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2001-2002

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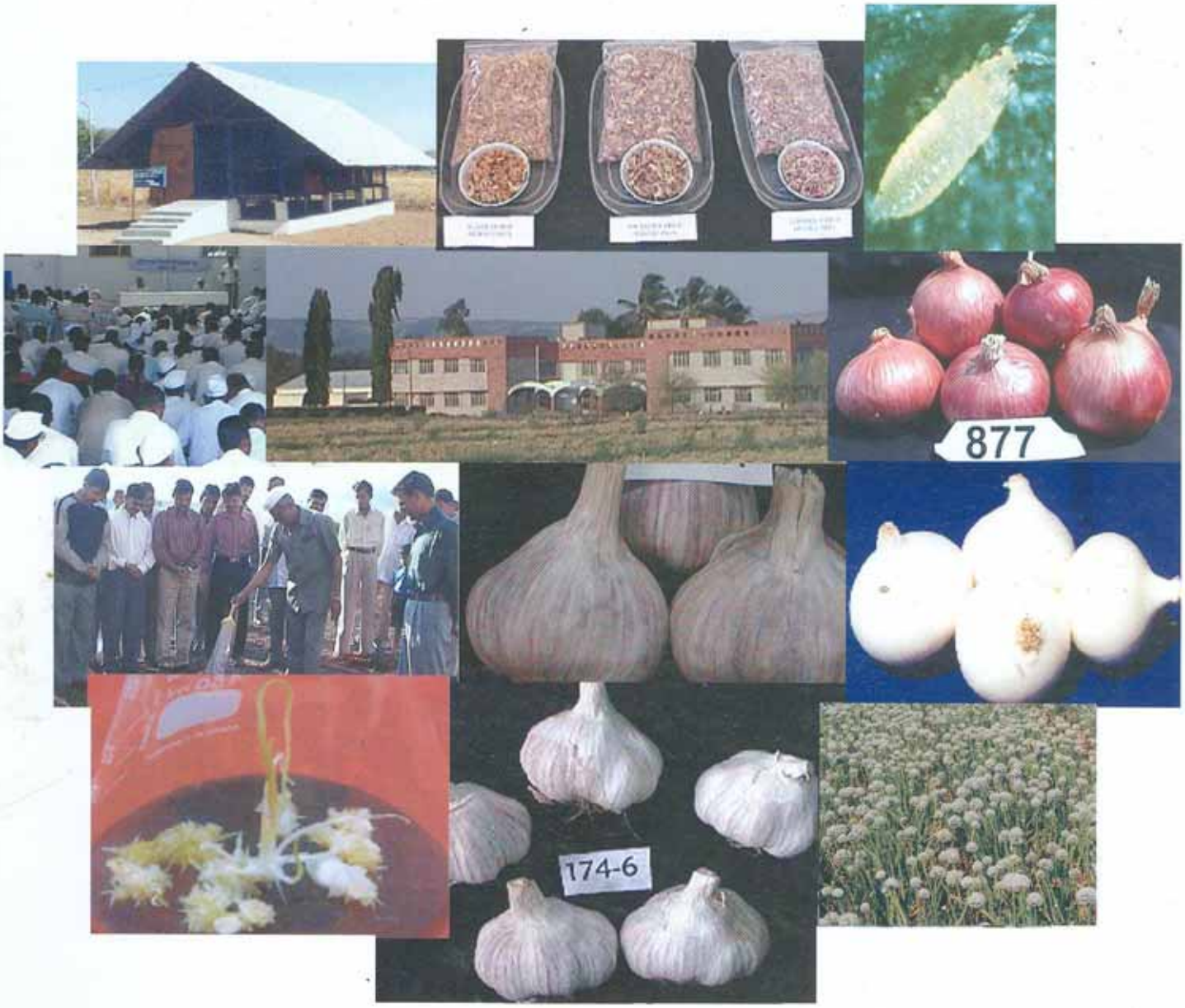

NATIONAL RESEARCH CENTRE FOR ONION & GARLIC

Rajgurunagar, Pune, Maharashtra - 410 505

NRCOG

ANNUAL REPORT 2001-2002

NATIONAL RESEARCH CENTRE FOR ONION AND GARLIC

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

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

NRCOG

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EXECUTIVE SUMMARY

Since its inception, National Research Centre for Onion and Garlic has been actively engaged in research activities towards the improvement of onion and garlic and is constantly striving for development of suitable methods to obtain an environment friendly, insecticide-pesticide free produce with desirable horticultural traits. The research activities are broadly classified into four categories - Crop improvement, Crop production, Crop protection and Post harvest technology.

In crop improvement, research is mainly focused on development of dark red onion for *kharif* and *rangda* season and light red, globose shaped onion for *rabi* season. During this year, 17 lines *in kharif* and 103 lines in *rangda* season of red onion were evaluated. In addition to this, 26 exotic hybrids were evaluated *vis a vis* locally adapted commercial onion varieties and two Indian hybrids. In white onion, 378 lines were collected from Maharashtra, Madhya Pradesh and Gujarat. 52 lines in *kharif*, 53 lines in *rangda* and 51 accessions in *rabi* were evaluated. Two new projects viz., breeding yellow onions for export and variability creation through mutation in onion have also been initiated. Under AICVIP trials, eight entries were evaluated.

In garlic, a total of 134 lines of garlic germplasm and 35 lines of elite germplasm were evaluated. Acc. No 74, 200 and 336 were found to be superior than the local check G-41. Garlic being an axesually propagated crop, utilization of diversity can only be achieved through bulb to row selection. Hence 294 bulb to row progenies from 40 germplasm lines were also evaluated and the results are promising. Further, work on creation of variability through mutation in garlic has also been initiated.

In heterosis breeding programme, crosses with MS 65 A were found to be more promising as compared to crosses with MS 48A. Next year the crosses will be made again and evaluated for confirmation of the results obtained this year. In tissue culture section, size of flower bud for haploid production has been standardized and encouraging results in onion - garlic micropropagation and somaclonal variation in garlic have been obtained.

In crop production, biofertilizers *viz.*, *Azotobacter* and *Azospirillum* are being used to study their effect on yield and other traits in onion and garlic. Studies on yield improvement in onion and garlic through potassium and zinc application is also being evaluated. With the concept of organic farming taking new significance, use of organic manures and chemical fertilizers is also being conducted to see their *vis a vis* performance.

In recent years, soil fertility – fertilizer use research is focused on cropping sequences. Studies on sequential cropping of well-delineated agro-ecological zones would help for optimization of nutrients input, thereby, maximizing the output. Investigations on onion based cropping sequence were carried out during *kharif*, late *kharif* and *rabi* season. Transplanting versus direct seeding and effect of seed pelleting were also taken into consideration to study their effect on onion yield. In order to minimize irrigation and maximize output, irrigation studies were also taken up in onion and garlic. Drip irrigation at 100% pan evaporation is showing promise as compared to other methods. Production technology in *kharif* season by using different shading material for nursery, different planting methods and use of preharvest treatments and different methods of curing is also being standardized.

In crop protection, population dynamics of thrips is being studied. The centre is developing a novel way for management of thrips by using barrier cropping method. Managament of thrips by studying different seedling root dip treatments, their duration and irrigation method is also underway. Germplasm screening for identification of thrips resistant / tolerant material is also being carried out by using LCR (Leaf curling rate) and LIR (Leaf injury rating). So far no germplasm line has been found to be resistant to thrips although some field tolerance has been noticed in some lines.

In post harvest studies, factors like seasonal variation, bulb size and neck thickness were studied to see their effect on losses. Pre harvest and post harvest handling and storage of onion by farmers were also studied to get an insight about farmer's methods of handling onion. Moreover, storage structures developed by farmers were also surveyed. Further, different storage structures constructed at the centre are also being evaluated. This centre has also developed a roller type manually operated onion grader to facilitate onion grading into five different grades. The machine is five times efficient than the labour with 98 per cent precision as against 50 per cent with manual grading.

This year, the website of our Institute was redesigned and optimized and launched with NIC, Pune. The website is available at the following URL path http://nrcog.mah.nic.in

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out. Also evaluation of onion and garlic germplasm for thrips and mites resistance is underway.

In post harvest technology, different types of storage structures are being studied to see their efficiency for increasing the shelf life of onion. Moreover different value added products from onion and garlic are also being made to make onion-garlic cultivation economically remunerative.

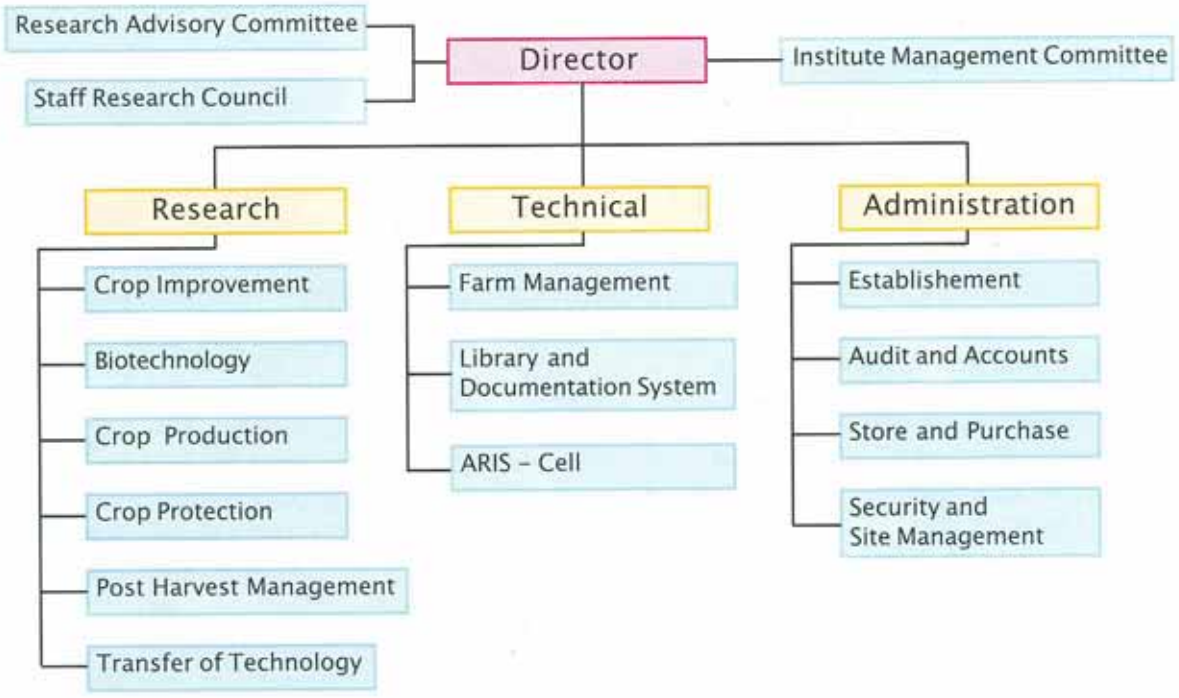
ARIS CELL

The ARIS cell was strengthened with 13 computers, two laser, three dot matrix, one scanner and two inkjet printers. All computers and printer are connected with LAN (Local Area Network) Internet and E-mail facility. ARIS cell is also equipped with Digital camera and LCD. ARIS cell provides hardware and software support to end user. Market Information System and Website for this institute has been developed by the ARIS CELL.

LIBRARY :

The library purchased 59 books and 23 journals worth Rs. 4.56 lakhs for this year. Library has also subscribed Hort-CD for retrieval reference. The library is also providing reference facility for the students of agriculture.

ORGANOGRAM OF NRC ONION & GARLIC



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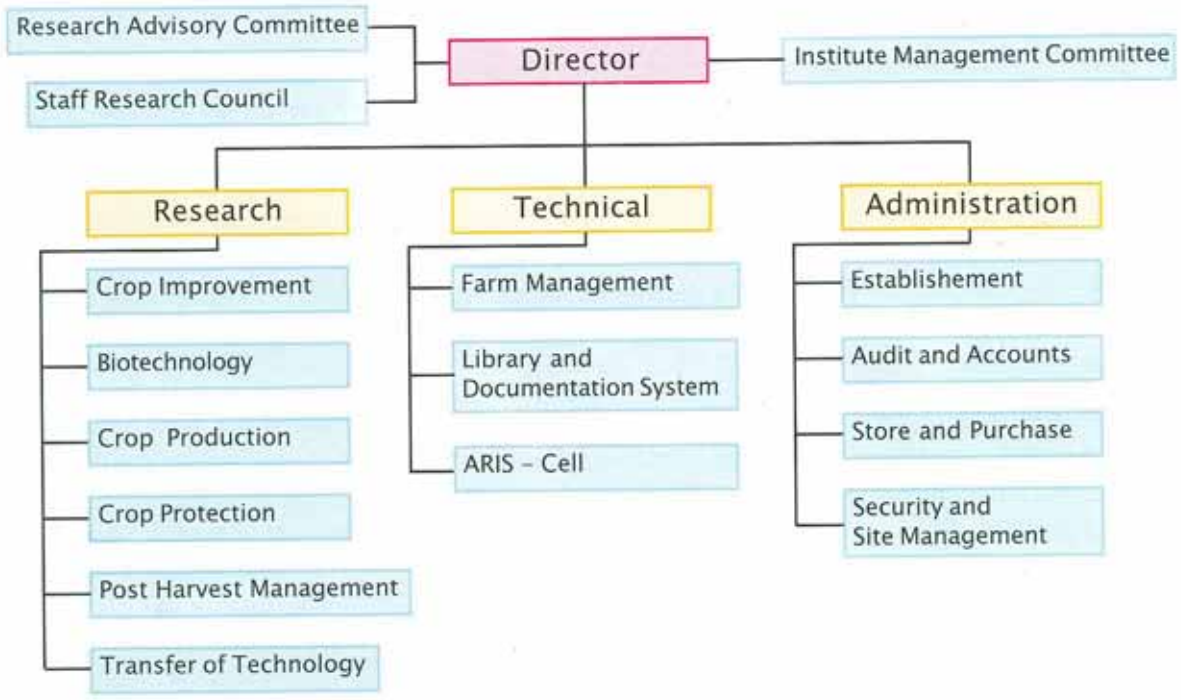

II. RESEARCH ACHIEVEMENTS

CROP IMPROVEMENT

ALLIUM BIODIVERSITY : COLLECTION, CHARACTERIZATION, EVALUATION AND MAINTENANCE OF TROPICAL ONION (ALLIUM CEPA. L.) AND GARLIC (ALLIUM SATIVUM L.) GERMPLASM

Germplasm evaluation

During *kharif,* 2001, 17 lines were evaluated for yield and adaptability along with three standard check varieties. The experiment was laid out in randomised block design in plots of 1 m x 1 m area with two replications. Transplanting of the varieties was done on 24th July and harvesting on 20th Oct, 2001. Due to high percentage of rotting and no bulb formation in a few lines, the yield was very poor ranging from significantly 8 - 16 t/ha. Based on statistical analysis, acc. No. 519-R, 513 and 533 performed significantly superior over N-53 whereas acc.No. 519-R and 513 were significantly superior over ADR in terms of marketable yield. In terms of total yield, no line recorded significantly superior yield than the check varieties (Table 1).

During *rangda* season, a total of 103 lines were evaluated along with seven check varieties and the experiment was laid out in randomised block design in two replications having a plot size of 1 x 1 m area. From the mean value, it was seen that B-780 was the best yielder among all the checks used with a total yield of 68.5 t/ha. and marketable yield of 53.0 t/ha. Accessions numbers 749 (53.5 t/ha) and 415 (48.3 t/ha) were showing yield at par with B-780 for marketable yield, whereas Acc. no 200, 535 and 158 were found to be at par with B-780 in terms of total yield (Table 2).

Eleven promising lines, selected on the basis of storability and TSS were evaluated along with standard check varieties N-2-4-1, B-780, ALR and Arka Niketan. The experiment was laid out in a randomised block design having a plot size of 2 x 1 m area in four replications and the material was planted on 3rd Oct and harvested on 11 Feb, 02. In terms of total yield, only one line (Acc. No. 546 - 63.3 t/ha) was statistically superior over one check, Arka Niketan, whereas, all the others lines were at par with the other checks except Acc. No.538, which was statistically inferior (Table 3). Its poor performance can be attributed to the very high percentage of doubles (72.5%) present. In the case of marketable yield, Acc. No. 597 (46.9 t/ha) and 592 (42.3 t/ha) were significantly superior over all checks except B- 780 (49.1 t/ha).

