days after planting(Table 48.1-48.4). Application of Carbofuran 3G granules at the time of planting resulted in significant reduction of thrips up to 30 days after planting. Though granule application at 15-day interval was effective over control, foliar spray with cypermethrin (60 g ai/ha) was superior over all other treatments. There was no significant difference in yield between drip and surface irrigation, but significantly more compared to sprinkler(Table 48.5). Low yield in sprinkler might be due to non-uniform distribution of water.

In case of garlic, irrigation system had no effect on thrips population any time after planting (Table 49.1 –49.3). Unlike in onion, sprinkler irriga-

tion had no effect due to the protection offered to thrips by the outer leaves. Application of carbofuran 3G granules was effective at 45 and 60 days after planting. Yields were significantly higher in drip and surface irrigation (Table 49.4)

Table 48.1 : Effect of different irrigation systems and different formulations on thrips infestation during *rabi*, 2000 at 30 DAP

Irrigation system(I)	Number of thrips per plant (T)				
	T1*	T2	T3	T4	Average (Irrigation)
Drip	29.5	33.2	50.9	51.3	41.2
Sprinkler	14.3	12.4	55.9	54.1	34.2
Surface	30.1	40.9	57.1	55.0	45.8
Average (Treatment)	24.6	28.8	54.6	53.5	
	I	T	I x T		
S.E.±	2.53	1.79	3.11		
C.D. (0.05)	7.52	5.33	9.24		

Table 48.2: Effect of different irrigation systems and different formulations on thrips infestation during *rabi*, 2000 at 45 DAP

Irrigation system(I)	Number of thrips per plant (T)				
	T1*	T2	T3	T4	Average (Irrigation)
Drip	2.2	32.9	2.4	61.1	24.6
Sprinkler	1.8	27.0	2.2	56.4	21.8
Surface	2.4	53.4	2.3	78.9	34.3
Average (Treatment)	2.1	37.8	2.3	65.5	
	I	T	I x T		
S.E.±	1.41	1.29	2.23		
C.D. (0.05)	4.20	3.83	6.63		

T1=Application of Carbofuran 3G@ 1Kg a.i/ha at the time of planting and foliar spray of Cypermethrin@ 60g a.i/ha from 30 DAP
T2=Application of Carbofuran 3G granules at the time of planting and at 15 day interval from 30 DAP; T3= foliar spray of Cypermethrin@ 60g a.i/ha from 30 DAP; T4= Control

Table 48.3 : Effect of different irrigation systems and different formulations on thrips infestation during *rabi*, 2000 at 60 DAP

Irrigation system(I)	Number of thrips per plant (T)				
	T1*	T2	T3	T4	Average (Irrigation)
Drip	2.2	69.3	2.1	94.0	41.9
Sprinkler	0.7	25.3	1.3	51.4	19.7
Surface	1.0	74.5	0.7	85.2	40.4
Average (Treatment)	1.3	56.4	1.4	76.9	
	I	T	I x T		
S.E.±	0.57	0.89	1.55		
C.D. (0.05)	1.70	2.67	4.62		

Table 48.4 : Effect of different irrigation systems and different formulations on thrips infestation on onion during *rabi*, 2000 at 75DAP

Irrigation system(I)	Number of thrips per plant (T)				
	T1*	T2	T3	T4	Average (Irrigation)
Drip	0.2	43.4	0.3	49.5	23.3
Sprinkler	1.1	21.0	0.3	29.2	12.9
Surface	0.7	83.2	0.2	85.6	42.4
Average (Treatment)	0.7	49.2	0.2	54.8	
	I	T	I x T		
S.E.±	0.88	0.96	1.66		
C.D.(0.05)	2.61	2.85	4.94		

*T1=Application of Carbofuran 3G@ 1Kg a.i/ha at the time of planting and foliar spray of Cypermethrin@ 60g a.i/ha from 30 DAP T2=Application of Carbofuran 3G granules at the time of planting and at 15 day interval from 30 DAP; T3= foliar spray of Cypermethrin@ 60g a.i/ha from 30 DAP; T4= Control

Table 48.5 : Effect of different irrigation systems and different formulations on onion bulb yield during *rabi*, 2000

Irrigation system(I)	Number of thrips per plant (T)				
	T1*	T2	T3	T4	Average (Irrigation)
Drip	48.7	34.8	47.3	35.8	41.6
Sprinkler	37.2	31.2	32.3	26.2	31.7
Surface	47.4	34.2	47.4	29.6	39.7
Average (Treatment)	44.5	33.4	42.3	30.6	
	I	T	I x T		
S.E.±	1.48	1.01	1.76		
C.D.(0.05)	4.39	3.02	5.24		

*T1=Application of Carbofuran 3G@ 1Kg a.i/ha at the time of planting and foliar spray of Cypermethrin@ 60g a.i/ha from 30 DAP T2=Application of Carbofuran 3G granules at the time of planting and at 15 day interval from 30 DAP; T3= foliar spray of Cypermethrin@ 60g a.i/ha from 30 DAP; T4= Control

Table 49.1 : Effect of different irrigation systems and different formulations on thrips infestation on garlic during *rabi*, 2000 at 45DAP

Irrigation system(I)	Number of thrips per plant (T)				
	T1*	T2	T3	T4	Average (Irrigation)
Drip	9.1	7.1	14.9	14.9	11.5
Sprinkler	11.7	6.6	14.8	15.1	12.0
Surface	10.8	13.5	14.7	15.2	13.6
Average (Treatment)	10.5	9.1	14.8	15.1	
	I	T	I x T		
S.E.±	NS	0.74	NS		
C.D.(0.05)	NS	2.21	NS		

Table 49.2 : Effect of different irrigation systems and different formulations on thrips infestation on garlic during *rabi*, 2000 at 60 DAP

Irrigation system(I)	Number of thrips per plant (T)				
	T1*	T2	T3	T4	Average (Irrigation)
Drip	53.7	43.3	55.4	60.1	53.1
Sprinkler	56.1	51.9	58.5	61.9	57.1
Surface	59.2	44.4	55.5	67.1	56.5
Average (Treatment)	56.3	46.5	56.4	63.0	
	I	T	I x T		
S.E.±	NS	1.87	NS		
C.D.(0.05)	NS	8.18	NS		

*T1 = Application of Carbofuran 3G@ 1Kg a.i/ha at the time of planting and foliar spray of Cypermethrin@ 60g a.i/ha from 30 DAP
T2 = Application of Carbofuran 3G granules at the time of planting and at 15 day interval from 30 DAP; T3 = foliar spray of Cypermethrin@ 60g a.i/ha from 30 DAP; T4 = Control

Table 49.3: Effect of different irrigation systems and different formulations on thrips infestation on garlic during *rabi*, 2000 at 75 DAP

Irrigation system(I)	Number of thrips per plant (T)				
	T1*	T2	T3	T4	Average (Irrigation)
Drip	45.5	46.6	48.9	55.3	49.1
Sprinkler	43.3	44.5	39.2	50.9	44.5
Surface	48.5	35.7	46.3	64.9	48.8
Average (Treatment)	45.8	42.3	44.8	57.0	
	I	T	I x T		
S.E.±	NS	2.46	NS		
C.D.(0.05)	NS	7.31	NS		

Table 49.4: Effect of different irrigation systems and different formulations on garlic bulb yield during *rabi*, 2000

Irrigation system(I)	Yield t/ha (T)				
	T1*	T2	T3	T4	Average (Irrigation)
Drip	12.1	10.1	11.0	11.1	11.1
Sprinkler	8.3	9.2	7.7	6.6	7.9
Surface	13.1	9.4	12.6	8.0	10.8
Average (Treatment)	11.2	9.6	10.4	8.5	
	I	T	I x T		
S.E.±	0.35	0.47	NS		
C.D.(0.05)	1.06	1.40	NS		

T1 = Application of Carbofuran 3G@ 1Kg a.i/ha at the time of planting and foliar spray of Cypermethrin@ 60g a.i/ha from 30 DAP
T2 = Application of Carbofuran 3G granules at the time of planting and at 15 day interval from 30 DAP; T3 = foliar spray of Cypermethrin@ 60g a.i/ha from 30 DAP; T4 = Control

Integrated pest and disease management in seed crop of onion

D.O.P: 12.12.2000 D.O.H: 20.05.2001 Variety: N-2-4-1 Design: RBD

Application of carbofuran granules at the time of planting was found very effective in checking thrips population up to 30 days after planting(Table 50). However, subsequent application of granules was not much effective compared to foliar spray of cypermethrin and monocrotophos. At 45 and 60 days after planting foliar sprays of cypermethrin (60 g ai/ha) and Carbosulfan (0.025%) were very effective in controlling thrips. Seed yield was higher in all the treatments compared to control. However highest yield was recorded in T1 and T2. There was no significant difference among the treatments with respect to 1000grain weight. No disease incidence was recorded during *rabi* season, 2000. Bulb rotting was recorded at 135 days in all the treatments and treatments have no effect on bulb rotting.