In *rangda* season 2001 - 02, twenty six exotic hybrids were evaluated for their superiority over the open pollinated locally adapted commercial varieties. The experiment was laid out in randomised block design with four replication in plots having size of 2 x 1 m area alongwith check varieties, B-780, ADR, N-53, Arka Niketan and Arka Lalima (Indian hybrid released by IIHR, Banglore). Planting was done in first week of October and harvested on 11 and 18 February, 2002. Among the hybrids studied, Cadillac (65.0 t/ha), HY3667 (66.6 t/ha), HY-9539 (72.8 t/ha), HY-3404 (78.1 t/ha) and Cyclone (86.5 t/ha) recorded significantly higher yield over all the check varieties. Sixteen hybrids were found to be significantly superior over the Indian hybrid Arka Lalima(Table 4). The

higher yield was due to bigger size of all exotic hybrids. All exotic hybrids were inferior to Indian open pollinated varieties and hybrid as far as T.S.S. is concerned.

Table 1: Evaluation of *kharif* onion germplasm in 2001

Date of Planting : 24.07.2001 Date of harvesting : 26.09.01
Plot size: 1 x 1 m No. of replications: 2

Acc. No.	Mkt. Yld (t/ha)	Total Yld (t/ha)	A Gr %	B Gr %	C Gr %	Dbls %	Rotted %
519-R	9.50	14.50	8.13	28.57	26.71	4.07	32.53
513	9.17	11.67	8.00	40.31	30.02	0.00	21.67
533	8.67	13.33	11.73	25.45	28.23	11.51	23.08
520	8.33	16.00	14.61	27.11	10.98	5.44	41.86
527	5.80	13.50	16.90	39.40	0.00	23.10	20.80
N-53	4.50	11.00	0.00	22.18	18.00	5.13	54.69
ADR	5.83	12.67	0.00	21.06	25.00	17.34	36.60
CD (0.05)	3.75	5.09					

Table 2 : Evaluation of onion germplasm during *rangda* 2001

Date of planting : 05.10.2001 Date of harvesting : 18.02.2002
Plot size: 1 x 1 m No. of replications: 2 Design: RBD

Acc. No.	Mkt Yld (t/ha)	Total Yld (t/ha)	Dbls %	Blts %	% AGr	% BGr	% CGr
200	37.5	62.8	30.8	8.1	24.3	29.6	7.2
535	29.5	60.0	43.3	9.1	17.5	26.5	3.7
158	41.0	59.8	20.3	10.9	46.5	15.5	6.8
749	53.5	57.8	4.6	3.1	46.9	34.8	10.8
415	48.3	55.8	9.3	3.8	37.0	42.9	7.1
B-780	53.0	68.5	12.5	9.8	60.2	14.8	2.8
C.D (0.05)	10.2	10.5					

Table 3 : Evaluation of elite onion germplasm during *rangda 2001 - 02*

Date of planting : 03.10.01 Date of harvesting : 11.02.2002
Plot size : 2 x 1 m No. of replications : 4 Design: RBD

Acc. No.	Total yld (t/ha)	Mkt yld (t/ha)	AGr %	BGr %	CGr %	P (cm)	E (cm)	N (cm)	Dbls %	Blts %	TSS (°Brix)
597	61.9	46.9 $x^{l}z^{l}a^{l}$	38.3	30.4	7.1	4.9	5.8	0.8	16.7	7.7	13.2
592	56.7	42.3 $x^{l}z^{l}a^{l}$	26.1	42.2	7.4	4.8	5.6	0.8	15.4	8.9	13.2
670	49.6	23.5	16.5	28.5	5.7	4.7	5.4	0.7	42.9	6.4	13.1
651	46.6	21.3	17.1	23.6	5.4	4.7	5.4	0.9	43.8	10.2	13.0
654	58.4	28.9	20.3	24.6	5.5	4.8	5.6	0.7	38.5	11.2	13.0
546	63.3 a^{l}	33.4	24.3	23.6	5.0	5.1	5.7	0.8	34.1	12.7	12.9
538	21.6	3.9	7.9	6.2	4.3	4.7	5.4	0.6	72.5	9.2	13.0
671	49.9	34.3	36.5	27.6	4.9	4.8	5.4	0.6	23.9	7.3	13.3
595	60.1	36.1	25.9	30.2	4.9	4.9	5.5	0.7	27.7	11.3	13.0
571	53.6	38.7 z^{l}	32.6	33.7	6.0	4.8	5.7	0.8	25.4	2.3	12.8
650	45.6	29.8	26.4	32.2	7.0	4.6	5.4	0.6	26.3	7.6	12.3
N-2-4-1	55.2 x	32.8 x	22.1	32.5	5.2	4.6	5.5	0.7	32.5	7.7	13.0
B-780	58.1 y	49.1 y	58.9	20.7	4.9	5.0	5.6	0.6	9.0	6.5	13.0
AL.R	55.3 z	27.8 z	19.3	25.7	6.0	4.6	5.5	0.7	41.8	7.4	13.0
A. Niketan	49.9 a	30.9 a	26.8	25.2	9.4	4.8	5.5	0.6	26.7	11.4	12.6
CD (0.05)	13.0	8.9									

Table 4 : Evaluation of exotic hybrids / varieties during *rangda 2001* - 02

D.O.S. : 14.08.2001 D.O.T. : 03.10.2001 D.O.H: 18.02.02
Plot Size: 2 x 1 m Replication : 2 Entries : 30

Acc. No.	Mkt. Yield (t/ha)	P (cm)	E (cm)	N (cm)	Double %	Bolters %	TSS (°Brix)	Pl. ht. (cm)	NOL	Bulb Colour
Cyclone	86.5 $x^1y^1z^1a^1b^1$	7.6	7.1	0.49	2.81	0.00	5.8	56.2	10.9	Y
HY-3404	78.1 $x^1y^1z^1a^1b^1$	6.6	6.7	0.51	13.19	0.00	7.7	54.2	11.2	DR
HY 9539	72.8 $x^1y^1z^1a^1b^1$	6.1	7.0	0.63	22.81	0.00	6.7	64.2	12.6	R
HY3667	66.6 $x^1y^1z^1a^1b^1$	7.3	6.9	0.61	16.19	0.00	9.0	59.5	12.6	LR
Caddilac	65.0 $x^1y^1z^1a^1b^1$	6.7	6.8	0.63	10.77	0.00	5.1	67.1	14.5	Y
DPS-2023	60.9 $y^1z^1a^1b^1$	6.5	6.8	0.67	25.88	0.00	8.7	58.2	12.8	W
DPS-1034	59.7 $y^1z^1a^1b^1$	7.4	5.7	0.40	3.17	0.00	5.8	60.6	13.2	Y
HN9730	59.1 $y^1z^1a^1b^1$	4.9	7.4	0.55	5.02	0.00	8.2	67.2	12.3	DR
Couger	58.5 $y^1z^1a^1b^1$	7.2	7.0	0.45	4.49	0.00	8.7	56.4	10.8	Y
DPSX 1029	57.9 $y^1z^1a^1b^1$	7.9	7.6	0.51	58.67	0.00	7.6	59.2	13.1	Y
Mercedes	47.1 $z^1a^1b^1$	6.5	6.7	0.38	3.80	0.76	6.9	55.8	10.2	Y
HN 9935	44.9 z^1b^1	4.7	7.1	0.69	20.04	0.00	11.6	62.5	13.5	LR
Pinnacle	44.6 z^1b^1	4.5	4.7	1.51	0.00	0.00	9.1	61.6	13.9	Y
Linda Vista	44.3 z^1b^1	7.5	7.2	0.57	15.29	0.00	7.4	63.3	11.6	Y
HN9735	44.0 z^1b^1	4.7	6.8	0.51	14.36	0.00	11.6	63.5	12.7	DR
HN9733	43.8 z^1b^1	4.9	6.9	0.97	13.04	2.42	11.2	61.5	14.1	DR
B-780	41.3x	5.3	5.5	0.61	14.53	5.57	12.5	61.5	11.3	R
A. D. R.	28.3y	5.1	5.5	0.55	37.76	10.53	11.3	52.2	10.7	DR
N-53	23.5 z	5.2	5.6	0.54	16.48	30.11	11.6	60.3	12.6	DR
A.Niketan	27.0 a	4.9	5.7	0.47	21.15	9.62	13.9	59.5	14.4	LR
A.Lalima	21.1 b	4.5	6.2	0.45	49.21	12.81	14.3	61.3	13.4	R
CD(0.05)	19.78						1.05			

BREEDING WHITE ONIONS FOR PROCESSING AND DESIRABLE HORTICULTURAL TRAITS

There is very little variability in white onion genotypes in India as far as T.S.S. is concerned. High TSS varieties over 17° Brix in short day onion is the need of processing industry. Secondly, storage life of white onion is also less as compared to red onion, hence there is shortage of white onions particularly during October to February which is a bottle neck to run the processing plant year round. White onion varieties particularly for *kharif* and *rangda* (Late *kharif*) are not available. Most of the germplasm is multiple centered which is not desirable for preparation of flakes. Besides this, resistant varieties against disease and insect pest are not available. Hence the above project is in progress since 2001-2002 with the objective to develop white onion varieties/ hybrids for high TSS for processing purpose to be grown in diffrent seasons.

Approaches followed are :

1. Collection and evaluation of white onion indigenous and exotic germplasm.
2. Recombination breeding.
3. Breaking available exotic hybrids/varieties for flowering for recombination breeding.
4. Heterosis breeding.
5. Mutation breeding.

Collection and evaluation of white onion indigenous germplasm.

Three hundred and eighty seven white onion germplasm lines were collected from different parts of Maharashtra, Madhya Pradesh and Gujarat during 2001-2002 (Table 5).

Table 5 : White onion collection during 2001-2002

State	District	Taluka	Village	No. of Germplasm collected		Total number of bulbs collected
				As Bulbs	As seed	
Maharashtra	15	49	112	208	35	
Gujarat	5	12	49	58	17	
M. P.	5	10	47	69	-	
Total	25	71	208	335	52	7199

T.S.S. of all the collected bulbs was recorded. Out of 7199 bulbs only 2.52% bulbs recorded TSS above 14° Brix. Only one bulb was found to have TSS up to 23° Brix which is 0.01 per cent of the total population (Table 6). This indicates that there is scope to develop varieties with high TSS in short day onion. Losses due to sprouting and rotting were also recorded in storage. After seven months 3 entries recorded no losses, whereas 14 entries recorded losses between 1 - 10 per cent (Table 8). Losses over 50% during storage were recorded in 134 entries (Table 7)

Table 6 : Number of onion bulbs above 14°Brix TSS in the collected material

TSS Range	No. of Bulbs	% Bulbs
14-14.9	90	1.25
15-15.9	51	0.70
16-16.9	25	0.34
17-17.9	11	0.15
18-18.9	10	0.13
19-19.9	4	0.05
20-20.9	7	0.09
>23	1	0.01
Total	199	2.52

Table 7 : Losses after 7 months in collected white onion germplasm during storage

% Losses (Range)	No. of entries
0	3
1-10	14
11-20	33
21-30	39
31-40	35
41-50	44
>50	134

Evaluation of white onion germplasm during *kharif*

52 entries collected in the form of seed from Maharashtra and Gujarat were evaluated during *kharif* season with check Phule Safed (Table 8). The seedlings were transplanted on 15 July, 2001 and harvested after 87 days of transplanting.

Significantly higher marketable yields were recorded in 19 entries (W-393, W-394, W-396, W-398, W-403, W-404, W-405,W-407,W-408, W-411, W-412, W-415, W-418, W-419, W-420, W-421, W-422, W-426 and W-440) over Phule Safed (Check) which yielded only 3.2 t/ha. Highest total and marketable yield were recorded in W-393 which was at par for marketable yield with W-394, W-396 and W-404. Total yields were quite high as compared with the marketable yield, which shows potentials to develop varieties with high yields. 17 entries viz. W-393, W-394, W-396, W-397, W-39, W-403, W-404, W-405, W-407, W-408, W-413, W-415, W-418, W-419, W-420, W-421 and W-440 recorded significantly higher total yields over check variety Phule Safed (8.70 t/ha). T.S.S. was highest in Phule Safed and eight entries viz. W-393, W-398, W-400, W-406, W-410, W-425, W-426 and W-427 had TSS at par with the check variety.

Table 8 : Evaluation of white onion germplam during *kharif* season

Date of Planting : 15. 7. 2001 Date of Harvesting : 13. 10. 2001
Net Plot Size : 4.04 x 1.10 m. Replications : 3

Acc.No.	Total Yld (t/ha)	Mkt. Yld. (t/ha)	A Gr %	B Gr %	C Gr %	Mkt %	Dbls %	Rot %	T.S.S. (° Brix)	% Knot Formation
W-393	22.39	11.05	16.3	22.6	10.5	49.4	18.0	32.6	9.91	0
W-394	16.61	10.04	18.6	28.7	13.2	60.5	25.3	14.2	8.52	16
W-396	13.19	10.10	19.1	31.9	25.5	76.6	6.4	17.0	8.88	30
W-398	11.84	6.45	7.1	26.1	21.3	54.5	26.1	19.4	9.55	30
W-400	7.86	3.48	0.0	22.9	21.4	44.3	32.1	23.6	9.71	5
W-403	18.35	6.79	7.6	18.3	11.0	37.0	23.2	39.8	8.78	61
W-404	13.24	10.16	23.7	27.5	25.4	76.7	4.2	19.1	8.65	19
W-405	15.38	8.08	9.7	20.8	25.1	52.6	30.9	13.5	8.02	21
W-406	4.77	1.68	0.0	17.6	17.6	35.3	52.9	11.8	11.02	67
W-407	14.25	8.42	21.7	24.0	15.7	59.0	22.4	16.1	8.51	7
W-408	14.98	8.42	17.2	25.8	13.1	56.2	15.4	28.5	8.80	14
W-410	3.87	2.19	0.0	27.5	29.0	56.5	43.5	0.0	9.92	75
W-411	9.65	5.89	4.1	19.8	37.2	61.0	20.3	18.6	—	67
W-412	10.55	7.74	6.4	25.5	41.5	73.4	8.0	18.6	9.02	43
W-415	3.64	668	15.6	20.6	12.8	490	9.9	41.2	7.34	57
W-418	11.39	6.06	11.3	24.6	17.2	532.	19.7	27.1	8.81	13
W-419	11.78	7.86	14.3	26.2	26.2	66,7	2.4	31.0	8.38	2
W-420	11.50	6.29	7.8	22.0	24.9	54.6	27.3	18.0	8.29	24
W-421	12.40	7.07	4.5	24.9	27.6	570	15.8	27.1	8.02	16
W-422	9.60	5.16	5.8	20.5	27.5	538	17.0	29.2	9.05	70
W-425	6.68	2.49	7.6	10.6	19.2	37.3	40.5	22.2	10.08	—
W-426	8.59	5.72	0.0	31.9	24.5	66.7	18.4	25.2	9.83	—
W-427	7.46	3.42	0.0	20.3	25.6	45.9	16.5	37.6	10.06	89
W-440	13.02	5.33	4.3	19.4	17.2	40.9	5.2	53.9	8.44	38
P.Safed	8.70	3.20	6.5	11.0	19.4	36.8	40.6	22.6	10.72	0
CD (0.05)	2.66	2.12							1.2	

Evaluation of white onion germplam during *rangda* (late *kharif*)

53 entries collected in the form of seed from Maharashtra and Gujarat were evaluated during late *kharif* season with white check Phule Safed and Agrifound White. The seedlings were transplanted on 3rd October, 2001 and harvested on 13th February, 2002 (Table 9).

Table 9 : Evaluation of white onion germplasm during *rangda* 2001-2002

Date of planting : 3.10.2001 Date of Harvesting : 13.02.2002
Replications : 2 Plot Size : 1.95 x 1m

Acc. No.	Total Yld (t/ha)	Mkt. Yld (t/ha)	%A Gr	%B Gr	%C Gr	%D Gr	%Dbls	%Blts	TSS (° Brix)
W-417	51.3	36.1	20.0	35.0	13.5	4.0	21.8	5.8	12.3
W-422	54.7	29.1	14.1	30.7	8.4	2.3	39.3	3.5	12.4
W-429	36.5	25.6	17.5	37.2	15.4	0.4	14.7	0.0	12.4
W-431	44.4	25.6	13.0	36.1	8.7	1.7	17.3	2.9	10.8
P. Safed	41.4	20.4	14.6	23.2	11.5	20.1	18.9	8.7	12.1
AFW	37.3	12.6	5.5	14.4	13.7	3.8	8.1	12.4	13.8
DPS2023	62.1	52.3	36.6	40.3	9.9	5.2	7.6	0.0	7.5
CD (0.05)	7.9	4.6							

Significantly higher marketable yields were recorded in four accessions (W-417, W-422, W-429 and W-431) over check Phule Safed (20.4 t/ha). Eleven entries gave significantly higher total yield over best check Phule Safed. Ten entries had no bolters, which is more desirable particularly during *rangda*. Higher but at par TSS were recorded in 12 accessions including check Agrifound White which ranged between 7.5 to 13.8°Brix.