Table 50 : Thrips infestation in seed crop of onion during *rabi*, 2000

Treatment	Thrips/plant				% bulb at 135 DAP	Seed yield (Q/ha)	1000 grain weight (gm)
	20DAP	30DAP	45DAP	60DAP			
T1	47.9	48.	5.5	41.9	3.4 (10.43)*	9.0	3.96
T2	63.3	58.4	5.3	29.9	14.4 (21.99)	8.3	4.19
T3	83.0	64.8	6.1	36.3	20.1 (26.39)	7.6	4.14
T4	44.7	65.2	56.0	103.0	16.5 (23.95)	6.4	4.14
T5	41.1	57.8	21.3	38.0	20.6 (26.28)	6.3	3.81
T6	61.7	91.2	81.2	102.5	20.3 (26.35)	6.4	3.69
T7	2.1	16.9	85.3	119.1	15.3 (22.66)	6.6	4.09
T8	65.1	118.7	155.8	160.7	15.1 (21.81)	5.2	3.75
S.E.±	5.19	6.38	7.32	8.33	NS	0.632	NS
C.D.(0.05)	11.15	13.69	15.71	17.88	NS	1.35	NS

* values in parentheses are arc-sine transformed

T1=Bulb treatment with Bavistin @ 0.2 % for 30 min.+ Bavistin foliar spray+ Cypermethrin(60g ai/ha); T2=Bulb treatment with Kavach @ 0.2 %+ Kavach foliar spray+ Cypermethrin (60 g ai/ha); T3=Bulb treatment with DM 45 @ 0.2 %+ DM 45 foliar spray + Cypermethrin (60 g ai/ha); T4=Bulb treatment with Imidacloprid @ 0.08 %+ Bavistin (1)/ Kavach (1)/ DM 45 (1)+ Imidacloprid@ 0.04%; T5=Bulb treatment with Carbosulfan @ 0.05 %+ Bavistin (1)/ Kavach (1)/ DM 45 (1)+ Carbosulfan@0.05% ; T6=Soil treatment with Trichoderma @ 20g/plot + Bavistin (1)/ Kavach (1)/ DM 45 (1)+ Monocrotophos(0.05%); T7=Soil treatment with Carbofuran 3G @ 1kg ai/ha+ Bavistin (1)/ Kavach (1)/ DM 45 (1)+ Carbofuran 3G; T8= Control

Management of stemphylium leaf blight (*Stemphylium vesicarium*) on onion and garlic

The treatments included Ocimum leaf extract (OLE 10%), Calotropis leaf extract (CLE) (10%), Mancozeb (0.2%),Bavistin (0.2%), Tilt (0.2%), Score (0.2%) and combinations of Mancozeb and OLE (1:1), Mancozeb and CLE (1:1). Monocrotophos (0.15%) was sprayed on the crop for controlling thrips.The seedlings of onion and cloves of garlic were planted in flat beds (3 m x 2 m) using RBD design with three replications. The planting of onion was done on 21.06.2000 and on 03.11.2000 in *kharif* and *rabi* season, respectively while for garlic, planting was done on 04.11.2000.

Table 51: Effect of various botanicals and fungicides on disease intensity of SLB on onion and garlic

Treatment	Onion (*Kharif*)		Onion (*Rabi*)		Garlic	
	Disease intensity (%)	Yield (t/ha)	Disease intensity (%)	yield (t/ha)	Disease intensity (%)	Yield (t/ha)
Score	27.20 (31.34)	.15.58	6.13 (14.33)	53.88	10.4 (18.80)	16.16
Tilt	31.80 (34.06)	14.04	7.8 (16.21)	48.91	11.2 (19.77)	18.07
Mancozeb	19.80 (26.33)	15.36	7.86 (16.28)	40.56	9.6 (18.01)	15.59
Bavistin	27.60 (31.65)	12.11	9.60 (17.91)	36.40	11.7 (19.95)	16.18
OLE	39.80 (39.06)	11.78	11.73 (20.01)	41.44	9.86 (18.21)	11.91
CLE	47.40 (43.53)	10.24	11.20 (19.35)	33.73	10.66 (19.02)	10.83
OLE+CLE	47.70(43.72)	10.33	5.6 (13.66)	41.91	12.26 (20.48)	15.09
M+OLE	38.00(38.01)	10.91	5.06 (12.97)	34.83	10.13 (18.55)	14.84
M+CLE	36.80 (37.33	15.91	10.13 (18.05)	38.83	8.05 (9.87)	16.29
Control	49.15(44.03)	13.08	18.4 (25.05)	45.76	10.9 (19.27)	10.76
CD (0.05)	4.27	NS	2.73	6.78	3.96	1.38

(* Arc sine values are in paranthesis) NS- Not Significant

In general, the disease intensity was higher in *kharif* season than *rabi*, in onion. In *kharif* season, disease intensity ranged from 19.80% (Manocozeb) to 49.15% (control), while, in *rabi* from 5.06% (Mancozeb) to 18.4% (control). None of the botanicals or combinations proved to be more effective than mancozeb for controlling disease. The differences in yield due to various treatment were non significant in *kharif*. However, during *rabi* season, score (53.88 t/ha) followed by tilt recorded highest yield (48.91 t/ha). In garlic, disease intensity ranged from 8.05% (M+ELE) to 12.26% (OLE+CLE). Mancozeb again proved to be most effective in controlling the disease. Tilt (18.07 t/ha) followed by M+CLE (16.29 t/ha) recorded highest yield (Table 51)

Disease survey for onion in Pune District

Survey was conducted from 29.01.2001- 01.02.2001 for disease in onion crops in 30 fields of 5 Talukas in District Pune. In general, crop of onion was good in all 30 fields. The transplanting was done during last week of October to first week of November 2000. Eleven farmers sprayed Cypermethrin to control thrips. Seven fields were free from diseases. The Stemphylium leaf blight (SLB) was recorded in 22 fields where disease intensity ranged from 4.80 to 35.20% (Table 52). The disease intensity was minimum (4.80%) in village Gosasi & Mukhari (Taluka – Shirur) and maximum (35.20%) in village Moshi (Taluka – Haveli).

Table 52 : Disease intensity of SLB in different villages

Taluka	No. of fields surveyed	No. of field where disease present	Disease intensity(%) range	Average
Khed	10	10	7.20 – 33.66	15.40
Shirur	6	4	4.80 – 16.80	10.40
Chakan	5	1	13.60	13.60
Maval	1	1	13.60	13.60
Haveli	8	6	8.00 – 35.20	21.40

Study of VAM from onion rhizosphere

Thirty samples from onion rhizosphere were collected during survey and were screened for number of spores. Wide range of spore count was observed in different samples. Out of 30 samples, Sample No 7/01 recorded maximum spore count (2998) (Table 53).

Table 53: Number of spores per sample from different fields

Sample.No.	No. of spores in 100 cc of soil	Sample No.	No.of spores in 100 cc of soil	Sample No.	No.of spores in 100 cc of soil
1/01	878	11/01	1862	21/01	571
2/01	305	12/01	1742	22/01	789
3/01	1107	13/01	1464	23/01	1030
4/01	546	14/01	1778	24/01	525
5/01	1044	15/01	1699	25/01	541
6/01	1594	16/01	1186	26/01	716
7/01	2998	17/01	422	27/01	757
8/01	1388	18/01	1300	28/01	726
9/01	1852	19/01	1052	29/01	521
10/01	1774	20/01	639	30/01	629

Epidemiological studies of stemphylium leaf blight (SLB)

Tilak Air Sampler (TAS) was installed in the centre of 20 plots of onion having individual plot size of 2 m x 3 m. Seedling were transplanted on 27.06.2000 for *kharif* season. For *rangda* and *rabi* season transplanting was done on 20.09.2000 and 20.10.2000. respectively. The disease was recorded only in *kharif* season which ranged from 5.92 - 23.52 per cent (Table 54). The no. of spores ranged from 14 to 1428. Exact co-relation between spore count and disease intensity could not be established.

Table 54: Spore counts and disease intensity of SLB on *kharif* onion

Dates	No. of spores/cm²	Disease Intensity(%) *
1 - 31 June 2000	Nil	
19 July 2000	Nil	5.92
27 July 2000	Nil	10.08
3 Aug. 2000	Nil	10.24
9 Aug. 2000	56	-
12 Aug. 2000	14	11.20
17 Aug. 2000	Nil	-
18 Aug. 2000	1428	-
19 Aug. 2000	25	-
28 Aug. 2000	140	-
29 Aug. 2000	154	-
30 Aug. 2000	126	-
31 Aug. 2000	56	-
1 Sept. 2000	420	-
2 Sept. 2000	28	-
3 Sept. 2000	Nil	23.52
25 Sept. 2000	Nil	17.60

* Average of four replications.