Evaluation of white onion germplasm during *rabi* season.

The germplasm screened during *kharif* and late *kharif* was also evaluated during *rabi* season. 51 accessions were transplanted on 16th December, 2001 in 2 replications and harvested on 16 April , 2002 (Table 10).

Among 51 entries, significantly higher marketable yields were recorded in 8 entries (W-404, W-415, W-418, W-430, W-438, W-439, W-440 and W-441) over best white check Phule Safed (37.18 t/ha), whereas 16 entries gave significantly higher yield which ranged between 48.53 to 66.15 t/ha over Phule Safed. Agrifound White total yield was at par with Phule Safed (43.62 t/ha). Highest total yield of 66.65 t/ha was recorded in W-418 which was significantly highest over all the entries. Eight entries recorded higher TSS over Phule Safed, which ranged between 12.3 to 12.7 ° brix. Number of doubles (below 5%) were quite less in 9 entries.

Table 10 : Evaluation of white onion germplasm during *rabi*

Date of planting: 16.12.2001 Date of harvesting: 16.04.2002
Net Plot size : 1.95 x 1 m Replications : 2

Acc. No.	Total Yield (t/ha)	Mkt. Yield (t/ha)	% A Gr	% B Gr	% C Gr	Dbls (%)	Blts (%)	TSS (° Brix)
W-404	54.74	42.18	39.8	30.2	7.0	22.0	0.9	11.0
W-415	54.87	43.85	53.7	23.1	3.0	19.2	0.9	10.5
W-418	66.15	47.44	57.0	12.6	2.1	22.5	5.8	10.1
W-430	51.49	41.77	42.8	31.2	7.1	10.2	7.7	11.6
W-438	46.92	43.97	49.2	39.6	4.9	1.9	0.0	11.3
W-439	45.51	41.79	42.0	37.2	12.7	4.8	2.0	11.7
W-440	50.51	46.54	47.0	38.1	7.1	1.0	3.0	11.6
W-441	45.38	42.82	42.4	46.3	5.6	3.4	0.8	11.0
P. Safed	43.62	37.18	40.0	37.0	8.2	9.1	4.5	11.1
AFW	44.36	22.44	19.4	26.6	4.6	25.7	23.7	12.1
CD (0.05)	5.33	4.45						1.34

CREATION OF VARIABILITY THROUGH MUTATION IN ONION

Mutation studies in onion are in progress using chemical mutagens viz. Sodium Azide, EMS, Colchicine and physical mutagen gamma radiation and results are awaited.

BREEDING YELLOW ONIONS FOR EXPORT

The project has been started in 2001-2002 to develop varieties suitable for export.

The approaches followed are as under :

1. Collection, evaluation and maintaitiance of yellow onion germplasm.
2. Evaluation of germplasm for different seasons viz. *kharif, rangda* and *rabi*.
3. Forcing long day exotic yellow onion varieties / hybrids to flower for recombination breeding.

Forty germplasm lines have been collected / isolated from segregating material and have been multiplied during *rabi* 2002 which will be evaluated in coming season.

Exotic hybrids were forced to flower with the use of growth regulator and cold treatments, which will be used further in recombination breeding with the Indian lines / varieties.

Evaluation of advanced lines during *rangda*

Five advanced lines selected from B-780 were evaluated during *rangda* along with other varieties to see the performance of selected material. The crop was transplanted on 4 October, 2001 and harvested on 6.2.2002. The experimental details and results are as follows:

Table 11 : Evaluation of advanced lines during *rangda* 2001 - 2002

Date of planting : 4.10.2001
Net Plot size: 1.95x 1.1 m
Entries: 5

Date of Harvesting : 6.2.2002
Replications : 3
Checks : 6

Entries	Mkt. Yield (t/ha)	Total Yield (t/ha)	%A Gr	%B Gr	%C Gr	% Dbls	% Blts	% Rot	P (cm)	E (cm)	N (cm)	T.S.S. (° Brix)
B-780-5-2-1(S)	57.09	60.53	64.47	26.52	3.34	3.49	2.18	0.00	5.03	5.62	0.73	11.68
B-780-5-3-1(R)	61.07	63.64	69.23	23.32	3.42	2.08	1.95	0.00	4.79	5.731	0.55	10.36
B-780-5-3-1(LR	56.57	59.75	68.53	20.55	5.59	2.60	1.69	1.04	4.78	5.66	0.50	12.96
B-780-5-2-2(S)	53.07	56.72	66 99	20.14	6.44	4.11	0.96	1.37	5.15	5.68	0.14	11.04
N-2-4-1 (720)	37.06	46.85	50.58	18.24	10.28	14.76	5.31	0.83	4.69	5.49	0.72	11.52
B-780	49.96	59.67	66.02	14.32	3.39	8.07	6.12	2.08	5.00	5.44	0.39	11.16
A. D. R.	30.16	60.37	33.72	12.87	2.83	38.35	6.82	5.41	4.67	5.59	0.66	11.12
A. Kalyan	39.32	49.81	53.51	19.19	6.24	12.32	8.74	0.00	4.75	5.41	0.64	12.24
A. Niketan	35.32	51.64	38.82	24.32	5.27	20.31	11.28	0.00	5.13	5.65	0.57	11.80
N-2-4-1	*49.96*	59.98	64.90	13.73	4.66	14.51	2.20	0.00	4.81	5.66	0.86	12.46
A.L.R.	32.05	48.72	52.63	9.57	3.59	24.16	7.66	2.39	4.48	5.31	0.78	12.24
Av.	46.15	56.59	58.08	18.03	4.90	12.93	4.90	1.16	4.86	5.58	0.67	11.63
CD (0.05)	8.57	7.21										

Significantly higher yield was recorded in B-780-5-3-1-R over B-780 and N-2-4-1, but it was at par with B-780-5-2-1(S), B-780-5-3-1(LR) and B-780-5-2-2(S) (Table 11). The percentage of marketable yield was quite high in these advanced lines which was above 90% except in N-2-4-1(720). Percentage of doubles as well as bolters were also quite low and A grade bulbs were more in these lines as compared to other varieties. Though the total yields were high in almost all the varieties yet they were at par except A. Niketan, A. Kalyan, ALR and N-2-4-1(720).

VARIETAL EVALUATION TRIAL ON ONION UNDER AICVIP DURING RABI

Eight entries were received from IIVR, Varanasi for evaluation of onion lines during *rabi* under the All India Co-ordinated Vegetable Improvement Project (Table 12). The crop was transplanted on 1.1.2002. The experimental details are as follows:

Table 12 : Evaluation of onion lines under AICVIP during *rabi* 2001-02

Date of Planting: 1.1.2002 Date of harvesting:7.5.2002 Entries: 9
Replications: 3 Plot size: 3x2m Check: 1

Entries	Total Yld.	Mkt. Yld.	%A Gr	%B Gr.	%C Gr.	% Dbls	% Blts	TSS (° Brix)	Bulb Colour
NHRDF282	43.44	21.44	19.95	19.82	9.59	48.59	0.00	11.67	DR
JNDWO85	33.19	22.80	10.33	26.36	34.48	7.87	25.86	11.73	W
A. Niketan	38.03	34.00	41.93	36.89	10.59	8.18	0.80	12.14	R
ALR	47.78	35.58	40.41	28.49	5.58	22.91	0.06	12.61	LR
Pb.White	41.19	19.80	11.53	24.07	12.47	49.90	0.34	12.46	W
RO-1	43.78	21.80	15.04	16.62	18.15	48.60	0.00	10.73	Y
PRO-6	46.55	14.50	11.58	11.10	8.47	68.32	0.36	11.65	DR
A.Pitambar	45.94	36.83	34.58	36.09	9.49	18.50	0.42	12.19	Y
N-2-4-1	49.78	42.11	48.66	30.80	5.13	13.50	0.56	12.83	LR
B-780	43.16	38.78	51.48	32.43	5.92	5.41	0.64	10.73	R
CD (0.05)	0.09	6.54					4.57		
Range	33.19	14.50	11.53	11.10	5.13	5.14	0.00	10.73	
	49.78	42.11	51.48	36.89	18.15	68.32	0.80	12.83	

Marketable yield was highest in N-2-4-1 (42.11 t/ha) which was at par with B-780 (43.16 t/ha) and it was followed by A.Pitambar, ALR and A.Niketan. Percentage of doubles were less than 10% only in A.Niketan and B-780. More than 80% marketable yields were recorded in A.Niketan, A.Pitambar, N-2-4-1 and B-780. Total yields were at par in all the entries except JNDWO85, A.Niketan and Punjab White as compared to check N-2-4-1 and ALR. TSS ranged between 10.73 to 12.83° brix.

Evaluation of promising garlic accessions

A total of 35 elite lines , based on their field stand and foliage growth, were evaluated in *rabi*, 2001-02 along with check varieties G-41, GG-1 and GG-2. The experiment was laid out in randomized block design in a plot of 3m x 2m along with two replications. Amongst the different elite lines screened, Acc. No. 74 and 200 were superior over check G-41 with regards to marketable yield. 35 lines were at par with GG-3; 27 with GG-2 and 3 lines (Acc. No. 74, 200 and 221) with G-41 (Table 13). In terms of total yield, Acc. No. 221, 74 and 200 were superior over GG-3. 36 lines were at par with GG-3; 31 with GG-2 and 3 lines (*viz.*, 221, 74 and 200) with G-41.

Table 13 : Promising accessions from elite garlic collection

Date of sowing : 24.10.2001 Date of harvesting : 24.10.2001

Plot size : 3 x 2 m Replications : 2

Acc.No.	P (cm)	E (cm)	N (cm)	Mkt. Yld (t/ha)	Total Yld (t/ha)	Avg. wt. Of 5 bulbs (gm)	Avg. wt. Of 50 clvs (gm)	Colour
74	3.0	3.8	0.5	16.6	17.0	95	50	W
200	2.9	3.7	0.5	16.6	17.0	95	58	W
221	3.2	3.7	0.5	15.9	17.2	110	60	W
229	2.9	3.6	0.5	15.2	15.4	90	45	W
201	3.1	4.0	0.5	14.8	15.6	51	53	W
G-41	2.8	3.5	0.5	15.5	15.8	78	45	W
GG-2	2.4	3.1	0.3	6.8	6.9	75	45	W
GG-3	2.5	3.2	0.4	5.2	5.6	70	50	W
CD (0.05)				0.91	0.49			

* Marketable Yield includes only A and B grade bulbs whereas total yield includes C grade bulbs also. Yield was taken of whole plant along with foliage also.

In garlic germplasm evaluation, Acc. No. 336 was statistically superior to G-41 and acc. No. 336, 345, 360, 355, 341, 358, 344, 362, 343, 356, 43, 279, 220, 351 and 144 were found to be significantly superior than GG-2 and GG-3 in terms of marketable yield. 15 lines were found to be at par with G-41 in terms of marketable yield. Whereas 11 lines were found to be at par with G-41 in terms of total yield. In terms of total yield acc. no. 44, 80, 144, 177, 184, 220, 279, 329, 336, 337, 339, 341, 343, 344, 345, 347, 351, 354, 355, 356, 357, 358, 360 and 362 were found to be significantly superior over GG2 and in addition to these lines acc. no. 194, 237, 260, 318, 320, 331 and 353 were found to be significantly superior than GG-3 (Table 14)

Table 14 : Evaluation of garlic germplasm during *rabi* 2001-2002

Date of sowing : 25.10.01 Date of harvesting : 29.03.2002

Plot size : 2 x 1 m Replications : 2

Acc.No.	P (cm)	E (cm)	N (cm)	Mkt. Yld (t/ha)	Total Yld (t/ha)	Avg. wt. of 5 bulbs (gm)	Avg. wt. of 50 clvs (gm)	Colour
336	2.5	3.0	0.4	16.0	16.0	58	28	P
345	2.6	3.3	0.4	13.6	13.7	58	23	P
360	2.4	3.1	0.4	13.0	13.0	70	35	P
355	2.6	3.1	0.5	13.0	13.7	73	43	W
G-41	3.2	3.7	0.6	12.9	13.5	105	63	W
GG-2	2.1	2.6	0.4	6.9	6.9	50	28	W
GG-3	2.4	2.7	0.4	6.6	6.6	60	25	W
CD (0.05)				3.09	2.53			

W-white P - purple

Bulb to Row Selection

A total of 294 bulb to row progenies from 40 germplasm lines , based on their weight and appearance, were planted for obtaining progenies superior to the existing germplasm lines. Based on the results obtained, some lines have been selected and will be further used for clonal selection to obtain material of superior quality (Table 15).

Table 15 :Bulb to row progeny selection in garlic

Acc No.	Bulb wt. (gm) 2001	Bulb wt. (gm) 2002	Increase in wt. (gm)	NoClv. 2001	NoClv. 2002	2002 No. of bulbs	Survival per cent
221-5	15	26.25	11.25	18	25.60	8	44.44
61-10	10	20.00	10.00	8	24.67	8	100.00
260-3	10	18.00	8.00	13	28.00	10	76.92
38-4	10	17.22	7.22	16	12.80	9	56.25
310-5	15	21.67	6.67	18	18.43	12	66.67
279-14	10	16.25	6.25	13	15.50	8	61.54
104-4	20	26.00	6.00	14	25.67	10	71.43
316-14	20	25.56	5.56	17	23.67	9	52.94
148-1	15	20.00	5.00	10	18.60	7	70.00
148-6	10	15.00	5.00	19	16.25	6	31.58

In *rabi* 2001, one bulb each, selected on the basis of weight and general appearance, from different accessions was planted. After harvest, data was recorded on the number of bulbs obtained, average bulb weight and average number of cloves. Survival percentage was calculated on the basis of number of cloves in the bulb in *rabi* 2001 and the number of bulbs obtained in *rabi* 2002. On the basis of data obtained, the best ten lines obtained having average bulb weight more than the parent one are summarized.

CREATION OF VARIABILITY IN GARLIC THROUGH MUTATION

Variability in garlic germplasm with reference to yield, disease and insect resistance is being exhausted. There is need to create variability, which is possible through mutation. Hence the project on mutation studies in garlic is in progress since 2001-2002. Different concentrations of chemical mutagens viz., sodium azide, EMS and colchicine and physical mutagen (gamma radiation) at different doses has been used with the following objectives.

1. To create variability in the garlic for more yield and resistance to diseases and insect pests.
2. To study the effect of different chemical and physical mutagens.

VARIETAL EVALUATION TRIAL ON GARLIC UNDER AICVIP DURING RABI

Ten entries were evaluated under All India Co-ordinated Vegetable Improvement Project along with check G-41 (Table 16). Field experimental details are as follows:

Table 16 : Evaluation of garlic lines under AICVIP during *rabi* 2001-02

Date of planting : 31.10.2001 Date of Harvesting : 22.3.2002 Replications: 4
Net Plot Size: 2x 0.9m Entries: 10 Check: 1

Entries	Total Yld (t/ha)	Mkt. Yld (t/ha)	%A Gr	%B Gr	%C Gr	P (cm)	E (cm)	N (cm)	NoClv.	Pl. ht. (cm)	NOL
KGS-1	0.31	0.00	0.0	0.0	0.0	1.56	1.37	0.34	0.0	30.5	7.4
DG-1	12.90	12.71	38.8	42.0	17.8	2.34	3.03	0.48	32.6	51.0	10.7
G-282	6.01	3.84	31.6	23.7	8.6	2.24	2.77	0.31	12.4	26.4	6.7
G-50	18.13	18.11	44.0	51.3	4.5	2.43	2.95	0.43	14.4	54.5	11.6
A.Parvati	4.26	0.00	0.0	0.0	0.0	2.37	1.88	0.51	0.0	62.7	9.4
G-323	18.33	18.33	46.2	47.0	6.8	2.38	2.94	0.44	14.0	55.0	12.3
GG-2	6.50	6.26	22.2	61.5	12.6	2.11	2.75	0.39	20.5	45.7	8.7
S.LOCAL	9.24	8.68	19.5	65.4	9.0	2.26	2.84	0.42	19.7	46.3	8.6
G-1	11.44	11.04	40.7	40.0	15.8	2.49	2.97	0.44	10.8	53.2	11.8
GG-3	8.10	7.81	29.8	52.5	14.1	2.01	2.57	0.34	19.7	46.7	8.4
G-41	15.61	14.94	47.6	41.8	6.3	2.53	2.85	0.35	16.1	49.8	10.0
CD (0.05)	2.72	2.67									

Only two entries viz. G-50 and G-323, gave significantly higher marketable yields of 18.11 and 18.33 t/ha, respectively over check variety G-41 (14.94 t/ha) with 14.4 and 14.05 number of cloves/bulb. Total yield was only higher in G-323 (18.33 t/ha). No marketable bulbs were formed in Agrifound Parvati and KGS-1. Average number of cloves were less in G-1 (10.8/bulb).