Vaseline coated slides were hung at 1, 2 & 3 feet distance from ground in the field of seasonal incidence and changed daily. The spore count was recorded daily for number of spores on the slides. (No of spores /cm^2)

Table 55: Number of spores / cm^2 on slides at three different heights from ground level

Dates	1 ft.	2 ft.	3 ft.	Dates	1 ft.	2 ft.	3 ft.
24.8.2000	17	11	5	10.9.2000	19	17	70
25.8.2000	2	1	1	11.9.2000	6	5	50
26.8.2000	50	20	8	12.9.2000	2	4	40
27.8.2000	49	19	6	13.9.2000	1	1	0
28.8.2000	47	8	1	14.9.2000	20	17	7
29.8.2000	102	19	2	15.9.2000	22	18	12
31.8.2000	176	31	12	16.9.2000	27	21	14
1.9.2000	82	14	1	17.9.2000	25	19	11
2.9.2000	32	11	1	19.9.2000	1	1	1
3.9.2000	38	13	2	20.9.2000	3	4	2
4.9.2000	44	25	3	25.9.2000	37	36	37
5.9.2000	98	44	7	26.9.2000	31	30	19
6.9.2000	38	30	28	27.9.2000	25	22	12
7.9.2000	90	69	68	28.9.2000	12	6	4
8.9.2000	28	28	9	29.9.2000	3	2	1
9.9.2000	20	19	110	30.9.2000	4	3	1

The spores trapped in general was higher when closer to the ground at one foot height. Maximum no of spores were recorded in August and September. The observations indicated that sporulation is high near canopy of onion plants and spores traps, therefore, should be fixed at the same level only i.e. one feet above groundlevel (Table 55).

Study of seasonal incidence of diseases on onion crop

The seedlings were transplanted from 1 June 2000 to 15 December 2000 at 15 days interval for studying seasonal incidence of various diseases. On each planting dates three plots each were sprayed with monocrotophos (I), Bavistin(F), Monocrotophos + Bavistin (I+E). Three plots were kept untreated and three plots were supplied with vermicompost. (Table 56) and two doses (2nd & 3rd) of urea.

Effect on marketable yield :

The marketable yield of onion was significantly influenced by various dates of plantings as well as disease management treatments. 1 June planting recorded 14.40 t/ha yield which declined afterwards till 15 August (4.8 to 9.6 t/ha). Later on, there was steady increase in yield from 23.83 to 58.91 t/ha. Transplanting between 15 Sept. to 15 October recorded highest yield than other dates (47.77 to 58.91 t/ha., respectively.) Among management treatments, highest yield was recorded when plots were sprayed with insecticide (33.28 t/ha) and insecticide + fungicides (34.06 t/ha).

Stemphylium blight :

The disease appeared throughout the planting dates with 5 to 71.33 intensity. Control plots re-

corded highest (29.23%) intensity while lowest was with vermicompost (13.60) followed by insecticide sprays (15.19%). This indicated predominant role of thrips in increasing disease intensity. Highest disease intensity was observed when seedlings were transplanted from 1 July to 1 Sept. (27.82 + 38.37%).

Anthracnose disease :

The disease appeared from 1 July to 15 August planting only. The intensity ranged from 2.02 to 12.83 per cent. Highest disease intensity (11.60%) was observed in the plots sprayed with only insecticides.

Bulb rotting :

Bulb rotting was observed from 15 June to 15 August planting (6.84 – 27.86%). Highest percentage of rotting was observed in transplanting done in August. The plots supplied with vermicompost recorded minimum percentage of bulb rotting (8.12%) than other treatments.

POST HARVEST TECHNOLOGY

Studies on performance of different *rangda* onion varieties during storage

Rangda onion is harvested during January – February which is sold immediately in the market. However, due to glut, the produce is required to be held for some time. The present day varieties/genotypes/land races grown by farmers during *rangda* season do not meet the standard on account of storage. Therefore, it was felt necessary to study the storage behavior of the released varieties during this season. The varietal differences were highly significant (Table 57.1 to 57.4) after 90 days of storage when planted during different dates. Physiological weight losses were negligible during early days of storage, however, those increased after 120 days of storage and reached maximum up to 210 days. This period incidentally matched with high humidity and low temperature during August and September months. The varieties like N-2-4-1 and Arka Niketan appeared to be good storer than others. Perferencewise Baswant-780 is the most accepted type during this season but the storage can be up to only 90 days after harvest. Even this feature is very good as compared to local types used for planting.

Table 56 : Effect of different dates of planting and disease management treatments on yield of onion and disease incidence

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Avg.
Transplanting	12.6.2K	16.6.2K	1.7.2K	15.7.2K	1.8.2K	15.8.2K	1.9.2K	15.9.2K	1.10.2K	15.10.2K	1.11.2K	15.11.2K	1.12.2K	15.12.2K	
Marketable yield (t/ha.)															
I	15.22	12.26	6.59	6.81	5.63	21.70	34.66	60.55	56.29	54.52	47.51	44.44	42.99	54.81	33.28
F	16.03	11.70	2.81	5.26	8.55	23.41	39.44	60.70	49.26	48.14	29.11	21.11	30.85	40.29	27.62
C	15.92	8.51	2.22	5.81	10.48	24.62	35.85	58.66	46.96	47.66	32.85	24.44	26.85	39.33	27.12
I + F	20.30	11.07	7.22	5.85	9.96	24.74	41.18	62.29	50.29	63.03	42.62	50.63	41.55	46.66	34.06
V	4.56	4.52	5.28	6.89	8.06	24.70	33.68	52.38	36.05	54.19	35.91	35.48	41.27	47.28	27.97
Average 14.1	9.6	4.81	6.1	8.5	23.8	37.0	58.9	47.8	53.5	37.53	35.2	36.7	45.7		
SLB - Disease Intensity (%)															
I	10.66	13.06	20.8	8.8	27.73	29.86	37.83	15.73	9.33	6.9	8.53	8.26	5.6	9.6	15.19
F	14.40	10.40	57.06	47.40	19.20	33.86	28.53	11.46	11.73	16.0	19.73	12.26	14.13	14.40	22.18
C	31.73	15.46	71.73	51.46	61.86	38.40	22.93	17.86	13.60	23.73	24.26	13.06	9.86	13.33	29.23
I + F	11.33	13.06	24.00	13.86	29.33	17.86	29.60	15.46	11.73	9.86	9.06	9.06	5.06	6.66	16.43
V	14.66	9.966	18.30	17.60	24.26	20.53	22.53	19.46	6.66	7.30	7.66	7.20	8.0	6.40	13.60
Average 18.67	12.38	38.37	27.82	32.47	28.10	28.28	15.99	10.61	12.75	13.84	9.96	8.53	10.07		
Anthracnose Disease Intensity (%)															
I			18.88	4.0	2.13	21.73									11.68
F			3.40	2.93	20.80	4.80									7.98
C			0.0	1.06	2.66	17.40									5.28
I + F			8.26	1.06	14.66	13.06									9.26
V			11.20	1.06	6.8	7.20									6.56
Average			8.34	2.02	9.41	12.83									
Bulb rot (%)															
I			3.32	7.67	15.89	42.99									17.46
F		2.1	9.99	9.99	21.32	25.14									13.70
C		6.9	10.55	10.55	28.54	23.46									16.00
I + F		12.3	0.663	0.663	36.55	32.86									16.60
V		7.9	0.0	0.0	9.47	14.85									8.02
Average		6.84	4.8	5.77	22.35	27.86									

I- Insecticide F- Fungicide C-Control I+F-Insecticide+Fungicide V-Vermicompost

Table 57.1 : Performance of different varieties of onion during storage transplanted on 22.09.1999

Date of Harvest: 24.01.2000 Date of storage:2.02.2000

	DAS	Arka Niketan	N-2-4-1	B-780	ALR	Phule Safed	CD (0.05)
Physiological loss of Weight (%)	30	11.9	7.30	8.27	8.35	8.57	0.48
	60	12.5	13.6	11.6	15.4	17.4	0.73
	90	19.6	20.2	26.4	16.5	24.0	0.67
	120	34.3	36.3	32.0	37.3	43.3	0.83
	150	37.0	38.7	35.5	40.9	52.3	0.67
	180	40.0	42.4	38.9	45.6	56.4	2.11
	210	42.0	46.8	46.6	51.0	-	1.72
Sprouting (%)	30	0.00	0.00	0.00	0.00	0.00	0.00
	60	1.30	0.00	0.00	0.00	0.00	0.06
	90	1.45	0.00	0.00	0.00	0.00	0.04
	120	1.45	0.00	0.00	0.00	0.00	0.02
	150	1.90	0.00	0.16	3.87	1.48	0.13
	180	2.04	2.10	1.80	5.3	12.0	5.15
	210	3.02	4.01	5.61	8.9	-	0.84
Rotting (%)	30	0.00	0.00	0.00	0.00	0.00	0.00
	60	1.90	1.15	3.00	5.00	7.93	0.19
	90	1.90	1.70	3.50	5.00	8.25	0.24
	120	2.10	1.70	3.65	5.40	8.70	0.30
	150	2.45	2.15	6.21	6.27	9.60	0.28
	180	2.80	2.50	6.75	6.90	12.3	0.32
	210	5.10	2.75	8.00	7.19	13.7	0.76
Total Losses (%)	30	11.9	7.30	8.27	8.35	8.57	0.74
	60	15.7	14.8	14.6	20.4	25.3	0.87
	90	23.0	21.9	29.9	21.5	32.3	2.99
	120	37.9	38.0	35.7	42.7	52.0	2.76
	150	41.4	40.9	41.9	51.0	63.4	1.44
	180	44.8	47.0	47.5	57.8	80.7	2.06
	210	50.1	53.6	60.2	67.1	-	1.18

DAS – Days after storage

Table 57.2: Performance of different varieties of onion during storage transplanted on 30.09.1999

Date of Harvest: 2.02.2000 Date of storage:14.02.2000

	DAS	Arka Niketan	N-2-4-1	B-780	ALR	Phule Safed	CD (0.05)
Physiological loss of Weight (%)	30	4.75	6.50	5.50	6.75	5.32	0.45
	60	8.20	7.95	9.25	11.5	14.8	0.61
	90	10.5	12.5	10.3	14.0	17.3	0.59
	120	16.4	15.7	27.3	22.1	30.0	2.49
	150	30.2	32.7	49.4	37.0	41.5	3.00
	180	40.6	38.8	56.7	41.0	-	2.86
	210	51.7	49.7	-	57.4	-	2.11
Sprouting (%)	30	0.00	0.00	0.00	0.00	0.00	0.00
	60	0.00	0.00	0.00	0.00	0.00	0.00
	90	0.50	0.00	0.00	0.00	0.00	0.00
	120	1.30	0.73	11.3	3.77	7.43	0.87
	150	3.00	1.70	18.5	5.99	30.0	2.47
	180	3.64	2.53	20.5	8.13	-	2.34
	210	4.75	6.51	-	12.5	-	2.75
Rotting (%)	30	0.00	0.00	0.00	0.00	0.00	0.00
	60	0.00	0.00	0.00	0.00	0.00	0.00
	90	0.00	0.00	0.00	0.00	0.00	0.00
	120	0.00	0.00	0.00	0.00	0.00	0.00
	150	0.00	0.00	0.00	0.00	0.00	0.00
	180	3.96	5.5	13.4	8.60	-	0.97
	210	4.10	2.79	-	9.45	-	1.14
Total Losses (%)	30	4.75	6.50	5.50	6.75	5.32	0.64
	60	8.20	7.95	9.25	11.5	14.8	0.53
	90	11.0	12.5	10.3	14.0	17.3	0.58
	120	17.7	16.4	38.6	25.9	37.4	1.88
	150	33.2	34.4	67.9	43.0	71.5	2.96
	180	48.2	46.8	90.6	57.7	-	3.97
	210	60.5	59.0	-	79.4	-	4.80

DAS – Days after storage

Table 57.3: Performance of different varieties of onion during storage transplanted on 20.10.1999

Date of Harvest: 1.03.2000 Date of storage : 13.03.2000

	DAS	Arka Niketan	N-2-4-1	B-780	ALR	Phule Safed	CD (0.05)
Physiological loss of Weight (%)	30	6.00	7.25	4.5	3.75	10.3	0.84
	60	11.4	10.7	6.10	5.00	17.3	0.96
	90	29.5	31.0	39.5	31.0	41.8	3.53
	120	32.3	36.5	55.3	32.0	50.3	3.73
	150	37.8	38.8	-	37.8	-	NS
	180	46.5	41.8	-	46.0	-	2.59
	210	51.0	49.0	-	51.7	-	2.63
Sprouting (%)	30	0.00	0.00	0.00	0.00	0.00	0.00
	60	11.8	13.8	19.5	11.5	18.3	1.84
	90	12.3	13.8	21.9	11.5	18.7	1.75
	120	13.7	15.3	24.3	12.2	21.0	1.72
	150	14.6	15.3	-	16.2	-	2.05
	180	17.1	16.0	-	17.0	-	1.98
	210	19.0	17.3	-	18.9	-	1.85
Rotting (%)	30	0.73	0.70	0.63	0.33	0.00	0.08
	60	1.00	2.87	11.3	1.33	2.83	0.47
	90	1.57	2.87	12.8	1.50	12.1	0.79
	120	1.83	4.20	14.4	3.20	15.2	0.61
	150	2.78	4.20	-	3.20	-	0.67
	180	4.22	5.00	-	5.10	-	0.76
	210	5.00	8.07	-	7.80	-	0.98
Total Losses (%)	30	6.73	7.95	5.13	4.08	10.3	1.00
	60	24.2	27.4	36.9	17.8	38.4	2.19
	90	43.4	47.7	74.2	44.0	72.6	3.30
	120	47.8	56.0	94.0	47.4	86.5	3.21
	150	55.2	58.3	-	57.2	-	2.60
	180	67.8	62.8	-	68.1	-	3.47
	210	75.0	74.4	-	78.4	-	1.73

DAS – Days after storage

Table 57.4: Performance of different varieties of onion during storage

Date of Harvest: 9.3.2000 Date of storage : 23.03.2000

	DAS	Arka Niketan	N-2-4-1	B-780	ALR	Phule Safed	CD (0.05)
Physiological loss of Weight (%)	30	6.00	7.25	4.50	3.75	7.0	0.46
	60	7.50	8.30	10.0	9.40	10.3	1.61
	90	25.0	25.3	29.5	27.0	36.3	1.93
	120	28.5	29.5	50.3	32.0	45.5	2.54
	150	31.4	31.8	-	33.5	64.0	3.73
	180	38.5	38.0	-	42.0	-	2.84
	210	40.0	40.5	-	47.1	-	2.46
Sprouting (%)	30	0.00	0.00	0.00	0.00	0.00	0.00
	60	0.00	0.00	0.00	0.00	0.00	0.00
	90	0.00	0.00	0.00	0.00	0.00	0.00
	120	0.00	0.00	25.3	0.35	9.60	0.96
	150	1.33	2.24	-	1.30	11.6	0.94
	180	11.1	2.52	-	5.95	-	1.83
	210	12.6	3.62	-	9.23	-	3.06
Rotting (%)	30	0.73	0.00	0.63	0.33	0.75	0.17
	60	2.35	0.00	1.27	0.50	3.00	0.23
	90	1.76	0.00	1.93	2.25	7.73	0.21
	120	23.0	0.33	3.51	3.25	8.50	1.17
	150	23.7	22.5	22.8	19.4	11.4	1.77
	180	24.0	22.5	23.6	20.0	-	2.87
	210	25.7	23.0	25.0	21.8	-	3.69
Total Losses (%)	30	6.73	7.25	5.13	4.08	7.75	0.46
	60	9.85	8.30	11.3	9.90	13.3	1.31
	90	26.8	25.3	31.4	29.3	44.0	2.20
	120	51.5	29.8	79.1	35.6	63.6	4.57
	150	56.4	56.5	-	54.2	87.0	3.37
	180	73.6	63.0	-	68.0	-	3.08
	210	78.3	67.2	-	78.1	-	2.49

DAS – Days after storage

Studies on performance of different *rabi* onion varieties during storage

Among different varieties, the storage potential of N-2-4-1, ALR and Arka Niketan were found superior than Phule Safed and Phule Suvarna. All the light red varieties could store very well up to 120 days after curing with 45-50 % losses. (Table 58). Losses due to sprouting were more after 180 days of storage. Increase in humidity > 70% after July might have increased sprouting (Table 59).