ONION HYBRIDS - HETEROSIS BREEDING PROGRAMME IN SHORT DAY TROPICAL ONION (ALLIUM CEPA L.)

(a) Evaluation of F1 Hybrids during *rabi* 2001-2002

Seeds obtained from the crosses made between 34 inbred lines with male sterile line MS65A and 32 inbred lines with with MS48A were planted in RBD along with all the parents during *rabi* with three checks (Table 17). The crop was transplanted on 18th Dec. 2001 and harvested on 15th April 2002. Among the check, ALR gave highest yield of 54 t/ha which was followed by B-780. Five F1 hybrids made with MS65A male sterile line and inbred lines viz. 444, 14-2-W, 153, 450 and 208 gave significantly highest yield (ranged between 73.3 to 95.7 t/ha) over the best check ALR (54.0 t/ha).

Table 17 : Evaluation of F1 Hybrids during *rabi* 2001-2002

Date of planting : 18.12.2001 Date of harvesting : 15.04.2002

Plot size : 1 x 1 m. Design : RBD Rep. : 2

F1 hybrids	Total yld. (t/ha)	Mkt. Yld. (t/ha)	P (cm)	E (cm)	N (cm)	Pl. ht. (cm)	NOL	TSS (^{0} Brix)
65x153	84.7	81.3	4.15	5.35	0.85	44.40	9.4	12.05
65x14-2-W	95.8	78.3	4.40	6.00	0.55	43.20	9.5	11.80
65x444	73.3	73.3	4.45	5.90	0.50	35.70	9.8	13.45
65x450	105.7	95.7	4.75	6.70	0.45	48.80	9.9	12.35
65x208	97.5	79.2	4.35	6.55	0.40	48.30	9.8	13.50
N-2-4-1 (Ck)	57.7	51.0	5.20	5.40	0.80	49.70	10.4	11.80
B-780 (Ck)	56.0	51.7	5.00	5.80	0.80	38.90	9.5	10.90
A.Niketan (Ck)	59.7	48.3	5.00	5.40	0.70	54.30	10.7	12.70
A.L.R. (Ck)	59.3	54.0	5.40	5.80	0.90	48.70	8.8	11.40
CD (0.05)	19.2	1.51						

b) Heterosis and per cent superiority studies in the F1 hybrids of onion

Heterosis over the best parent and percentage superiority over the check varieties were studied among the crosses made using two male sterile lines (MS48A and MS65A) and the inbred lines. Heterosis was significantly higher in thirteen F1 hybrids over their respective better parent, which ranged between 39.63 to 108.10 per cent. Only one F1 hybrid between MS48A x 202 (68.28 t/ha) was significantly superior with 92.32% heterosis over the better parent 202 (35.5 t/ha) (Table 18). But, 12 F1 hybrids made between male sterile line MS65A and inbred lines (444, 14-2-W, 465, 153, 450, 133, 169-2, 131, 208, Arka Niketan and 179) gave significantly superior heterosis over their respective better parent, which ranged between 39.63 to 108.10%.

Percentage superiority over the check varieties was also calculated. It was found that the percentage superiority in five F1 hybrids made between male sterile line MS65A and the inbred lines viz. 444, 14-2-W, W-153, 450 and 208 was significantly higher than the best check ALR (54.0 t/ha), which ranged between 35.81 to 77.27% with the yield ranging between 73.34 to 95.7 t/ha. But, none of the F1 hybrids made between male sterile line MS48A and the inbred lines were significantly superior than the best check ALR (Table 19).

Table 18: Heterosis and per cent superiority over better parent and check varieties of the F1 hybrids with MS48A

Sr. No.	Entries	Mkt. Yld of parents (t/ha)	Mkt. Yld of F1 hybrids with MS48A (t/ha)	% Heterosis over BP	% Superiority of the F1's over		
					N-2-4-1	B-780	ALR
1	MS48A	32.00	--	--	--	--	--
2	202	35.50	68.28	92.32	33.87	32.13	26.44

Table 19 : Heterosis and per cent superiority over better parent and check varieties of the F1 hybrids with MS65A

Sr. No.	Entries	Mkt. Yld of Parents (t/ha)	Mkt. Yld of F1 Hybrids With MS65A (t/ha)	% Heterosis over BP	% Superiority of the F1 hybrids over		
					N-2-4-1	B-780	ALR
1	MS65A	33.5	—	—	—	—	—
2	444	40.00	73.34	83.35	43.80	41.93	35.81
3	14-2-W	54.33	78.28	44.07	53.48	51.48	44.95
4	465	38.00	71.65	88.54	40.49	38.66	32.69
5	153	55.66	81.30	46.04	59.41	57.34	50.56
6	450	46.00	95.73	108.10	87.70	85.26	77.27
7	133	48.66	67.95	39.63	33.24	31.50	25.83
8	169-2	41.33	71.35	72.63	39.90	38.08	32.13
9	131	35.00	63.35	80.99	24.22	22.60	17.31
10	208	45.00	79.15	75.89	55.20	53.18	46.57
11	A.Niketan	48.33	70.25	45.35	37.75	35.95	30.09
12	179	39.67	69.90	76.22	37.06	35.28	29.44
13	147	11.67	59.95	78.96	17.55	16.02	11.02

ALLIUM INBREDS: IN VITRO HAPLOID PRODUCTION IN ONION (ALLIUM CEPA L.)

Standardisation of bud size : Buds of var. N-2-4-1 of different sizes were collected and 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 inocluation.

Media : MS media was used for tissue culture.

Hormones : Different concentrations of the following plant growth regulators viz., BA (0.5 - 5.0 mg/l), Kinetin (0.5 - 5.0 mg/l), TDZ (0.01 - 2 mg/l) and 2iP (0.01 - 2 mg/l) and also auxins viz., 2,4 - D (0.1 - 0.5 mg/l) and Picloram (0.01 - 5.0 mg/l) were tried alone or in different combinations for induction of androgenic and gynogenic response.

Explants : Anthers, ovary, immature and unopened flower buds, one or two days before anthesis, were tried to induce androgenic and gynogenic response.

Genotypes : Variety N-2-4-1 and B-780 was used as per availability.

Results : Most of the combinations using BA, Kin and 2iP alone or in different concentrations gave no significant results except Kin 5mg/l, where callus formation in immature flower buds was observed whereas, in the case of TDZ, 0.05 and 2 mg/l resulted in profuse callusing from flower bud explants which after twenty to thirty days started producing small green protuberances in plenty. With regard to 2, 4-D, there was no response in any of the explants tried. In case of picloram, callus initiation was observed from flower bud explant at concentration of 5 mg/l. With respect to the effect of different explants towards androgenic and gynogenic response, it was noted that flower bud and ovary only responded, whereas, anthers didn't at all respond to any of the treatments tried.

Micropropagation in Onion and Garlic

MS media along with different concentrations of cytokinins viz., BA (0.5 - 5.0 mg/l), Kinetin (0.5 - 5.0 mg/l), TDZ (0.01 - 2 mg/l) and 2iP (0.01 - 2 mg/l) and auxins viz., 2,4 -D (0.1 - 5.0 mg/l) and Picloram (0.01 - 5.0 mg/l) were tried alone or in different combinations for induction of multiple shoots. Also effect of two cytokinins was analysed using Kin. and BA in different concentrations and combinations. Young etiolated leaves, shoot tip, basal portion with meristem, root and root tip of genotypes N-2-4-1 and B-780 were used as per availability.

It was seen that when two cytokinins were used in combination, the result was detrimental . Most of the explants showed toxic effect within 30 days of culture. Amongst all the PGR's tried, picloram (0.05 & 0.1 mg/l) gave good callus from shoot tip explant followed by root explant. The callus produced many light green protuberances after transfer into media containing 0.05 mg/l TDZ. Similarly, TDZ 0.05 & 2.0 mg/l gave callus with dark green protuberances within 20-25 days of culture. But no further regeneration was observed and hence were transferred to basal media without any hormones to try for obtaining plantlets. No multiple shoots could be obtained either in onion or in garlic from any of the combination tried but efforts are on.

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 and 0.1 % bavistin for 15 min. and washed under running water for one hour. Surface sterilization was done using 70% alcohol for 1 minute followed by 0.1 % $HgCl_2$ for 10 min. The sterilized explants were washed 4 to 5 times with sterile distilled water and then inoculated in MS media. *In vitro* grown roots, root tip, young etiolated leaves and basal portion with meristem were used as explants for initiating callus.

Different concentrations of plant growth regulators viz., BA (0.5-5.0 mg/l), Kinetin (0.5 - 5.0 mg/l), TDZ (0.01 - 2 mg/l) and 2iP (0.01 - 2 mg/l) and auxins viz., 2,4 - D (0.1 - 5.0 mg/l) and Picloram (0.01 - 5.0 mg/l) were tried for callus induction.For induction of callus, picloram (0.5 - 5.0 mg/l) was found effective for callus induction from root tip and root explant. Also combinations of picloram 1 mg/l alongwith Kinetin 0.1 - 0.2 mg/l gave good callus.

CROP PRODUCTION

Studies on biofertilizers and nitrogen levels

To know the relative performance of *Azotobacter* and *Azospirillum* bacteria under different nitrogen levels on the yield and quality of onion and garlic, a field study was carried out during *rabi* 2001-02. The results of the above investigation are discussed below:

Table 20 : Effect of bio-fertilizers and nitrogen levels on the total yield, TSS and storability of onion and garlic bulbs in *rabi* 2001-02.

Treatment	Onion			Garlic	
	Total Yield (t/ha)	% Storage Loss after 6 months	TSS (°Brix)	Total Yield (t/ha)	% Storage Loss after 6 months
N_0	22.21	27.0 (31.3)	11.5	6.30	34.3 (35.8)
N_{50}	30.25	32.5 (34.8)	12.7	8.42	35.1 (36.8)
N_{75}	33.25	45.5 (42.4)	13.1	9.19	37.0 (37.5)
N_{100}	39.42	57.5 (49.3)	13.5	12.19	38.8 (38.5)
N_{50}+*Azotobacter*(Az)	53.92	35.0 (36.3)	13.3	9.34	32.6 (34.8)
N_{75}+ (Az)	48.92	41.0 (39.8)	12.9	9.94	32.9 (35.0)
N_{50}+*Azospirillum*(As)	56.33	28.0 (31.9)	13.9	10.46	30.5 (33.5)
N_{75}+(As)	54.25	35.0 (36.3)	13.3	11.27	31.7 (34.3)
N_{50}+(Az+As)	51.42	37.0 (37.5)	12.4	10.49	35.2 (36.4)
N_{75}+(Az+As)	49.75	43.0 (41.0)	12.5	10.31	34.7 (36.1)
CD (0.05)	8.55	0.9	NS	1.11	0.8

Note: N_0: No nitrogen application, N_{50}: Application 50 % nitrogen, N_{75}: 75 %nitrogen application, N_{100}: Application of 100% nitrogen of RDF. P & K was applied uniformly to all the treatments as per recommendation. The data in parentheses indicate arcsin tranformed value

Azotobacter spp. and *Azospirillum* spp. were soil inoculated @ 4 kg/ha, after thoroughly mixing with the vermicompost. The bio-fertilizers was applied to soil as single or both along with two levels of nitrogen. The effect of bio-fertilizers with nitrogen levels were compared with only nitrogen applied treatments on the bulb yield of onion and garlic (Table 20).

In onion, application of *Azospirillum* with 50% of nitrogen of RDF gave at par yield to the treatment receiving 100% nitrogen fertilizer alone. The total soluble concentration of the onion bulbs was not influenced by the bio-fertilizers as the results were found to be non significant. However, storability of the bulbs after 6 months in aerated plastic crates in ambient conditions improved significantly due to bio-fertilizers. Lowest storage losses (27.0%) were recorded due to no nitrogen application and highest losses due to full dose of nitrogen (57.5%) were recorded. Significant reduction and minimum storage losses due to application of 50% N + *Azospirillum* was recorded.

In case of garlic, the highest yield of 12.19 t/ha was noticed due to 100% nitrogen application. Application of *Azospirillum* along with 75% nitrogen gave at par yield of 11.27 t/ha when compared to 100% nitrogen treatment. The minimum storage losses in garlic was recorded due to the treatment receiving 50% N + *Azospirillum* (30.5%), followed by 75% N+ *Azospirillum*.

Effect of potassium sources and levels on the yield and qualtiy of onion and garlic bulbs

Potassium and sulphur play important role in improving the quality apart from improving the yield of bulb crops. Two sources of potassium, KCl and K_2SO_4 were tried at different levels and applied as basal and in split in the present study (Table 21).

Table 21 : Effect of potassium sources and levels on the yield, TSS and storability of onion and garlic bulbs during *rabi* 2001-02

Treatment	Onion		Garlic		
	Total Yield (t/ha)	% Storage Loss after 6 months	TSS (°Brix)	Total Yield (t/ha)	% Storage Loss after 6 months
T1: K_0 (Control)	35.91	65.0 (53.7)	12.4	6.98	38.5 (37.2)
T2: KCl-50 (b)	46.13	41.0 (39.8)	12.6	9.23	29.3 (32.8)
T3: KCl-50 (b+1s)	46.93	32.5 (34.7)	13.0	9.45	27.8 (31.8)
T4: KCl-75 (b)	50.13	31.5 (34.1)	13.3	9.64	28.7 (32.4)
T5: KCl-75 (b+1s)	48.48	30.5 (33.2)	13.9	9.74	27.2 (31.4)
T6: KCl-100 (b)	50.83	34.0 (35.7)	13.9	9.88	28.6 (32.3)
T7: KCl-100 (b+1s)	48.32	33.0 (35.1)	13.6	8.70	26.2 (30.8)
T8: K_2SO_4-50 (b)	46.67	35.0 (36.3)	13.3	9.61	27.7 (31.7)
T9: K_2SO_4-50 (b+1s)	46.40	32.0 (34.4)	13.1	9.78	27.8 (31.8)
T10: K_2SO_4-75 (b)	52.91	31.0 (33.8)	13.5	9.82	27.0 (31.3)
T11: K_2SO_4-75 (b+1s)	53.14	25.0 (30.0)	12.8	9.83	26.9 (31.2)
T12: K_2SO_4-100 (b)	53.45	28.5 (32.3)	13.3	10.77	26.6 (31.1)
T13: K_2SO_4-100(b+1s)	55.91	25.0 (30.0)	13.7	11.29	26.1 (30.7)
CD (0.05)	7.35	3.0	NS	1.22	1.4

Note:- K_0: No potassium; 50, 75 & 100: kg of potassium applied as KCl (MoP) or K_2SO_4(SoP) , b: basal application; b+1s: basal and one split at 30 DAT in equal quantity. For storage, 10 kg bulbs of onion and garlic were stored in perforated plastic crates in ambient conditions for a period of 6 months, periodical sorting was done.

(The data in parentheses indicate arcsin tranformed value)

Generally, the rate of potassium applied to onion and garlic crops is 50 kg/ha (KCl) as basal. In the above studies application of K_2SO_4 @ 100 kg/ha as basal and one split gave significant total yield of onion bulbs (55.91 t/ha) over normal practice of applying 50 kg K/ha (KCl as MoP) yielding 46.13 t/ha. The influence of potassium sources and its levels was non significant on the TSS values of onion bulbs. Maximum storage losses of 65.0% for onion bulbs was recorded when no potassium (K_0 treatment) was applied. All the potassium treatments either KCl (MoP) or K_2SO_4 (SoP) showed significant difference over K_0. Significant minimum storage losses of 25% was recorded due to treatments receiving 75 and 100 kg K, respectively, as K_2SO_4, when applied as a basal dose and in one split in equal quantities.