Table 58 : Performance of *rabi* onion varieties during storage

Date of Harvest: 22.04.2000 Date of Storage : 05.5.2000

	DAS	Arka Niketan	N-2-4-1	B-780	ALR	Phule Safed	PSwarna	CD (0.05)
Physiological loss of Weight (%)	30	23.4	21.3	27.8	22.9	26.1	24.3	1.59
	60	25.7	25.9	34.3	24.5	30.6	33.5	2.45
	90	29.3	28.1	-	29.3	42.9	41.9	3.56
	120	33.4	32.1	-	31.3	56.6	51.1	2.44
	150	35.9	37.3	-	32.9	-	-	2.67
	180	40.8	41.0	-	41.5	-	-	2.74
	210	52.1	46.0	-	45.4	-	-	2.98
Sprouting (%)	30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	60	0.00	0.00	9.60	0.00	2.67	0.00	0.54
	90	1.08	0.00	-	0.68	12.9	14.3	3.51
	120	1.58	1.78	-	1.09	18.0	27.9	1.99
	150	2.68	2.48	-	1.32	-	-	2.16
	180	3.67	3.41	-	5.03	-	-	1.96
	210	25.0	21.5	-	27.8	-	-	3.83
Rotting (%)	30	0.00	0.00	3.2	2.5	0.00	4.0	0.23
	60	0.00	0.00	7.90	4.30	5.85	6.27	0.33
	90	10.4	11.5	-	10.4	9.28	10.6	1.03
	120	10.7	11.8	-	10.4	9.28	10.9	1.99
	150	10.7	12.0	-	11.3	-	-	1.60
	180	12.0	12.4	-	11.9	-	-	2.09
	210	12.5	12.8	-	12.3	-	-	2.88
Total Losses (%)	30	23.4	21.3	31.0	25.4	26.1	28.3	2.63
	60	25.7	25.9	51.8	28.8	39.2	39.7	3.01
	90	40.8	39.6	-	40.4	65.8	66.8	2.74
	120	45.7	45.7	-	42.8	83.9	89.9	4.14
	150	49.3	51.8	-	45.5	-	-	4.51
	180	56.3	56.8	-	58.4	-	-	3.25
	210	89.6	80.3	-	85.5	-	-	3.53

DAS – Days after storage

Table 59: Mean temperature and relative humidity during storage period from Feb-2000 to Dec.2000

Month	Temperature (°C)			Relative Humidity(%)		
	Maximum	Minimum	Average	Maximum	Minimum	Average
February	27.0	18.2	22.6	76.5	42.3	59.4
March	28.9	13.0	20.9	68.6	42.5	55.5
April	31.7	19.2	25.5	66.2	26.7	46.5
May	31.2	21.5	26.4	78.6	45.8	62.2
June	26.2	22.9	24.5	82.9	64.98	73.9
July	25.7	21.3	23.5	84.0	71.0	77.5
August	23.8	21.7	22.7	84.3	13.9	79.1
September	26.6	22.1	24.3	63.2	50.4	56.8
October	25.9	21.2	23.5	82.8	68.7	75.8
November	23.5	20.8	22.2	75.9	60.1	68.0
December	20.5	14.3	17.4	66.5	50.5	58.5

Preliminary studies on storage performance of garlic var.G.41

The storage experiment was conducted in garlic bulbs var G.41 (Table 60) with and without tops under ambient storage condition. The results revealed that no significant difference was observed up to 150 days after storage. Afterwards, garlic bulbs with tops recorded the lowest per cent of physiological weight loss (23.5 %) compared to bulbs without tops(33.3%).

Table 60 : Storage performance of garlic var. G-41 with and without tops

Treatments	Weight Loss(%)						
	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS	180 DAS	210 DAS
T1	8.18	20.4	20.9	21.9	22.4	22.9	23.5
T2	6.53	21.5	23.1	25.5	27.4	31.9	33.3
Avg.Mean	7.35	20.9	22.0	23.5	24.9	27.4	28.4
CD (0.05)	NS	NS	NS	NS	NS	5.21	6.59

T1 – With Tops , T2 – without tops, DAS – Days After Storage

III EDUCATION AND TRAINING

SPECIAL LECTURES

Speaker	Title	Venue
K.E. Lawande	Bhajipala Pikavaril Kid Roganche Niyantran, All India Radio, Nashik (Aug. 14, 2000)	YCMOU, Nashik
K.E. Lawande	Pomegranate Production Technology (Sept. 27, 2000)	NRCAH, Bikaner
K.E. Lawande	Onion Production and Export Challenges and Opportunities (Oct. 30, 2000)	Bejo Shital Seed Pvt. Ltd., Jalna
M.N. Maholay	Pavsali Pikavaril rog, kid va tyache Niyantran (July 25, 2000) and Locomotive Company Ltd,	Bhamboli, Tal. Khed, Dist. Pune organized by Tata Engineering Pimpri, Pune
M.N. Maholay	Kanda Lagwadiche Adhunik Tantra (Sept 21, 2000)	Nirgudsar, Tal. Ambegaon, Dist. Pune organized by Zuari Industries Ltd., Pune

Extension Services

- 55 Farmers attended a training programme on onion and garlic production, pest and disease management on onion and garlic at NRCOG, Rajgurunagar for 2 days i.e. 19 & 20/3/2001 organised by SPIC PHI Seed Ltd., Pune
- 80 Farmers visited NRCOG on 16/03/2001 and were guided by scientists of NRCOG regarding National Water Resource – Developed program organized by SDAO, Rajgurunagar

TRAINING

SCIENTIFIC

Name	Title	Duration	Institute
V. Sankar	Statistical softwares for data analysis	April 4-15, 2000	NAARM, Hyderabad
P.S. Srinivas & V. Sankar	70th FOCARS	June 2 – Sept.29, 2000	NAARM, Hyderabad

Asha Devi, A & Anil Khar	DNA Fingerprinting	Aug. 31 – Oct. 3, 2000	CPRI, Shimla
M.N. Maholay	MS-Office, Internet and E-mail	Oct. 9- 20, 2000	NIC, Pune
P.S. Srinivas	Biodiversity of Phytophagous mites and recent advances in their management	Feb, 19- Mar. 11, 2001	TNAU, Coimbatore

TRAINING ABROAD

Md. A. Aziz Qureshi	Sustainable Horticultural Production under Climatic constraints	Oct. 31 – Dec. 19, 2000	Hebrew University of Jerusalem, Israel

TECHNICAL

G. Sivaramakrishnan	Bibliometrics	Aug. 21 – Aug. 26, 2000	INSDOC, New Delhi
A.P. Trivedi	MS-Windows 98, MS-Office	Oct. 18- 20, 2000	NRCOG, Rajgurunagar Organised by Siemens

ADMINISTRATIVE

D.B. Mundharikar	MS-Office II-98, Excel and Access	Aug. 7 – 12 , 2000	IASRI, New Delhi
R.K. Dedge	MS-Office, Internet and E-mail	Sept. 19 – 29, 2000	NIC, Pune
S.S. Joshi	MS-Office, Internet and E-mail	Oct. 9 – 20, 2000	NIC, Pune
S.C. Sharma & N.R. Gaikwad	MS-Windows 98, MS-Office	Oct. 18- 20, 2000	NRCOG, Rajgurunagar Organised by Siemens
P.S. Tanwar	5th Special Workshop on Roster rewriting/recasting for Liaison Officer for SC/ST/ OBC and dealing assistants	Nov. 10 – 13, 2000	NIPA, Bangalore
N. Gopal	One day reorientation programme on the contract labour (Regulation and abolition) act, 1970.	Dec. 2, 2000	NIPA, Bangalore
N. Gopal	8th All India Conference on implementation of the guidelines and norms laid down by the Hon'ble Supreme Court of India regarding sexual harassment and gender justice	Dec. 6 – 7, 2000	NIPA, Bangalore

II. RESEARCH ACHIEVEMENT :
CROP IMPROVEMENT

Allium Biodiversity : Collection, Characterization, Evaluation and Maintenance of tropical Onion (*Allium cepa L.*) and Garlic (*Allium sativum* L.) Germplasm

ONION GERMPLASM

A. Germplasm Collection

During April-May 2000, onion and garlic germplasm was collected from Gujarat and Orissa. In Gujarat, places visited were Rajkot, Shishnag, Kalavad, Nikavah, Gondal, Jetpur, Dhorajee, Junagarh, Visavadar, Mahuva and Bhavnagar whereas, in Orissa, onion and garlic samples were collected from Angule, Sambalpur, Cuttack, Bhubaneshwar,Damnia and Aiginia. The material was collected from markets as well as farmers field. From Gujarat, a total of 20 samples in onion with colour ranging from light red, Dark red, white, yellow to brown and in garlic, 31 samples and 2 commercial varieties GG-2 and GG-3 were collected with colour variation ranging from white, red, pink to violet. From Orissa, a total of 10 samples in onion and 20 samples in garlic were collected with colour variation from light red, dark red, white to pink .

In addition to this, wild species of onion were obtained from Centre for Genetic Resources, Netherlands. In total, 67 lines of Allium spp. were procured. The wild species are *Allium oschaninii* O. Fedtsch, *Allium schergianum, Allium roylei* Stern, *Allium tuberosum* Rottl., *Allium ampeloprasum, Allium guttatum* Stev., *Allium senescens, Allium galanthum* Kar., *Allium flavum, Allium altaicum, Allium vavilovii* M, Pop., *Allium vavilovii x cepa, Allium fistulosum* and *Allium cepa*.