In garlic, the minimum total yield of 6.98 t/ha was recorded due to no potash application. Significant higher yields of 9.23 t/ha and 9.61 t/ha were recorded due to 50 kg K as basal application of KCl and K_2SO_4 respectively, over Ko treatment. The highest garlic bulb yield of 11.29 t/ha was noticed due to 100 kg K/ha as K_2SO_4 was applied in equal amounts as basal and one split. The highest storage losses in garlic was found due to No K application (38.5%). Here also, rest of the potash treatments were significant over control (No potash treatment). But among the K sources, K_2SO_4 recorded minimum losses over KCl as K source. The minimum storage losses due to potash application at higher doses was seen in both the sources of K at 100 kg K/ha.

In general, it was noticed that split application of K_2SO_4 had better effect than KCl on yield of onion and garlic bulbs and this could be to the additive effect of sulphur present in K_2SO_4.

Effect of Zinc treatments on yield, TSS and storability of onion and garlic bulbs

In the initial studies at this centre, foliar application of micronutrients did not show any significant effect on the yield or quality of onion and garlic bulbs (except zinc the response was mild on shelf life of bulbs). The value for DTPA extractable Fe, Mn and Cu in different soil block of the research station were in sufficient range. However, the available Zn was just near the sufficient range (>0.5ppm). An elaborate study, to know the effect of different zinc treatments was carried during *rabi* 2001-02. The results obtained are presented below (Table 22).

Table 22 : Effect of different zinc treatments on the yield, TSS and storability of onion and garlic bulbs in *rabi* 2001-02

Treatment	Onion			Garlic	
	Yield (t/ha)	% Storage Loss after 6 Months	TSS (°Brix)	Yield (t/ha)	% Storage Loss after 6 Months
T_1	40.18	58.3 (49.9)	12.8	10.28	37.3 (37.6)
T_2	35.25	55.0 (47.9)	13.2	9.55	31.3 (32.6)
T_3	39.41	56.0 (48.4)	12.2	9.92	31.7 (33.0)
T_4	38.13	55.0 (47.9)	13.1	9.45	31.0 (33.0)
T_5	37.44	53.0 (46.7)	13.4	9.64	31.0 (33.0)
T_6	39.20	56.0 (46.7)	13.0	9.66	29.4 (32.8)
T_7	35.47	54.5 (47.6	13.3	10.44	27.9 (31.9
T_8	35.25	57.0 (49.1)	13.5	9.68	27.6 (33.1)
T_9	38.24	53.5 (47.0)	13.3	9.26	26.6 (29.1)
CD (0.05)	NS	1.7	NS	NS	3.2

Note:- T_1 only NPK, T_2 T_{1+} $ZnSO_4$ @ 20 kg/ha, T3: T1+$ZnSO_4$ @ 40kg/ha, T4: T2+soaking garlic cloves for ½ hr in 0.05% $ZnSO_4$ or seedling root dip in onion, T5: T3+ soaking garlic cloves for ½ hour, or seedling root dip in onion, T6: T2+ vermicompost @ 1t/ha, T7: T3+seedling root dip in onion, T8: spray 100 ppm $ZnSO_4$ at 30, 45 and 60 DAT, T9: spray of 500ppm $ZnSO_4$ at 30, 45 and 60 DAT.
The data in parentheses indicate arcsin tranformed value

The experiment was conducted to study the effect of different zinc treatments on the yield of onion and garlic bulbs. It was found that zinc application either to soil, soaking or root dip and foliar application did not proved significant over control (only NPK treatment). This could be due to reason that the soils were not really deficient for zinc.

There was no significant difference between the zinc treatments over control on the quality parameter, 'TSS in onion bulbs. However, significant difference in bulbs was noticed over control. In case of onion, minimum storage losses of 53.0% was noticed due to application of NPK +40 kg $ZnSO_4$ + seedling root dip in 0.05% solution of $ZnSO_4$ for half an hour, followed by foliar application of 100 ppm zinc sulphate at 30, 45 and 60 days after transplanting (DAT).

The response to zinc treatments on garlic storage was quite better than onion. Treatment effects due to T7, T8 and T9 were significant over direct soil of zinc (T2 and T3). Minimum storage losses in garlic was recorded due to foliar application of 500 ppm of zinc sulphate at 30, 45 and 60 DAT.

Studies on Organic manures and Chemical fertilizers

Combined application of organic manures and fertilizers helps in improving the yield, saving of chemical fertilizers. A Study was conducted to know the effect of three organic manures namely: farm yard manure, vermicompost and poultry manure and different levels of fertilizer doses. The results of onion and garlic yield, TSS and shelf life of bulbs due to combined application of organic manures and fertilizer is presented below (Table 23).

Table 23 : Effect of organic manures and fertilizers on the total yield, TSS and storability of onion and garlic during *rabi* 2001-02

Treatment	Onion		Garlic		
	Total Yield (t/ha)	% Storage Loss after 6 months	TSS (°Brix)	Total Yield (t/ha)	% Storage Loss after 6 months
F_0	29.05	44.5 (41.8)	12.0	5.01	29.4 (32.8)
F_{100}	45.76	58.5 (49.9)	13.6	10.15	38.9 (38.6)
$F_{50}+FYM_5$	36.35	41.2 (39.8)	12.9	9.04	31.6 (34.2)
$F_{75}+FYM_5$	42.39	47.5 (43.6)	13.2	9.59	34.2 (35.8)
$F_{50}+FYM_{10}$	40.50	37.0 (37.5)	13.1	10.28	26.0 (30.7)
$F_{75}+FYM_{10}$	46.09	39.5 (38.9)	12.8	10.32	35.9 (36.8)
$F_{50}+VC_5$	37.74	47.0 (43.3)	12.8	9.63	34.7 (36.1)
$F_{75}+VC_5$	39.00	49.0 (44.4)	13.6	9.70	35.9 (36.8)
$F_{50}+VC_{10}$	40.84	51.5 (45.9)	13.8	10.17	31.9 (34.4)
$F_{75}+VC_{10}$	41.56	54.0 (47.3)	13.5	10.48	36.0 (36.9)
$F_{50}+PM_5$	41.44	28.0 (31.9)	13.7	9.47	26.8 (31.2)
$F_{75}+PM_5$	43.71	35.0 (36.2)	14.0	9.45	30.7 (36.9)
$F_{50}+PM_{10}$	42.83	35.0 (36.2)	14.3	11.91	27.9 (31.8)
$F_{75}+PM_{10}$	49.36	39.5 (37.9)	14.4	12.14	32.3 (34.6)

Note:- F0, F50, F75 & F100: Fertilizer application at 0, 50 75 & 100 per cent pf RDF.
FYM: Farm yard manure applied @ 5 and 10 t/ha, VC: Vermicompost applied at 5 and 10 t/ha, PM: Poultry manure applied at 5 and 10 t/ha. (The data in parentheses indicate arcsin tranformed value)

Application of two levels of fertilizers, 50 and 75 percentage of RDF, respectively along with two rates (5 and 10 t/ha) of organic manures namely, FYM, vermicompost and poultry manure were studied to know the effect on above parameters of onion and garlic bulbs. The organic manure treatments were compared with the ones receiving no fertilizer and 100 % fertilizer (Table 4). In onion crop, application of FYM and poultry manure at lower rate (5t/ha) and with 75 % RDF gave on par yield results when compared to only 100% RDF treatment. Poultry manure applied at 10 t/ha along with 75% RDF produced significant yield (49.36 t/ha) of onion bulbs over 100% RDF application. Though there was an increase in the values of TSS in onion bulbs due to combined application of organic manures and fertilizers, the treatment effects were non significant in improving the TSS.

The shelf life of both onion and garlic was significantly improved due to organic manures + reduced doses of fertilizer application. In onion, maximum storage losses of bulbs during 6 months period was noticed in treatment receiving 100% recommended dose of fertilizer (RDF) without organic

manures. Significant minimum storage losses of 28.0% was recorded due treatment receiving 50% RDF + 5 t/ha poultry manure. In garlic, the bulb yield due to poultry manure @ 10 t/ha + 75% RDF showed significant over only 100% RDF treatment. The minimum storage losses in garlic was recorded due to treatment 50% RDF + FYM @ 10 t/ha (26.0%) followed by 50% RDF + poultry manure @ 5 t/ha (26.8%) and 50% RDF + poultry manure @ 10 t/ha (27.9%).

ONION BASED CROPPING SYSTEM

In recent years soil fertility - fertilizer use research is focused on cropping sequences. Fertilizer recommendations are made for cropping sequence as a whole taking into account the yield of preceding crop and their residual effect.

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, rabi* and summer season with different onion based cropping sequence (Table 24). Among the various cropping sequences calculated, aster in *kharif* season followed by onion in *rabi* season recorded the highest C:B ratio of 1:2.11) and potato-wheat sequence (1:2.10). But legume based cropping patterns like, preceding crop of soybean followed by onion and groundnut followed onion sequences noticed the highest onion yield of 37.5 and 32.5 t/ha, respectively during *rabi* season. The increased yield could be attributed to preceding crop of soybean and groundnut and their residual effect was beneficial for succeeding crop of onion (Table 25). Further studies on the uptake of plant and soil nutrients and its correlation with yield and yield characters are to be evaluated consecutively for three or more years to study the effect of different sequence on soil fertility status and other properties also.

Table 24 : Treatment Details

Cropping sequence	Summer (Feb - May)	*Kharif* (June - Sept)	*Rangda* (Sept - Feb)	*Rabi* (Nov- April)
S1	-	Aster	-	Onion (N-2-4-1)
S2	-	Marigold	-	Onion (N-2-4-1)
S3	-	Potato	-	Wheat
S4	-	Potato	-	Onion (N-2-4-1)
S5	-	Grountnut	-	Onion (N-2-4-1)
S6	-	Soybean	-	Onion (N-2-4-1)
S7	-	Bajra	-	Onion (N-2-4-1)
S8	-	Bajra	-	Wheat
S9	-	Onion (B-780)	-	Onion (N-2-4-1)
S10	Groundnut	-	Onion(B-780)	-
S11	Cucumber	-	Onion(B-780)	-
S12	-	Onion(B-780)	-	Potato

Table 25 : Comparative Yield Performance (t/ha), Total returns and Cost - Benefit ratio to Onion based Cropping System

Sequence	Yield (t/ha)				Cost of production (Rs/ha)	Gross Income (Rs/ha.)	Total Returns (Rs/ha.)	C:B Ratio
	Summer	*Kharif*	Late *Kharif*	*Rabi*				
S1	- Aster -243000 bundles -			Onion (33.5)	72050	152650	80600	1:2.12
S2	-	Marigold(10.8)	-	Onion(31.4)	56950	116800	59850	1:2.05
S3	-	Potato(24.5)	-	Wheat(3.61)	57200	120140	62940	1:2.10
S4	-	Potato(25.1)	-	Onion(31.9)	73700	149650	75950	1:2.03
S5	-	Groundnut (2.71)	-	Onion(32.5)	52500	102940	50440	1:1.96
S6	-	Soyabean(2.25)	-	Onion (37.5)	51500	100875	40625	1:2.11
S7	-	Bajra(2.67)	-	Wheat(3.92)	33050	57265	24215	1:1.73
S8	-	Bajra(2.35)	-	Onion(32.5)	48500	82625	34125	1:1.70
S9	-	Onion(25.6)	-	Wheat(4.00)	43070	85200	42130	1:1.97
S10	Groundnut*(2.83)	--	Onion (37.2)	--	46415	86575	37160	1:1:87
S11	Cucumber(15.6)	-	Onion(37.2)		53750	105600	51850	1:1.96
S12		Onion (23.2)	-	Potato (19.5)	58725	118350	59625	1:2.01

* Summer Groundnut yield was low compared to 2000 summer, because of poor germination and also sclerotium rot incidence.

Transplanting versus direct seeding on yield and quality of Onion

Raising of onion nursery during *kharif* season is tough task especially during the month of May-June due to very high temperature and monsoon. More over it takes more time and higher inputs and also needs careful management. So to overcome such uncontrollable problem, there is a good scope of raising onion crop through direct seeding method.

The present investigation was carried out in onion var. N-2-4-1 with three methods of planting in *rabi* season. Significant difference was noticed among the different methods of planting. Among the treatments, transplanting method recorded the highest marketable bulb yield of 42.1 t/ha. followed by direct sowing by row sowing method (33.7 t/ha) (Table 26). The increased yield may be due to bigger bulbs and more precent of marketable bulb yield. The lowest yield (29.1 t/ha) was recorded in direct sowing by broad casting method. In direct seeding by broad casting method, plant to plant spacing was not maintained properly which led to development of more C grade bulbs.

Table 26 : Effect of transplanting versus direct seeding on yield and quality of onion

Date of planting : 26.12.2002 Date of harvesting : 3.05.2002

Treat-ments	Total Yld (t/ha)	Mkt. Yld (t/ha)	A Gr %	B Gr %	C Gr %	Pl. ht. (cm)	NOL	N (cm)	E (cm)	P (cm)	Avg.Wt. (g)	Pl. ht. (cm)	NOL
T1	47.5	42.1	42.1	29.8	16.6	62.5	9.3	0.85	6.10	5.3	63.2	62.5	9.3
T2	41.7	33.7	32.0	28.4	26.2	62.0	9.0	0.84	5.5	4.3	54.7	62.0	9.0
T3	38.4	29.1	26.3	20.9	35.8	61.3	8.8	0.87	5.0	4.1	49.3	61.3	8.8
CD (0.05)	3.19	1.74											

T1 - Wet Transplanting, T2 - Direct seeding by row sowing, T3 - Direct seeding by broad casting

EFFECT OF SEED PELLETING AND PLANTING METHODS ON YIELD IN ONION (AICVIP)

Seed pelleting offers scope for incorporating organic or chemical substances to the seed for improving germination, vigour and controlling micro environment in which seed germinates. Pelleting regulates the size of seeds for percision planting by man/machine and reduces the amount of seeds required to plant and cut the work for thinning the crop. Hence, a comprehensive trial was laid out under AICVIP during *kharif* and *rabi* seasons in flat and raised method of planting.

There was no clear cut difference noticed in between treatments. Among various treatments and methods of planting, during *kharif* season, the highest germination (93.5%) and marketable bulb yield (30.1t/ha) was obtained with T5 treatment (DAP 3g/kg of seed +Borax 0.1g/kg of seed + Bavistin 3/kg of seed) followed by T6 (DAP-3g/kg of seed + Borax 0.1 g/kg of seed + $Znso_4$ 0.3g/kg of seed) 91 percent and 29.5 t/ha respectively in raised bed system. In *rabi* season, again T5 treatment proved its superiority with respects to higher bulb yield (31.4t/ha) and seed germination (83.1%) (Table 27).