B. Germplasm Evaluation

B.1 Indigenous Germplasm

During *kharif* 2000, a total of 46 indigenous onion lines were evaluated along with standard check B-780. The experiment was laid out in randomized block design in two replications having plot size of 1m x 1m area. Planting of the material was done on 13 July and harvesting on 15 Oct. 2000. Because of heavy rains at maturity, only 23 lines performed well. Based on statistical analysis, no line performed significantly superior to the check variety (Table 1).

During *rangda* 2000, 84 indigenous lines were evaluated along with standard check varieties ADR, B-780 and N-2-4-1. The experiment was laid out in randomized block design in two replications having plot size of 1m x 1m area. Planting of the material was done on 1 August and harvesting on 20 Jan 2001. For marketable yield, acc. No 574, 678, 616, 636, 637,634 and 685 were significantly on par with the check variety N-2-4-1 (Table 2). No variety was found to be significantly superior or at par with the check variety B-780 (48.3 t/ha).

Thirty accession lines recorded significantly higher TSS than the check variety B-780 (11.5) and were at par with the check variety N-2-4-1 (13.0) (Table 2.1). Acc. No. 559 recorded significantly higher TSS (16.3°B) than both the check varieties.

In terms of doubles percentage, acc. No. 631 recorded no doubles and acc. no's 551, 635, 822, 685, 554, 576, 686, 600 and 568 recorded doubles percentage less than 10% (Table 2.2). For bolters, nine accessions recorded bolters less than 1% (Table 2.3).

IV AWARD AND RECOGNITION

K.E. Lawande, Director

- Received award "Krishi Patrakarita for the year 2000 by Vasantrao Naik Agri. cultural Research and Rural Development Foundation, Mumbai on 1st July, 2000.
- Received award "Research in Agriculture for the year 2000" from Khed Taluka Grahak Hakka Sammittee, Rajgurunagar
- Fellow, Indian Society of Vegetable Science, Varanasi
- Member, Task Force on Production and availability of quality seed and planting material of Horticulture Crops, NHB, Gurgaon.
- Member, Sub Group Working on Horticultural Development for formulation of 10th five year plan (2002-2007)

- Member, Research Review Committee Meetings for Horticultural Crops and PHT, MPKV, Rahuri
- Member, School Council in Agricultural Sciences, YCMOU, Nashik

V PUBLICATIONS

NRCOG Publication

Lasoon Utpadan (Marathi)

Popular articles

Sankar V., Lawande, K.E. and Khar, A. 2000. Physiological Disorders in Onion. *In* : Weekly *Udyaniki Jeevan* Vol.6, No.41. 30 April.

Lawande, K.E., Sankar V, Khar A. and Qureshi, A.A. 2000. Garlic. *Kisan World*. 27(5) : 63-64.

Sankar, V., Lawande, K.E., Khar, A. and Qureshi, A.A. 2000. Physiological disorders in onion. *Agro India*. Vol.IV (10-11), Oct.-Nov. pp 30-31.

Sankar, V., P.C. Tripathi, Mahajan, V., A. Qureshi and K.E. Lawande. 2001. Value added products of onion and garlic. *Agro-India*. Feb.-March. pp.50-51.

Presentations in Conferences/Workshops/Symposium

Qureshi, A.A. 2000. Role of plant nutrient on the quality parameters of onion and garlic. *In Project Abstracts of the 7th International Post Graduate Course on Sustainable Horticultural Production under Climatic Constraints*. 31 Oct. – 19 Dec., 2000. pp 9.

Lawande, K.E. 2000. Onion and Garlic Improvement in India. *National Symposium on Onion-Garlic Production and Post Harvest Management – Challenges and Strategies Souvenir. In : 'Abstracts and Papers' of National Symposium on Onion-Garlic Production and Post Harvest Management – Challenges and Strategies*. Nov., 19-21, 2000.

Asha Devi, A. and Khar, A. 2000. Preliminary studies on *in vitro* regeneration from flower bud explants of

onion (*Allium cepa* L.) pp:186. Ibid.
Kirtane, S., Lawande, K.E., Khar, A. and Dhumal, K.N. 2000. Induced macromolecular variability in onion (*Allium cepa* L.). pp:194. Ibid.
Qureshi, Md. A.A., Sankar, V. and Lawande, K.E. 2000. Evaluation of granulated ammonium sulphate on the growth and yield of onion. pp:210. Ibid.
Sankar, V., Khar, A., Asha Devi, A. and Lawande, K.E. 2000. Effect of mother clove size on growth and yield of garlic var. G-41. pp:220. Ibid.
Sankar, V., Khar, A., Asha Devi, A. and Lawande, K.E. 2000. Evaluation of exotic hybrids during *rabi* season. pp:194. Ibid.
Srinivas, P.S. and Lawande, K.E. 2000. Economics in management of onion *thrips*. pp:218. Ibid.
Srinivas, P.S. and Lawande, K.E. 2000. Efficacy of certain botanicals in management of onion *thrips*. pp:218. Ibid.
Srinivas, P.S. and Lawande, K.E. 2000. Population dynamics of onion *thrips*. pp:219. Ibid.
Maholay, M.N. and K.E. Lawande. 2000. Effect of time of sowing on diseases and yield of onion crop. pp 219. Ibid.
P.C. Tripathi, R.K. Verma, M.K. Verma, G. Pandey, A.A. Sofi and K.E. Lawande. 2000. Effect of time of planting on performance of garlic cv. Agrifound Parvati under U.P. hill condition. pp.209. Ibid.
Sankar, V., Anil Khar, A. Asha Devi and K.E. Lawande. 2001. Genetic variability and character association in *rabi* onion. In : *Eighth all India Conference on Cytology and Genetics - Souvenir & Abstracts.* Jan. 23 - 25, 2001 pp.34.

Workshop Proceedings

Kirtane, S., Lawande, K.E., Khar, A. and Dhumal, K.N. 2000. Mutagenic effects in Onion (*Allium cepa* L.). *In : 3rd International Crop Science Congress 2000,* Germany, August 17-22, 2000.

VI RESEARCH PROGRAMMES CURRENTLY IN PROGRESS

Institute Projects:

Project Title	PI	CoPI(s)
Allium Biodiversity : Collection, Characterization, Evaluation and Maintenance of tropical onion (*Allium cepa* L.) and Garlic (*Allium sativum* L.) Germplasm	Anil Khar	Asha Devi, V. Mahajan, A. A. Qureshi, V. Sankar, M. N. Maholay, P. S. Srinivas
Heterosis breeding programme in Short-Day Tropical onion (*Allium cepa* L.)	Anil Khar	Asha Devi, V. Mahajan
Allium inbreds: *In vitro* haploid production in onion (*Allium cepa* L.)	Asha Devi	Anil Khar
Studies on somaclonal variation in garlic (*Allium sativum* L.)	Asha Devi	Anil Khar
Development of Integrated Nutrient Management Package for Onion and Garlic	A. A. Qureshi	M. N. Maholay, V. Sankar

Project Title	PI	CoPI(s)
Screening onion and garlic germplasm for resistance to thrips, eriophyid mite	P. S. Srinivas	
Integrated Pest Management in Onion	P. S. Srinivas	A. A. Qureshi
Integrated Management of diseases on onion and garlic	M. N. Maholay	
NATP Projects:		
Development of vegetable hybrids (Onion)	K. E. Lawande	
Central Sector Scheme:		
Organic cultivation of onion		
Breeder seed production of onion seed B-780	K. E. Lawande	P.C.Tripathi
Revolving Fund Scheme:		
Onion seed production	K. E. Lawande	P.C.Tripathi

VII IMC, SRC AND RAC MEETINGS

1. Institute Management Committee (IMC) Meeting:

The 3rd IMC meeting was held on 18.2.2001 under the chairmanship of Dr. K.E. Lawande, Director, NRCOG. Dr. B.S. Dhankhar, ADG (VC), ICAR, New Delhi, Dr. M.K. Banerjee, Principal Scientist, IIVR, Varanasi, Dr. A. Aziz Qureshi, Ms. A. Asha Devi, Mr. Anil Khar, Scientists, Mr. S.C. Sharma, AFAO and Mr. N. Gopal, AAO & Member Secretary attended the meeting. Stress was given towards development of infra-structural facilities at this centre to carry out research activities.

2. Staff Research Council (SRC) Meeting:

The 2nd SRC meeting was convened on 8-9 Feb. 2001. Dr. K.E. Lawande, Director, NRCOG presided over the meeting. Dr. S.H. Shinde, HOD Agronomy, Dr. U.N. Mote, Prof. (Agril. Entomology), Dr. N.D. Jambhale, Prof. (Agril. Botany) and Prof. S.A. Memane, Plant Pathologist of MPKV, Rahuri attended the meeting. The scientists presented their research projects, which were finalized for presentation in the RAC meeting.

3. Research Advisory Committee (RAC) Meeting:

The 2nd & 3rd RAC meetings were held on 20.4.2000 and 17.2.2001 under the chairmanship of Dr. M.L. Pandita (Advisor, F&VP, NDDB Project). Dr. B.S. Dhankhar, ADG (VC), Dr. P.N. Kale, Dr. B.N. Shinde, Dr. U.B. Pandey, Director, NHRDF, Mr. C.B. Holkar, Chairman, VFC attended the meeting with Dr. (Ms.) M.N. Maholay as Member Secretary. Research projects (RPF-I) were finalized in the second meeting of RAC. Dr. P.C. Tripathi, Sr. Scientist (Hort.), and Dr. V. Mahajan, Sr. Scientist (Hort.) presented RPF-I.

VIII PARTICIPATION IN SEMINARS/SYMPOSIA/MEETINGS/CONFERENCE ETC.:

Dr. K.E. Lawande, Director attended 'Agricultural programme for All India Radio as Chief Guest' at YCMOU, Nashik on 14 August 2000.

Dr. K.E. Lawande, Director attended a short course and delivered lecture on 'Pomegranate Production Technology' at NRCAH, Bikaner from 20-29 September 2000.

Dr. K.E. Lawande, Director attended 'Directors meeting of the ICAR Institutes' at NBPGR Auditorium, Pusa, New Delhi on 12-14 October, 2000.

Dr. K.E. Lawande, Director attended 'National Seminar on Onion Production and Export-Challenges and Opportunities – as Guest Speaker at Bejo Sheetal Seeds Pvt. Ltd., Jalna on 30 October 2000.

Dr. K.E. Lawande, Director, Dr. M.N. Maholay, Dr. P.C. Tripathi, Sr. Scientists, Ms. Asha Devi, A., Mr. Anil Khar, Dr. P.S. Srinivas and Mr. V. Sankar, Scientists attended 'National Symposium on Onion-Garlic Production and Post Harvest Management – Challenges and Strategies at YCMOU, Nashik from 19-21 November 2000.

Dr. K.E. Lawande, Director attended 'Meeting of Task Force to analyze issues related to production and availability of quality seed and planting material of Horticulture Crops' at NHB, Gurgaon on 1 December 2000.

Dr. K.E. Lawande, Director attended the XIXth Group meeting of AICVIP and was nominated Chairman of Session II : Collection, Evaluation and Conservation at IIVR, Varanasi from 15-18 January 2001.

Mr. V. Sankar, Scientist (Hort.) attended 'Eighth All India Conference on Cytology and Genetics' at Bangalore from January 23-25, 2001.

Dr. K.E. Lawande, Director attended the 'I Sub-Group – Working Group on Horticulture Development for Formation of Xth Five-Year Plan (2002-2007)' at Bagwani Bhavan, New Delhi on 6 February 2001.

Dr. K.E. Lawande, Director attended 'Planning Commission Xth Plan Sub-Group on Vegetable Meeting' at Bagwani Bhavan, New Delhi on 26 February 2001.

IX WORKSHOPS/SEMINARS ORGANISED

'National Symposium on Onion-Garlic Production and Post Harvest Management – Challenges and Strategies at YCMOU, Nashik from 19-21 November 2000 organised by NHRDF, Nashik , NRCOG, Rajgurunagar and ISVS, Varanasi

X DISTINGUISHED GUESTS:

Mr. M.D. Asthana	Pr. Advisor (Ag.), Planning Commission, Govt. of India, New Delhi	10.07.2000
Dr. B.S. Dhankhar	ADG (VC), ICAR, New Delhi	02.09.2000
Mr. S.K. Patra	DGM, NABARD, Head, Agril. Engg., Mumbai	14.09.2000
Dr. Kirti Singh	Ex-Chairman, ASRB & Secretary, NAAS, New Delhi	18.11.2000
Dr. R.N. Pal	DDG (Hort.), ICAR, New Delhi	18.11.2000
Dr. M.L. Pandita,	Advisor, F&V Project, NDDB, Mangolpuri, Delhi	18.11.2000
Dr. D.G. Dhandhar	Director, ICAR Research Complex for Goa, Goa	18.11.2000

Mr. Sahebrao Vitthal Butte Patil	Ex-MLA, Maharashtra State Assembly, Tal. Khed, Dist. Pune	18.11.2000
Mr. Narayanrao Pawar	MLA, Maharashtra State Assembly, Tal. Khed, Dist. Pune	18.11.2000
Mr. Amar Prasad Satpathy	Minister of State for Agriculture, Govt. of Orissa, Orissa, Bhubaneshwar	21.11.2000
Dr. N.K. Sawant	Scientist (Soil Science), Pune	25.01.2001
Mr. K.G. Thomas	Dy. Director Development, DASD, Ministry of Agriculture, Cochin, Kerala	31.01.2001
Dr. V. Ranga Rao	Ex. Director (Oilseeds), Hyderabad	09.02.2001
Dr. R.N. Pal	DDG (Hort.), ICAR, New Delhi	25.03.2001
Dr. S.N. Puri	Vice-Chancellor, MPKV, Rahuri	29.03.2001
Total no. of farmers visited the centre		628

XI PERSONNEL

STAFF POSITION:

S.No.	Category	Sanctioned Posts	Filled	Vacant
1.	Scientific	16	10	06
2.	Technical	18	08	10
3.	Administrative	11	08	03
4.	Supporting	23	07	16
	TOTAL	68	33	35

Name	Designation
Dr. K.E. Lawande	Director
Dr. (Ms.) M.N. Maholay	Sr. Scientist (Plant Pathology)
Dr. P.C. Tripathi	Sr. Scientist (Horticulture)
Dr. V. Mahajan	Sr. Scientist (Horticulture)
Dr. Md. A. Aziz Qureshi	Scientist (Soil Science)
Ms. Asha Devi, A.	Scientist (Genetics)
Mr. Anil Khar	Scientist (Horticulture)
Dr. P. Satya Srinivas	Scientist (Entomology)
Mr. V. Sankar	Scientist (Horticulture)
Mr. M. K Chandraprakash	Scientist (Computer Application)
Mr. S.C. Sharma	Assistant Finance & Accounts Officer
Mr. N. Gopal	Assistant Administrative Officer
Mr. G.S.S.R. Krishnan	Technical Officer T-5 (Library)

Mrs. S.S. Joshi	Assistant
Mr. D.B. Mundharikar	PA to Director
Mr. N.L. Gore	Technical Assistant T-4 (Field/Farm)
Mr. A.P. Trivedi	TechnicalAssistantT-II-3 (Field/Farm)
Mr. H.S.C. Shaikh	T-II-3 (Computer Programmer)
Mr. S.P. Kandwal	Sr. Clerk
Mr. P.S. Tanwar	Sr. Clerk
Mrs. N.R. Gaikwad	Hindi Typist
Mr. R.K. Dedge	Jr. Clerk
Mr. D.M. Panchal	Technical Assistant T-1 (Lab.)
Mr. R.B. Baria	Technical Assistant T-1 (Field/Farm)
Mr. B.A. Dahale	Tractor Driver T-1
Mr. S.P. Yeole	Jeep Driver T-1
Mr. S.K. Said	Beldar, SSG II
Mr. R.S. Kulkarni	Lab Attendant, SSG I
Mr. P.E. Tadge	Lab Attendant, SSG I
Mr. P.R. Sonawane	Lab Attendant, SSG I
Mr. M.S. Kale	Messenger, SSG I
Mr. S.D. Waghmare	Watchman, SSG I
Mr. N.H. Shaikh	Messenger, SSG I

Transfers:

Name	Designation	Institute to which transferred	Date of transfer
Mr. S.U. Vyas	Jr. Clerk	NRCMAP, Boriavi, Anand (Gujarat)	12.04.2000

XII BUDGET

FINANCIAL POSITION (2000-2001):

(Rs. in lakh)

Sub Heads	Plan		Non-Plan	
	Budget	Expenditure	Budget	Expenditure
Establishment Charges	25.67	25.67	11.31	11.31
TA	3.00	2.99	0.40	0.40
Other Charges	30.23	30.23	5.80	5.80
Works	91.10	91.10	4.00	4.00
TOTAL	150.00	150.00	21.51	21.51

कार्यकारी सारांश

राष्ट्रीय प्याज एवं लहसुन अनुसंधान केन्द्र ने नासिक से राजगुरुनगर स्थानान्तरित होने के बाद तीन वर्ष पूर्ण कर लिये। इस तीन वर्षो में प्याज एवं लहसुन अनुसंधान योजनाकंन के विभिन्न आयामों में कुछ महत्वपूर्ण मील के पत्थर स्थापित किये। केन्द्र पर अनुसंधान कार्य कुछ वृहद आयामों यथा फसल उन्नयन, फसल उत्पादन, फसल संरक्षण तथा कटाई उपरान्त प्रौद्योगिकी पर किये जा रहे हैं। वर्ष २०००-२००१ की कुछ विशिष्ट उपलब्धियाँ निम्नलिखित हैं।