Table 27 : Effect of seed pelleting and planting methods on Onion production

Treat-ments	*Kharif* Season						*Rabi* Season					
	Flat Bed			Raised Bed			Flat Bed			Raised Bed		
	Seed Germi-nation (%)	Average Weight of bulb (g)	Mkt. Yield (t/ha)	Seed Germi-nation (%)	Average Weight of bulb (g)	Mkt. Yield (t/ha)	Seed Germi-nation (%)	Average Weight of bulb (g)	Mkt. Yield (t/ha)	Seed Germi-nation (%)	Average Weight of bulb (g)	Mkt. Yield (t/ha)
T1	85.4	41.5	24.4	88.7	47.3	27.0	83.0	52.3	30.5	85.2	50.2	28.9
T2	84.0	40.7	23.9	87.3	45.6	26.1	81.2	49.6	30.0	83.7	53.7	29.5
T3	81.2	38.5	23.7	84.1	45.1	25.9	80.6	50.5	30.6	86.5	45.5	28.4
T4	82.5	30.5	24.1	85.8	44.3	26.0	78.2	52.3	30.7	82.0	48.6	28.7
T5	86.7	48.5	25.8	93.5	52.3	30.1	83.1	59.9	31.4	88.0	55.9	29.8
T6	89.2	45.2	25.5	91.0	50.7	29.5	85.4	57.7	31.2	88.7	53.5	29.5
T7	80.9	46.0	25.7	82.9	54.1	28.1	80.1	56.2	31.0	83.6	53.6	29.6
T8	80.3	42.3	24.6	83.4	48.7	28.1	77.8	51.6	30.6	82.5	51.8	28.5
T9	86.1	39.5	23.0	92.2	45.5	26.8	85.7	48.7	30.5	87.3	47.5	28.3
T10	83.4	37.8	23.1	85.5	43.9	24.8	76.9	47.0	30.1	80.4	49.3	28.7
T11	79.1	33.8	22.7	82.7	42.5	24.5	75.4	47.5	29.8	77.3	45.6	28.5
T12	75.6	32.5	20.3	78.9	41.2	24.2	70.5	46.1	26.7	74.2	44.0	28.1
SEd	3.28	1.09	1.60	4.69	1.41	1.49	5.44	1.46	3.29	4.92	1.39	3.22
CD (0.05)	6.81	2.27	3.32	9.73	2.92	3.09	11.3	3.02	6.82	10.2	2.87	6.69

T1-DAP (3g/kg of seed), T2 -Borax (0.1g/kg) T3-$ZnSO_4$ (0.3g), T4-Bavistin (3g) T5-DAP + Borax + Bavistin, T6-DAP + Zn So4 + Bavistin T7 - *Azospirillum* (100g/kg of seeds) T8 - *Trichoderma viridae* (4g/kg of seeds) T9-Commercial micronutrient mixture (20g/kg of seeds) T10- Karanj Leaf Powder (500g/kg of seed), T11 - Karanj Seed Kernel Powder (500g/kg of seed), T 12 - Control

IRRIGATION STUDIES IN ONION AND GARLIC

Flood or surface irrigation method is widely practiced in India which results in inefficient use of irrigation water due to losses in evaporation, deep percolation and distribution, while water use efficiency of properly designed and well managed micro irrigation system is about 90 per cent. Hence more emphasis should be given to irrigation method to get the higher productivity and reduce the comsumption of water.

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 different methods and levels of irrigation, drip irrigation at 100% PE recorded the highest marketable bulb yield in both the crops (onion - 43.5 t/ha and garlic 14.5 t/ha). The yield increase over surface was 11.5% in onion and 1.58% in garlic. The percentage of A grade bulbs was higher in drip system than other irrigation systems in both the crops in best treatment (drip irrigation at 100%PE) (Table 28 & 30)

In best treatment (Drip at 100% PE), water saving was 41.7% in onion and 40.7% in garlic over surface irrigation. The highest water use efficiency was observed at 50% PE in both drip and sprinkler systems of irrigation but there was marked reduction in yield (Table 29 & 31).

Table 28 : Irrigation studies in onion

Date of planting : 03.12.2001 Date of harvesting : 24.04.2002

Treat ment	Total Yld. (t/ha)	Mkt. Yld. (t/ha)	%A Gr	%B Gr	%C Gr	Pl.ht (cm)	NOL	N (cm)	E (cm)	P (cm)	Avg. wt./ Bulb (g)	% Blts	%Dbls.	TSS (°brix)
Drip 50%PE	32.5	29.6	25.5	37.3	28.3	57.7	9.1	0.65	5.00	4.22	47.3	3.41	5.58	13.1
Drip 75%PE	44.1	36.1	40.2	27.4	14.3	64.5	10.7	0.71	5.85	5.27	56.2	3.70	9.40	12.6
Drip 100%PE	56.5	43.5	52.6	17.4	7.10	69.6	10.9	0.75	6.15	5.34	62.4	9.23	13.7	12.5
Sprinkler 50%PE	27.1	23.7	22.3	40.8	24.4	53.2	9.3	0.62	5.10	3.72	42.9	4.66	7.84	12.9
Sprinkler 75%PE	38.7	30.4	36.1	26.3	16.2	62.9	10.1	0.69	5.35	4.42	49.5	9.54	11.9	12.7
Sprinkler 100%PE	50.4	38.2	42.4	15.2	18.2	67.5	10.7	0.77	5.71	4.93	58.7	10.7	13.5	12.3
Surface Irrigation On 50mm CPE at 7 cm depeth	51.8	37.6	41.7	18.6		65.4	10.6	0.81	5.58	4.72	59.1	17.3	10.1	12.2
CD (0.05)	2.45	2.54												

Table 29 : 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)	20.4	30.6	40.8	23.7	35.4	47.3	70
Water saving (%)	70.9	56.3	41.7	67.0	49.4	32.4	-
Yield(t/ha)	29.6	36.1	43.5	23.7	30.4	38.2	37.6
Yield increase(%)	-21.3	-3.99	13.6	-36.9	-19.1	1.57	-
Water Use Efficiency (Kg/ha-cm)	1450.9	1179.7	1066.2	1000.0	858.8	807.6	537.1

Table 30 : Irrigation studies in garlic

Date of planting : 2.11.2002 Date of harvesting : 15.3.2002
Plot Size : 1.2 x 40 m Spacing : 15 x 10 cm

Treatments	Mkt. Yld (t/ha)	Pl. ht. (cm)	NOL	N (cm)	E (cm)	P (cm)	Avg.Wt of bulb (g)	A Gr (%)	B Gr (%)	C Gr (%)	No.of cloves /bulb
Drip-50%PE	8.63	53.1	9.5	0.65	3.44	2.91	23.4	43.6	39.6	16.8	18.0
Drip-75%PE	13.2	61.7	9.7	0.72	4.30	3.41	30.6	51.5	40.1	8.42	20.3
Drip-100%PE	14.5	63.4	10.1	0.74	4.40	3.72	33.7	57.2	35.3	7.70	23.1
Sprinkler 50%PE	7.30	51.0	9.4	0.61	3.22	2.75	21.2	38.6	32.1	29.3	13.2
Sprinkler 75%PE	10.7	56.8	10.3	0.75	3.77	3.10	27.4	40.9	37.5	21.6	17.8
Sprinkler 100% PE	12.8	60.5	10.0	0.73	4.25	3.54	31.9	50.6	34.7	14.7	19.4
Surface Irrigation On 50 mm CPE at 7 cm depth	13.0	61.3	9.9	0.76	4.30	3.65	31.5	52.7	30.4	16.9	21.5
CD (0.05)	1.42										

Table 31 : 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)	22.9	34.3	45.7	24.3	36.5	48.6	77.0
Water saving (%)	70.3	55.6	40.7	68.4	52.6	36.9	-
Yield (t/ha)	8.63	13.2	14.5	7.30	10.7	12.8	13.0
Yield increase (%)	-33.6	1.54	11.5	-43.8	-7.7	1.54	-
Water use effciency (kg/ha.cm)	376.9	384.8	317.3	300.4	293.2	263.4	168.8

PRODUCTION TECHNOLOGY FOR KHARIF ONION

Onion is mainly grown in *rabi* season, but it is also grown in substantial area in *kharif* season in peninsular India to fulfil the requirement during October to December. The productivity of kharif onion is lower as compared to *rabi* season. The season of this are non availability of package of practices, higher incidence of diseases, failure in attaining maturity etc. Since the area under *kharif* onion in increasing day by day it is necessary to develop a complete package of practices for *kharif* onion.

Effect of shading on nursery production in *kharif*

Different shading materials i.e. agro shade net 50%, agro shade net 75% and hessian cloth, were used for shading from top, western and southern sides in nursery sown in flat beds during summer season. The results showed that hessian cloth provided significantly better seedling than agro shade nets (Table 32).

Effect of date and method of planting on yield of *kharif* onion

Among the three dates of planting i.e. June 1 5, Julyl, and July I 5, the first two dates produced almost double yield than the third date of planting. Among the methods of planting, bbf with drip irrigation produced higher yield as compared to other methods of planting (Table 33 & 34).

Effect of Pre harvest treatment for forced maturity

Various chemicals i.e. herbicides, salts, fertilizers were tried in *kharif* season for the leaf desiccation, forced maturity and enhancing storability. But none of the chemical was found successful in leaf desiccation, forced maturity and enhancing storability (Table 35). The 2-4, D treatments induced stress elongation causing heavy damage to the crop. Many chemicals were also applied during late *kharif* season. These treatments increased rotting, sprouting and weight loss during storage (Table 35).

Effect of curing

Various treatments were tried for curing of *kharif* onion. The polyethylene tunnel was found to reduce the weight losses, but increased rotting.

ORGANIC CULTIVATION IN ONION

The organic cultivation of agricultural crop is increasing in view of the health hazards caused by use of various chemical fertilizers and pesticdes. Considering these points, an experiment on organic cultivation of onion cv. B-780 was conducted in *kharif*-2001 comprising of 9 treatments of various organic manures and their combinations with two irrigation systems i.e. drip and surface. The control plot was given recommended doses of fertilizers and pesticides. In organic manure treatments, three sprays of *Verticillium lecani* were given 30, 45 and 60 days after transplanting. The results revealed that the yield in all organic manure treatments was lower than absolute control (no fertilizer.). The plot treated with recommended dose gave the double yield as compared to other

treatments. As far as the irrigation systems are concerned, drip with BBF was found better than surface irrigation system (Table 36). Similar experiment was repeated on same plot in *Rabi*-2001 season with onion cv. N-2-4-I. The result show that the RDF showed higher yield than all the organic manure treatments except poultry manures treatment. The yield in drip irrigated bed was higer than flat beds in all the treatments (Table 37).

Table 32 : Effect of shading on nursery production during Summer

Date of sowing : 17.04.01 Date of uprooting : 01.06.01 Plot Size : 1 x 1 m

Treatments	Days to germinate	% Final stand	Seedling Height (cm)	Seedling Girth (cm)	No. Of Leaves/plant	Root Length (cm)
No shading	13.6	21.79	19.12	0.31	3.22	1.61
Shading with 50% Agro-shade net	10.4	47.43	22.38	0.26	3.42	1.81
Shading with 75% Agro-shade net	10.2	46.02	22.52	0.22	2.06	1.65
Shading with Hessian cloth	10.2	43.8	24.98	0.29	3.42	1.87
CD (0.05)	0.65	4.96	3.87	0.04	0.28	NS

Table 33 : Effect of dates of planting on yield of *kharif* onion cv. Baswant -780

Plot Size : 3.4 x 2.4 m

Date of Planting	Date of Harvesting	Total Yield (t/ha)	Mkt. Yield (t/ha)	% A Gr	% B Gr	% C Gr	% Dbls	% Blts	% Rotted	TSS (Brix)	E (cm)	P (cm)	N (cm)
15.06.01	24.09.01	33.74	35.32	43.95	39-28	7.95	4.03	4.43	5.94	10.33	5.80	4.55	0.85
01.07.01	05.10.01	30.77	29.84	23.63	65.50	8.70	3.28	1.05	15.64	9.45	5.38	4.55	0.88
15.07.01	23.10.01	13.55	12.73	35.03	35.15	18.5	4.90	0.91	16.04	10.50	5.08	4.23	0.80

Table 34: Effect of method of planting on yield of *kharif* onion cv Baswant - 780

Plot Size : 3.4 x 2.4 m

Method of Planting	Dates of Harvesting	Total Yield (t/ha)	Mkt. Yield (t/ha)	% A Gr	% B Gr	% C Gr	% Dbls	% Blts	% Rotted	TSS (°Brix)	E (cm)	P (cm)	N (cm)
Flat bed	24.9,05.01 & 23.10.01	28.16	25.33	27.63	53.60	8.73	3.87	3.0	11.87	9.83	5.23	4.5	0.77
Raised bed	24.9.05.10 & 23.10.01	22.58	21.72	24.97	53.43	17.80	1..90	2..63	11.62	10.07	5.13	4.43	0.0
Ridges & Furrows	24..09, 05.1.0 & 23.1 0.01	28.18	25.99	39.20	43.50	9.53	4..97	2.07	14.51	10.0	5.1	4.50	1.0
BBF with drip irrigation	24..09, 05.10 & 23.1 0.01	35.22	33.82	45.03	40.10	10.9	5.53	0.81	12.16	10.0	5.20	4.27	0.8

Table 35: Effect of pre-harvest sprays on foliage, yield and storability of kharif onion cv B-780 stored under ambient conditions for 2 months (Oct. - Dec. 2001)

Date of Spraying : 06.10.2001 Plot Size : 3 x 2 m Date of planting : 11.07.2001 Date of harvesting : 24.10.2001

Treat-ment	Total Yield (t/ha)	Plants Showing Injury (%)	Phy. wt. loss (%)				Rotting (%)				Sprouting (%)				Black mold				Visual disorder / Symptom
			15	30	45	60	15	30	45	60	15	30	45	60	15	30	45	60	
T1	22.61	—	16.6	24.8	40.5	40.5	0.00	0.8	16.7	16.7	5.6	19.4	26.1	33.1	0.0	0.0	00	00	Neck elongation
T2	26.84	0.3	9.8	10.4	32.6	37.2	0.00	11.6	12.0	12.0	8.1	17.3	27.7	33.5	0.0	2.9	3.4	3.4	Dark green foliage
T3	25.65	1.3	4.3	7.2	27.2	28.6	0.29	1.5	13.1	13.1	7.2	7.9	32.4	39.6	0.0	5.8	5.8	5.8	Dark green foliage
T4	10.52	—	17.5	28.7	"	"	0.00	16.7	"	"	10.3	30.9	"	"	0.0	0.0	0.0	0.0	Neck elongation
T5	13.54	—	11.3	11.3	19.2	23.7	0.00	12.5	16.7	16.7	5.4	5.4	22.4	30.4	0.0	0.0	0.0	0.0	Neck elongation
T6	22.71	9.7	1.7	11.5	"	"	0.00	13.1	"	"	4.9	14.7	"	"	0.0	4.9	4.9	4.9	Partial foliage destruction
T7	21.93	20.0	15.9	28.2	67.7	"	0.00	12.8	23.1	"	4.6	4.6	5.9	"	0.0	0.0	0.0	0.0	Considerable foliage destruction
T8	28.93	6.0	2.1	2.1	2.6	18.8	0.00	12.6	22.6	22.6	5.4	7.5	23.7	33.3	0.3	3.0	3.0	3.0	Partial foliage destruction
T9	22.94	11.0	3.4	11.2	31.6	34.8	0.00	5.4	5.4	5.4	0.9	14.4	25.2	34.4	0.0	0.0	0.0	0.5	Partial foliage destruction
T10	27.60	6.7	1.4	2.3	5.7	10.3	0.00	11.1	21.1	21.1	5.2	16.3	22.3	45.2	0.0	0.0	0.0	0.0	Dark green foliage
T11	20.23	3.7	3.1	4.6	8.2	12.4	0.00	5.4	25.4	25.4	8.8	25.8	32.5	48.6	0.0	0.0	0.0	0.0	—
T12	29.10	5.0	3.4	20.5	18.4	11.5	0.40	8.5	12.9	12.9	3.4	20.5	34.7	47.2	0.0	3.4	3.4	3.4	Neck fall
T13	3.77	6.3	8.7	11.1	19.1	23.3	0.00	8.4	8.4	8.4	2.3	14.1	30.9	46.8	0.0	0.0	0.2	0.2	—
T14	33.85	5.7	6.4	9.1	10.1	12.5	0.00	9.7	19.9	20.2	6.0	20.9	43.2	67.1	0.0	4.3	4.5	4.7	Neck fall
T15	3.85	0.0	7.4	11.4	12.4	15.2	0.00	6.2	16.2	16.2	9.3	16.2	27.8	48.1	0.0	0.0	0.5	0.5	—
CD (0.05)	4.3																		

T1: 2.0% Pot. Nitrate, T2 : 1% Urea, T3 : 2% Urea, T4 : 1% 2,4-D, T5 : 2% 2,4-D, T6 : 1% Glyphosate, T7:2% Glyphosate, T8: 0.2% Goal, T9 : 0.4% Goal, T10: 2% Ca chloride, T11:1% Ca chloride, T12 : 2% Ca chloride, T13:1% Na chloride, T14 : 2% Na chloride, T15 : No spray

Table 36 : Response of *Kharif* Onion cv. B-780 to organic manures

Date of Planting : 18.06.01 Date of Harvesting : 18.10.01 Plot Size : 18 Sq. M.