फसल उन्नयन में गुजरात व उड़ीसा से जनन द्रव्य का संकलन किया गया। प्याज एवं लहसुन के जनन द्रव्य का मूल्याकन मौसमानुसार उपयुक्तता, समान रंग तथा उत्पादकता के आधार वांदित औद्यानिक गुणो युक्त लाइनों की पहिचान करने के लिए किया गया यह एक जारी रहने वाली प्रक्रिया है तथा वांद्यित अच्छी लाइनों पहिचानने में कम से कम चार से पाँच वर्ष लग जायेगें। इसके अतिरिक्त जैव विविधता के महत्व को देखते हुए प्याज तथा लहसुन के जनन द्रव्य का रखरखाव एक प्राथमिक मुद्दा है। केन्द्र ने आनुवंशिक संशोधन केन्द्र, नीदरलैण्ड से मूल्यांकन व रखरखाव के लिए जंगली जातियों की खरीद की है। इसके अधिक प्याज व लहसुन की व्यावसायिक किस्मों की मौसमानुसार अनुकूलनशीलता तथा उन्नयन हेतु मूल्यांकन किया जा रहा है, इनमें बसवन्त ७८०, खरीफ तथा रांगड़ा के लिए उपयुक्त पायी गयी है जबकि एन-२-४-१ तथा अर्का निकेतन रबी मौसम के लिए सर्वोत्तम किस्मों पायी गयी। रबी मौसम की इन किस्सों की भण्डारण क्षमता भी अच्छी है। जैव प्राद्योगिकी के और बढ़ते रुझान को ध्यान में रखते हुए वैज्ञानिक गण प्याज में एकगुणित तथा लहसुन में सोमाक्लोनस प्राप्त करने के प्रोटोकाल विकसित करने में कार्यरत हैं। हालाकिं इन लक्ष्य की प्राप्ति के लिए छोटा सा कदम उठाया गया है। भविष्य में किस्मों के पहिचान स्तर के लिए आणुविक पहिचान हेतु पर शोध पर ध्यान केन्द्रित किया जायेगा।

प्याज में प्राय: हेटरोसिस प्रजनन, द्विवर्षीय होने तथा अन्तप्रजनन अवनवन से जुड़ी विषमगुणसूत्रता के कारण नही हो पाता है। इसके फलस्वरूप प्याज में मात्र एक या दो व्यावसायिक संकर उपलब्ध हैं। अत: भविष्य में निर्यातोन्मुख बाजार की आवश्यकताओ की पूर्ति के लिए प्याज में संकर किस्मों के विकास कार्यक्रम आरंभ किया गया है।

फसल उत्पादन के अन्तर्गत प्याज के खेती को आकर्षक और लाभप्रद बनाने के लिए उपयुक्त फसल योजना के विकास का कार्य प्रगति पर है। भविष्य में श्रमिक तथा पानी की कमी को देखते हुए जल के बेहतर उपयोग के लिए टपक एवं छिड़काव सिंचाई विधियों पर अनुसंधान आरंभ किया गया है। इस वर्ष के परिणामों से स्पष्ट होता है कि टपक तथा छिड़काव विधियों में जल की बचत के साथ-साथ उत्पादन में वृद्धि हुई। इस तकनीक के बारे में कृषकों को जानकारी देने तथा इस पर उनका विश्वास स्थापित करने के लिए केन्द्र तथा कृषकों के खेतों पर और अधिक परीक्षणों की आवश्यकता है। उत्पादन लागत कम करने तथा प्रति एकड़ आय बढ़ाने के लिए प्याज की सीधे खेत में बुवाई तथा लहसुन में बड़ी फाकों का रोपण सामग्री के रुप में उपयोग पर शोध कार्य चल रहा है।

इस वर्ष में अनुसंधान प्रक्षेत्र का मृदा गुणों के आधार पर मृदा मानचित्र का निर्माण किया गया तथा इससे दीर्घ तथा सूक्ष्म तत्वों का शोध परीक्षण तथा मृदा पर पड़ने वाले असर भी देखा जा सकेगा। यह एक सर्व विदित तथ्य है कि फासफोरस एवं गन्धक उत्पाद की गुणवत्ता को प्रभावित करते हैं अत: इस विधा पर भी प्रयोग आरंभ किये हैं। वर्तमान समय में जैविक खेती के बढ़ते सिद्धान्त को देखते हुए जैविक खेती के अच्छी गुणवत्ता तथा आर्थिक तौर पर सम्भव तरीको विकसित करने का कार्य आरंभ किया गया है।

फसल संरक्षण में बीमारियाँ यथा-वैगनी धब्बा, स्टेमफीलियम झुलसा तथा कीड़े यथा थ्रिप्स फसल को बुरी तरह प्रभावित करते हैं। अत: इनके असर को कम करने के लिए रोपण तिथि में फेरबदल, जैविक पीड़क नाशकों, वनस्पतियों तथा विभिन्न फफूँदनाशियों पर प्रयोग किये जा रहे हैं। इससे अधिक प्रतिरोधिता के नये स्त्रोतों की खोज के लिए जनन द्रव्य का मूल्याकंन किया जा रहा है। फफूंदनाशकों के छिडकाव के समय की भविष्यवाणी के लिए स्पोर की गिनती तथा इनका बीमारी की तीव्रता तथा थ्रिप्स के देहलीस्तर में सह सम्बन्ध खोजने का कार्य भी जारी है। इससे इन हानिकारक रसायनों के प्रयोग को कम करने तथा उत्पादन लागत कम करने में सहायता मिलेगी।

प्याज एक शीघ्र खराब होने वाली फसल होने के कारण नुकसान उष्ण मौसम में ८० प्रतिशत तक हो सकता है। प्याज एवं लहसुन दोनों में अधिक भण्डारण क्षमता वाली लाइनों की पहिचान के लिए अनुसंधान प्रयास जारी है।

केन्द्र द्वारा प्याज एवं लहसुन उत्पादन के बारे में कृषकों को शीघ्रताशीघ्र जानकारी देने के लिए केन्द्र पर उन्हें प्रशिक्षण दिया जाता है। कृषकों को जानकारी देने के लिए केन्द्र द्वारा मराठी भाषा में 'लसूण उत्पादन' नामक पुस्तिका का प्रकाशन किया गया।

इस वर्ष में भारतीय सब्जी विज्ञान सोसायटी तथा राष्ट्रीय बागवानी अनुसंधान एवं विकास प्रतिष्ठान, नाशिक के सानिंध्य में राष्ट्रीय सेमिनार ''प्याज एवं लहसुन उत्पादन व सस्योत्तर प्रबन्धन-चुनौतियाँ तथा रणनीतियाँ'' का यशवन्तराव चव्हाण राष्ट्रीय मुक्त विश्व विद्यालय, नाशिक में आयोजन किया गया। केन्द्रीय कृषि मंत्री माननीय नीतीश कुमार जी द्वारा उदघाटित इस सेमिनार में देशभर के लगभग १७० वैज्ञानिकों, निजी संस्थाओं, नीतिनिर्माताओं तथा योजनाकारों ने भाग लिया।

केन्द्र के प्रयोगशाला-प्रशासनिक भवन का शिलान्यास समारोह १८ नवम्बर २००० को सम्पन्न हुआ। डॉ. रवीन्द्र नाथ पाल, उपमहानिदेशक (बागवानी) इस समारोह के मुख्य अतिथि थे। भूमि पूजन कार्य डॉ. रवीन्द्र नाथ पाल, केन्द्र की ओर से विशिष्ट गणों का स्वागत भाषण डॉ. भूप सिंह धनखड़ तथा केन्द्र के विकास की जानकारी डॉ. कीर्ति सिंह द्वारा सम्पन्न किये गये। सभी विशिष्ट गणों द्वारा केन्द्र पर शोध तथा ढाचागत सुविधाओ के विकास के लिए किये उत्साह वर्धक प्रयासों लिए केन्द्र के कर्मचारियो की सराहना की। श्री. नारायणराव पवार, विधायक ने कृषकों को प्याज व लहसुन के अधिक उत्पादन तथा अधिक लाभ प्राप्त करने के लिए नयी प्रौद्योगिकियों को अपनाने की सलाह दी। श्री. वी. वी गुप्ता, अधिशासी अभियन्ता, के. लो. नि. वि. ने प्रस्तावित भवन के बारे में जानकारी दी, जो कि १५००० वर्ग फुट में फैली है तथा जिसकी अनुमानित लागत २.२५ करोड़ होगी।


NATIONAL SYMPOSIUM ON
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NOVEMBER 19-21,2000 NASIK.
RAPPORTEUR
CHAIRMAN