Treat-ment	Total Yld (t/ha)		Yield %A Gr		% B Gr		%C Gr		Rotted (%) Bulbs		TSS °Brix		E (cm)		P (cm)		N (cm)	
	D	F	D	F	D	F	D	F	D	F	D	F	D	F	D	F	D	F
T1	16.90	12.97	32.3	30.9	50.5	51.9	16.8	17.3	6.0	16.2	10.1	10.7	4.6	4.1	4.5	3.9	0.6	0.5
T2	8.00	4.49	6.8	0.0	44.4	31.4	47.3	68.7	8.7	17.6	10.6	10.9	4.1	3.7	4.0	3.5	0.6	0.6
T3	9.00	5.07	4.7	0.0	32.5	23.4	52.2	75.4	2.5	15.8	9.8	10.8	4.4	3.5	4.3	3.4	0.8	0.6
T4	7.38	2.96	3.1	0.0	47.4	20.4	46.7	97.2	14.7	38.2	10.3	10.7	4.0	3.4	3.9	3.5	0.7	0.7
T5	8.25	4.94	0.0	0.0	29.4	22.6	61.7	60.6	1.9	11.0	9.8	10.6	3.8	3.5	4.0	3.5	0.8	0.6
T6	8.98	3.44	2.7	0.0	45.9	16.9	51.9	83.6	23.9	25.8	10.2	10.8	4.4	3.4	4.1	3.5	0.8	0.7
T7	8.81	4.24	13.3	0.0	46.3	31.4	39.4	70.5	8.0	12.0	10.1	10.2	4.1	3.7	4.1	3.6	0.7	0.7
T8	7.29	4.09	11.1	0.0	35.0	24.6	51.0	75.6	2.5	22.8	10.5	10.3	4.0	3.5	3.9	3.5	0.9	0.8
T9	7.54	5.95	0.0	0.0	35.0	27.5	62.5	66.8	9.7	17.3	10.3	10.8	4.0	3.3	3.9	3.3	0.9	0.5
C.D. (0.05)	1.17	1.16									1.15	1.49	0.44	0.49	0.16	0.55	0.30	0.17

D : Drip F : Flat Bed

TI: Recommended dose i.e. 100:50:50 NPK Kg/ha.
T2 : F. Y. M. (20 t/ha)
T3: F.Y.M. (10 t/ha) + Neem cake (1.0 t/ha)
T4: Poultry manure (10 t/ha)
T5: Press mud (10 t/ha)
T6: Press mud (10 t/ha) + Neem cake (1.0 t/ha)
T7: Press mud (10 t/ha) + Poultry manure (5 t/ha)
T8: Vermicompost (2t/ha)
T9: Control (No Fertilizer)

Table 37 : Response of *rabi* onion cv. N-2-4-1 to organic manures

Date of planting : 25.12.01 Date of harvesting : 26.04.02

Plot Size : 18 Sq. M

Trea ments	Total Yield (t/ha)		Mkt. Yield (t/ha)		%A Gr		%B Gr		%C Gr		%Double		%Bolters		TSS (° Brix)		Pl Ht. (cm)		NOL	
	D	F	D	F	D	F	D	F	D	F	D	F	D	F	D	F	D	F	D	F
T1	33.58	23.98	31.15	23.0	32.4	25.3	0.68	0.14	25.63	40.9	43.33	40.9	0.6	0.1	13.2	17.1	40.9	43.3	6.7	5.6
T2	22.75	11.86	21.53	11.7	7.9	17.2	2.50	0.0	46.08	37.8	37.57	37.8	2.5	0.0	12.8	13.1	37.8	37.5	6.8	6.6
T3	20.93	11.85	20.87	11.4	6.8	10.7	0.28	0.0	51.70	37.5	35.03	37.5	0.2	0.0	13.9	14.4	37.5	35.0	6.6	6.3
T4	36.39	16.97	33.56	16.6	23.5	17.5	2.55	0.0	14.38	48.9	41.03	48.9	2.5	0.0	13.5	12.4	48.9	41.0	8.0	6.3
T5	21.36	11.40	21.11	11.1	11.4	14.4	0.00	0.0	48.22	38.6	29.37	38.6	0.0	0.0	13.5	14.5	38.6	29.3	6.5	5.8
T6	21.02	8.38	20.74	8.7	5.1	7.11	0.10	0.0	52.22	38.9	32.87	38.9	0.1	0.0	13.2	16.1	38.9	32.8	6.6	6.1
T7	28.79	15.97	27.36	15.8	14.9	15.6	1.77	0.0	32.76	40.1	6.57	40.1	1.7	0.0	14.7	13.1	40.1	6.5	6.5	6.3
T8	20.04	8.72	19.38	7.9	6.9	7.80	0.72	0.0	54.60	35.5	6.30	35.5	0.7	0.0	13.4	11.5	35.5	6.3	6.3	6.0
T9	21.34	9.03	20.41	8.9	6.7	12.7	0.00	0.9	43.66	37.0	6.73	32.0	0.0	0.9	13.8	13.7	37.0	6.7	6.7	6.2

D- Drip Irrigation F-Flat Bed

T1: Recommended dose i.e. 150:50:50 NPK Kg/ha ; T2 : F.Y.M. (20 T/ha) ; T3 : F.Y.M. (10 t/ha) + Neem cake (1.0 t/ha) ; T4 : Poultry manure (10 t/ha) ; T5 : Press mud (10 t/ha) ; T6 : Press mud (10 t/ha) + Neem Cake (1.0 t/ha) ; T7 : Press Mud (10 t/ha) + Poultry manure ; T8 : Vermicompost ; T9 : Control (No Fertilizer)

Effect of organic and inorganic fertilizers on growth and yield of garlic var. G-41 under different irrigation systems

Sustained production strategies often involve judicious application of inorganic fertilizers with organic sources. 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 the soil. Therefore, the present study was undertaken to assess the organic and inorganic fertilizers requirement of garlic under drip and surface irrigation methods.

The result of the study revealed that there was significant effect on growth, yield and yield contributing characters of garlic bulbs due to different organic, inorganic fertilizers and methods of irrigation. Among the treatments, combined application of recommended does of organic manures (FYM 25 t/ha) and in organic fertilizers (100% recommended doses of fertilizers) recorded the highest bulb yield in garlic (9.83 t/ha) under drip irrigation system which was on par with application of

FYM 12.5t/ha + Vermicompost 4 t/ha + 50% of recommended doses of fertilizers (9.32 t/ha) in same system of irrigation. In surface irrigation also, the higher yield was obtained from FYM 25 t/ha + 100% NPK fertilizers (8.52 t/ha) followed by 50% FYM (12.5 t/ha) + Vermicompost (4 t/ha) and NPK fertilizers (8.14 t/ha) applied. These results infer that there is scope for management of garlic with lower rates of manures applied with reduced recommended doses of fertilizers to get higher yield (Table 38).

Table 38: Effect of organic and inorganic fertilizers on growth and yield of garlic var. G-41 under different irrigation systems

Date of planting : 19.11.2001 Date of harvesting : 17.04.2002
Plot size (Drip) : 1.2 x 20 m Plot Size (Surface) : 3 x 2m

Treatment	Drip Irrigation					Surface Irrigation				
	Mkt. Yield (t/ha)	Avg. Wt. of bulb (gm)	%A Gr	%B Gr	%C Gr	Mkt. Yield (t/ha)	Avg. Wt. of bulb (gm)	%A Gr	%B Gr	%C Gr
T1	8.32	17.0	36.9	39.0	24.1	7.02	16.4	26.1	32.7	41.2
T2	7.97	17.4	28.4	44.9	26.7	6.94	15.2	22.4	47.3	30.3
T3	7.61	16.3	26.1	46.4	27.5	6.56	14.5	20.1	42.7	37.2
T4	8.40	18.3	30.4	45.0	23.6	7.13	17.9	25.2	33.6	41.2
T5	8.84	18.6	39.7	40.0	20.3	7.63	18.3	28.5	50.7	20.8
T6	8.61	19.2	36.5	43.4	20.1	7.35	17.0	25.3	41.2	33.5
T7	9.32	19.5	42.1	35.6	22.3	8.14	18.7	31.8	44.0	24.2
T8	8.53	18.3	37.6	41.2	21.2	7.20	17.5	26.1	35.8	38.1
T9	8.95	18.6	40.8	39.1	20.1	7.87	18.1	33.1	45.1	22.1
T10	9.83	20.7	43.8	36.3	19.9	8.52	19.2	35.2	42.5	22.3
CD (0.05)	1.25					1.12				

TI - FYM 25 t/ha, T2 - Vermicompost 8 t/ha, T3 - Vermicompost 4 t/ha, T4-FYM (12.5t/ha) + Vermi compost (4t/ha) T5-FYM (12.5t/ha) + 50% of Recommended dose of fertilizer, T6 - Vermicompost (4t/ha) + 50% of Recommended doses of fertilizer, T7, FYM (12.5t/ha) + Vermi compost (4t/ha) + 50% of Recommended dose of fertilizer, T8 - FYM (12.5t/ha) + Vermicompost (4t/ha) + Neem cake, T9 - 100% of recommended dose of fertilizer, T10 - FYM (25t/ha) + 100% of Recommended dose of fertilizer

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

The productivity of garlic is very low in our country compared to China and other countries. The low productivity is mainly due to use of old varieties, poor quality planting material and traditional cultivation practices. Hence the present study was under taken to find out effect of suitable mother clove size of garlic on yield.

The treatment comprised of three sizes of mother cloves (0.4 to 0.5g, 0.8 to 1.0 and 1.4 to 1.5g). Among the treatments, mother clove size of 1.4 to 1.5g recorded the highest yield (12.8 t/ha), plant height and more number of leaves per plant. This might be due to bigger bulb clove size which contributed more reserved food to the plant for the better growth and development (Table 39).

The data regarding three years performance is presented in table 40 which indicates that mother clove size of 1.4 to 1.5 g consistently gave higher yield which was closely followed by medium clove size of 0.8 to 1.0g

Table 39 : Effect of mother clove size on growth and yield of garlic var. G.41

Date of planting : 3.11.2001 Date of harvesting : 14.03.2002
Plot size : 3 x 2m Spacing : 15 x 10 cm

Treat-ments	Mkt. Yield (t/ha)	Pl. ht (cm)	NOL	N (cm)	E (cm)	P (cm)	Avg. Bulb Wt. (g)	NOC	%A Gr	%B Gr	%C Gr
T1	9.15	54.2	10.5	0.67	3.22	2.57	20.3	18.2	37.5	23.4	39.1
T2	10.3	61.7	10.2	0.69	3.65	2.91	27.9	19.8	48.3	29.5	22.2
T3	12.8	69.4	10.7	0.71	4.71	3.12	31.4	23.1	54.7	33.6	11.7
CD(0.05)	1.15										

Table 40 : Yield performance of garlic var. G-41 over the last three years

Treatments	Average Weight of Bulb (g)			Mean	Marketable Yield (t/ha)			Mean
	1999-2000	2000-2001	2001-2002		1999-2000	2000-2001	2001-2002	
T1	12.5	18.5	20.3	17.1	3.80	8.81	9.15	7.25
T2	16.8	22.9	27.9	22.5	5.15	9.44	10.3	8.30
T3	21.5	28.4	31.4	27.1	7.62	11.4	12.8	10.6
CD (0.05)					4.40	1.27	1.15	

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

Effect of chilling and growth regulator treatments of garlic cloves on growth and yield of garlic var. G-41

Mature garlic bulbs have some amount of dormancy during storage period which delays the sprouting and field establishment. So the attempt was made in garlic to break the dormancy of mother bulbs by chilling and also by various growth regulators and chemical treatments to ennance early and uniform emergence in the field.

The results revealed that irrespective of duration of chilling, all chilled mother cloves (kept at 5° C) noticed the early emergence in field and T1 (cloves kept at 5° C for 30 days) recorded very early emergence of sprouts in the field (3.1 days) compared to chemical and growth regulator treatments. (Table 41) Later on the growth phase ceased and recorded very low yield compared to control. Among all the treatments, over night soaking of garlic mother bulbs in BA at 20 ppm recorded significantly highest bulb yield of 11.4 t/ha followed by treatment of chilling at at 5° C for 5 days (11.3t/ha) and GA at 20 ppm (11.2t/ha).

Table 41 : Effect of chilling and growth regulator treatments of garlic mother bulbs on growth and yield of garlic var. G.41

Date of planting : 4. 11. 2001 Date of harvesting : 23.3.2002
Plot Size : 3 x 2m Spacing : 15 x 10 cm
Vareties : B-780 from 01.06.2001 to 15.10.2001
N-2-4-1 from 01.11.2001 to 15.12.2001

Treat-ments	Mkt. Yld (t/ha)	% A Gr	% B Gr	% C Gr	N (cm)	E (cm)	P P (cm)	Pl. ht (cm)	NOL	Avg. Wt. of bulb (g)	NoClv
T1	11.3	45.5	37.8	16.7	0.95	4.32	2.91	66.3	10.7	21.7	16.3
T2	10.7	39.1	44.3	16.6	0.83	4.10	3.15	60.2	10.2	19.5	17.1
T3	10.5	40.7	41.5	17.8	0.72	3.21	3.90	63.5	11.0	18.0	17.5
T4	7.42	27.2	21.8	51.0	0.65	3.10	2.57	49.1	8.9	15.6	13.0
T5	4.55	23.5	22.4	54.1	0.57	2.52	2.85	42.6	7.5	13.4	11.3
T6	3.27	18.3	20.5	61.2	0.52	1.97	2.15	36.5	5.2	12.5	10.5
T7	10.3	38.1	45.8	16.1	0.52	3.75	4.48	68.7	10.7	25.6	19.6
T8	11.2	49.3	37.5	13.2	0.87	4.26	3.17	67.3	10.5	27.9	21.3
T9	10.6	45.0	33.9	21.1	0.91	4.51	3.62	69.5	11.1	29.4	21.9
T10	11.4	51.3	30.7	18.0	0.89	4.34	2.93	66.1	10.6	28.2	23.5
T11	10.5	47.6	31.4	21.0	0.77	4.10	2.75	67.4	10.4	26.3	22.0
T12	11.0	48.7	34.5	16.8	0.85	3.97	2.62	65.8	10.8	25.0	24.7
T13	11.0	41.5	37.5	16.8	0.82	3.21	3.80	66.7	10.9	27.4	24.7
T14	10.2	41.5	37.3	21.2	0.88	3.21	3.80	64.0	10.7	27.4	20.4
T15	9.45	36.1	33.7	29.9	0.79	3.15	2.26	60.5	10.1	20.5	20.0
CD (0.05)	1.73										

T1-Chilling of mother bulbs at 5° C for 5 days, T2 - Chilling of mother bulbs at 5° C for 10 days; T3-Chilling of mother bulbs at 5° C for 15 days; T4 - Chilling of mother bulbs at 20° C for 20 days, T5 - Chilling of mother bulbs at 5° C for 25 days, T6 - Chilling of mother bulbs 5° C for 30 days, T7 - GA 10 ppm, T8 - GA 20 ppm, T9 - BA 10 ppm, T10 - BA 20 ppm, T11 - Thiourea 500 ppm, T12 - Thiourea - 1000 ppm, T13- KNO_3 - 500 ppm, T14 - KNO_3 - 1000 ppm, T15 - Control

CROP PROTECTION

INTEGRATED PEST MANAGEMENT IN ONION

Population dynamics of thrips in onion

Infestation of thrips was significantly higher on the crop planted on, 1st July, 1st November and 15th November. Crop planted on 15 August and 1 September recorded significantly lower thrips. The marketable yield was significantly lower in 1st & 15th June and 1st July plantings and significantly higher in 15th September followed by 1st September plantings. During *rabi* season, lowest yields were recorded in 1st & 1 5 th November plantings. Yield loss of more than 50% due to thrips was noticed in *rabi*. Two population peaks, one in August and the second in Jan-Feb were noticed. Rainfall and maximum, minimum temperature had a negative correlation with thrips population (Table 42)

Table 42 : Effect of date of planting on thrips incidence in Onion under protected and unprotected regimes

Date of planting : At 1 5 day interval from 1.6.01 to 15.12.01

	Thrips/Plant Regimes		Marketable Yield (t/ha) Regimes		Total yield (t/ha) Regimes	
	Protected	Unprotected	Protected	Unprotected	Protected	Unprotected
1.6.2001	1.08 (1.03)	41.95 (6.48)	39	1.33	45.00	15.33
15.6.2001	1.22 (1.10)	43.31 (6.55)	25.52	0.18	32.81	9.11
1.7.2001	1.96 (1.39)	57.76 (7.59)	30.96	1.63	35.41	2.44
15.7.2001	3.58 (1.89)	15.89 (3.99)	8.59	8.85	18.19	9.85
1.8.2001	1.29 (1.13)	10.04 (3.17)	9.63	0.96	18.00	26.22
15.8.2001	0.97 (0.98)	6.05 (2.46)	33.00	29.59	37.00	29.52
1.9.2001	0.48 (0.69)	6.89 (2.60)	49.37	40.26	53.07	42.04
15.9.2001	0.57 (0.75)	14.84 (3.85)	65.52	48.79	72.33	55.26
1.10.2001	2.46 1.54	34.95 5.91	53.81	38.78	58.95	41.30
15.10.2001	2.95 (1.71)	38.32 (6.19)	52.27	31.96	63.07	36.04
1.11.2001	2.25 (1.50)	53-83 (7.34)	38.26	13.07	76.78	36.30
15.11.2001	2.57 (1.60)	58.37 (7.64)	40.74	10.89	71.22	35.63
01.12.2001	1.89 (1.37)	38.02 (6.17)	36.85	25.26	58.48	32.63
15.12.2001	2.82 (1.68)	26.29 (5.12)	44.89	33.19	52.92	37.44
C.D.(0.05)	0.29	0.46	9.22	3.87	10.13	3.92

Values in parentheses are square root transformed.

Barrier cropping for management of thrips in onion

Thrips are weak fliers and carried to long distances by wind. Blocking adult thrips can reduce the initial and subsequent pest load on onion. Barrier crops can be employed for this purpose.

Barriers employed: 2 rows of wheat on all four sides (2W); 2rows of maize in zigzag manner on all four sides (2M); one inner row of wheat and outer row of maize (MW); No Barrier (NB) as a check.

The lowest number of thrips was recorded in 2M (10.49/plant) and MW (11.19/plant) compared to 26.54 thrips/plant where no barrier was present (Table 43) . Based on the adult thrips trapped, blocking was highest in MW (86.86%) and 2M (83.08%) at 50 cm height compared to 2W (66.0%). At 100 cm height blocking was highest with 2M (76.44%) followed by MW (67.41) whereas 2W blocked only 18.88% (Table 44). On overall basis, the percentage blocking was highest in 2M (80.45%) and MW (79.17%). 51.29% blocking was recorded with 2W (Table 45). Coccinellid predators were higher in plots where maize was used as barrier. Stemphylium blight was higher in 2M (27.73%) and MW (28.93%) plots compared to control (16.20%). The marketable yield was higher in control compared to onion plots grown with barriers.

Table 43 : Thrips-nymphs density on onion under different barrier crops during *rabi*, 2001

D.O.P . 28.11.2001 D.O.H. 20.4.2002

Date of Observation	Age (days)	2W	MW	2M	NB
28.12.01	30	5.96	8.08	7.13	9.55
11.01.02	44	20.60	20.10	23.20	32.00
18.01.02	51	27.30	16.30	12.70	29.60
25.01.02	58	63.20	40.98	35.43	73.01
02.02.02	66	4.86	3.08	3.38	6.48
08.02.02	72	2.11	1.65	2.05	4.53
15.02.02	79	5.45	1.38	1.36	12.41
22.02.02	86	10.98	2.88	2.96	28.31
01.03.02	93	18.30	6.33	6.18	42.98
Avg.		17.64	11.19	10.49	26.54

Table 44 : Adult thrips density on onion under different barrier crops

Date of observation	Age (days)	2W	MW	2M	NB
28.12.01	30	0.00	0.00	0.00	0.00
11.01.02	44	8.30	5.00	4.30	9.90
18.01.02	51	13.10	8.50	5.70	17.10
25.01.02	58	11.06	10.15	8.18	14.20
02.02.02	66	0.20	0.05	0.01	0.58
08.02.02	72	0.75	0.45	0.30	2.25
15.02.02	79	1.81	0.48	0.26	4.36
22.02.02	86	1.30	0.61	0.48	3.73
01.03.02	93	0.53	0.05	0.28	1.91
Average		4.11	2.81	2.16	6.00

Table 45: Per cent blocking of adult thrips at different heights under different barrier crops

Age (Days)	Trap	2W	MW	2M	NB
60	t1	34.14	86.17	82.92	0.00
	t2	43.69	62.13	66.02	0.00
68	t1	63.88	91.11	84.44	0.00
	t2	2.56	51.28	57.69	0.00
75	t1	80.16	84.64	82.35	0.00
	t2	31.19	75.69	88.07	0.00
Overall blocking %		51.29	79.17	80.45	0.00

t1 -50cm t2-100cm

Effect of Seedling Root Dip (SRD) on thrips infestation on onion

At present, granule application at the time of planting was recommended for thrips control. This practice is expensive. Therefore an alternative method called Seedling Root Dip, which is economical, was evaluated for thrips control in the initial stages of onion growth.

At 25 days after planting (DAP) SRD with all the insecticides were significantly superior over control. Also at 40 DAP, these treatments were effective in controlling thrips. Foliar spray with carbosulfan at 0.05% was found significantly superior over other treatments at 40,55 and 70 days after planting. Total yield was significantly higher in treatments T5, T3 and T6 and were on par (Table 46).

Effect of duration of root dipping on thrips infestation on onion

To know the optimum dipping period for SRD a field trial was conducted by dipping seedlings for 2h, 4h, 6h & 12h in 0.025% and 0.05% carbosulfan.

Up to 20 DAP no significant difference was observed among treatments. At 30 DAP, SRD for 6 h at 0.025% and for 12 h at 0.05% were found significantly superior over other treatments (Table 47).

Table 47 : Effect of duration of root dipping on thrips infestation in onion during *rabi*, 2001

Date of planting : 28.11.2001 Design: RBD

Treatment	Thrips per plant			
	10 DAP	20 DAP	30 DAP	46 DAP
T1	0.0041	0.00	10.23	23.45
	(1.00)	(1.00)	(3.14)	(4.84)
T2	0.00	0.00	17.80	26.80
	(1.00)	(1.00)	(4.14)	(5.18)
T3	0.00	0.00	19.67	25.10
	(1.00)	(1.00)	(4.41)	(5.00)
T4	0.00	0.1	9.53	24.83
	(1.00)	(1.05)	(3.08)	(4.98)
T5	0.00	0.3T	7.43	21.17
	(1.00)	(1.15)	(2.64)	(4.60)
T6	0.00	0.07	10.63	20.93
	(1.00)	(1.03)	(3.26)	(4.57)
T7	0.00	0.00	13.33	23.97
	(1.00)	(1.00)	(3.65)	(4.88)
T8	0.00	0.2	8.90	22.40
	(1.00)	(1.09)	(2.88)	(1.73)
T9	0.07	0.2	17.45	19.40
	(1.03)	(1.09)	(4.17)	(4.40)
T10	0.00	1.9	21.35	31.35
	(1.00)	(1.62)	(4.62)	(5.59)
C.D. (0.05)	115	115	1.06	0.46

T1- SRD carbosulfan (0.025%) for 2 hr.
T2- SRD carbosulfan (0.05%) for 2 hr.
T3- SRD carbosulfan (0.05%) for 2 hr.
T4- SRD carbosulfan (0.05%) for 4 hr.
T5-SRD carbosulfan (0.025%) for 6 hr.
T6-SRD carbosulfan (0.05%) for 6 hr.
T7-SRD carbosulfan (0.025%) for 12 hr.
T8-SRD carbosulfan (0.05%) for 12 hr.
T9- Carbofuran 3G/l ka ai/ha application
T10-control

Effect of duration of root dipping on thrips infestation on onion

To know the optimum dipping period for SRD a field trial was conducted by dipping seedlings for 2h, 4h, 6h & 12h in 0.025% and 0.05% carbosulfan.

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Date of planting : 28.11.2001 Design: RBD

Treatment	Thrips per plant			
	10 DAP	20 DAP	30 DAP	46 DAP
T1	0.0041	0.00	10.23	23.45
	(1.00)	(1.00)	(3.14)	(4.84)
T2	0.00	0.00	17.80	26.80
	(1.00)	(1.00)	(4.14)	(5.18)
T3	0.00	0.00	19.67	25.10
	(1.00)	(1.00)	(4.41)	(5.00)
T4	0.00	0.1	9.53	24.83
	(1.00)	(1.05)	(3.08)	(4.98)
T5	0.00	0.3T	7.43	21.17
	(1.00)	(1.15)	(2.64)	(4.60)
T6	0.00	0.07	10.63	20.93
	(1.00)	(1.03)	(3.26)	(4.57)
T7	0.00	0.00	13.33	23.97
	(1.00)	(1.00)	(3.65)	(4.88)
T8	0.00	0.2	8.90	22.40
	(1.00)	(1.09)	(2.88)	(1.73)
T9	0.07	0.2	17.45	19.40
	(1.03)	(1.09)	(4.17)	(4.40)
T10	0.00	1.9	21.35	31.35
	(1.00)	(1.62)	(4.62)	(5.59)
C.D. (0.05)	115	115	1.06	0.46

T1- SRD carbosulfan (0.025%) for 2 hr.
T2- SRD carbosulfan (0.05%) for 2 hr.
T3- SRD carbosulfan (0.05%) for 2 hr.
T4- SRD carbosulfan (0.05%) for 4 hr.
T5-SRD carbosulfan (0.025%) for 6 hr.
T6-SRD carbosulfan (0.05%) for 6 hr.
T7-SRD carbosulfan (0.025%) for 12 hr.
T8-SRD carbosulfan (0.05%) for 12 hr.
T9- Carbofuran 3G/l ka ai/ha application
T10-control

Effect of irrigation systems on thrips infestation in onion

In modern agricultural practices of onion, use of micro irrigation systems became an integral part. Therefore, it is essential to know the thrips infestation under different irrigation systems.

Irrigation systems : Drip, Sprinkler and Surface
Insecticide treatments:
T1 = Application of Carbofuran 3G@ 1 Kg 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@ 60 g a.i/ha from 30 DAP;
T4 = Control

At 30 DAP thrips population was significantly low in sprinkler irrigation than in drip and surface irrigation. From 45-75 DAP, thrips number significantly reduced in sprinkler and drip compared surface irrigation. Among the insecticide treatments, T1 and T3 were significantly superior over other treatments. Marketable yield was highest in drip-irrigated crop. Significantly higher total yields were obtained in drip and surface irrigation.

REACTION OF ONION GERMPLASM TO THRIPS DURING RANGDA SEASON

Host plant resistance is relatively permanent and ecologically safer. At present, there is no known variety of onion for thrips resistance. Screening of onion germplasm is necessary to identify the sources of resistance in onion.

During *rangda* (late *kharif*) season, 88 lines of red and white onion were screened for thrips resistance. The screening method is based on Leaf Injury Rating (LIR) on 0-5 scale. However, twising and curling and distortion of leaf are also common symptoms of thrips attack. These symptoms may not be quantified by the existing LIR. Therefore a new 0-5 scale called Leaf Curl Rating was developed on the basis of which onion germplasm was screened (Table 48).

LIR : leaf Injury Rating on 0-5 scale
0= no damage
1 = 20% leaf area damaged
3 = 60% leaf area damaged
4 = 80% leaf area damaged
5 = 100% leaf area damaged
TR : total rating (LIR + LCR)

LCR : Leaf curling rating on 0-5 scale
0 = crect leaves;
1 = <90^0 curling; 2=90^0 curling;
3 =90 -180^0 curling;
4 = moderate twisting or all leaves 180^0 curling;
5 = complete curling and twisting of leaves

Table 48 : Screening of onion germplasm during *rangda*.

Rating range	LIR	LCR
0-1	Nil	Nil
1-2	Nil	21
2-3	3	62
3-4	74	5
4-5	11	Nil

Among the 88 lines of onion, the damage caused by thrips ranged between 4.7 to 7.2. Commercial variety B-780 recored the lowest leaf damage with a total rating of 4.7 . The highest injury was noticed on W432 and W441 with a rating of 7.2. Curling and twisting of leaves was highest in 15R (3.6) whereas highest leaf injury with a LIR of 4.3 was recored on Acc. No. 205. With regard to yield, the lines with Acc. No. 482, 505, 535, 749 were at par with B-780 (42.5 t/ha). Total bulb yield was significantly highest (68.5 t/ha) in the line 12-3. However 24 lines were found at par with the variety B-780. This study suggests that despite having higher thrips population and their damage certain lines showed tolerance and recorded higher yields.

POST HARVEST STUDIES IN ONION

Onion is essential part of our daily diet. This creates availability constant year around demand of onion. Although onions are grown almost all round the year but major produce come from *rabi* season onion. The major part of rabi produce is stored to fulfill the requirement of onion during lean season, but the stored losses aer very high. Various faculty are assosciated with storability of onion. Thus a project wast stated to assess the storage losses and find measures to reduce these losses.

Assessment of storage losses

Seasonal variation

Various experiments were conducted to assess the storage losses in all three onion growing seasons i.e. *rabi, kharif& late kharif.* In *rabi* season, the total losses were 37.4% after four months of storage from May to September. The major contribution was due to physiological weight loss (28.6%) while 7.7% loss was lost due to neck rot. Black mold affected 14.7% onion (Table 49).

In *kharif* season, the physiological weight losses were higher (46.0%) after two months of storage. The major reasons of higher losses were lack of proper curing due to high atmospheric humidity and recurrent rains during harvesting period . The sprouting incidence was very high in the stored *kharif* onion and more than 25% of the onion were sprouted within 60 days of storage, but the incidence of black mould was lower than *rabi* season (Table 50).

In late *kharif* season, related lower losses during storage due to weight loss and rotting. The occurrence of sprouting and black mold was also less after 60 days of storage (Table 51).

Effect of bulb size and neck thickness

The experiments on bulb size revealed that the physiological weight losses were higher in small size bulbs while rotting losses were not influenced by the size of the bulbs. The sprouting losses were more either in small size bulbs or in big size bulbs & less in medium sized bulbs (Table 52). Neck thickness did not influence considerably either weight loss or rotting (Table 53).

Behaviour of cold stored onion

The bulbs of onion were stored at a low temperature (0 - 1 ^{0}C) and 65-70% RH for four months. These bulbs were taken out from cold storage and kept at ambient temperature for two months. The observations on physiological loss in weight, sprouting, black mold, rotting, etc. were recorded at three days interval.

The results revealed that the weight loss was at constant rate throughout the post storage period. The total loss in weight during this period was 34.2 %. As far as the rate of sprouting is concerned, it increased steeply from 1.3 to 25% up to the second week and thereafter slowed down. The total sprouting was about 34%, while the rotting and black mould were almost nil up to three weeks. There was no significant difference in total soluble solids during post storage period (Table 54)

Survey of pre and post harvest handling and storage of onion

Storage losses

The survey of storage losses in onion was conducted in all the major onion growing areas of Maharastra. The survey report revealed that the losses were 25-50 % in majority of the storage structures irrespective of storage environment and method (Table 55).

Maturity indices, pre and post harvest handling

The survey study revealed that 93% farmers harvest *rabi* onion when more than 50% plants showed neck fall. Few farmers harvest onion when leaves of onion become yellow. As far as the harvesting method is concerned, more than 80% of the farmers harvest onion manually. Only 15 -20 % farmers use hand hoe for harvesting. The practice of curing with leaves is generally not done by majority of the farmers while shade curing is performed immediately after cutting neck by almost 75% of the farmers (Table 56)

Survey of onion storage structures

The survey of storage structures revealed that 44.6% onion storage structure were temporary type. While 30.2 % structures were permanent. As far as the capacity of the store is concerned, it depends on the area under the onion cultivation. The majority of temporary structures were less than 20 tonnes capacity while majority of the permanent structures were more than 20 tonnes capacity. The majority of the temporary structures are constructed with wooden pots and grass roof. The floor of temporary structures were *kuchha* and the sidewalls were usually thatched with pigeon pea stalks or wheat straw. The semi permanent structures were found to be constructed with wooden pots, iron angle frames, while mangalore tiles were most commonly used as roofing material. The floors of the semi permanent structures were either *kuchcha* or sand filled.

As far as the permanent structures concerned , they were usually constructed with iron

channels, RCC pillars with *pucca* floor. The side walls were constructed with bamboo (19.04 %) . wooden bantams (52.38 %) or chain-links (26.19 %). The roof was found to be constructed with G.I. sheet (73.8 %) or asbestos sheets (2 1.42%) (Table 57A, B & C).

Performance of onion grader

A roller type manually driven onion grader has been designed and fabricated by NRC Onion and Garlic. This grader has designed to facilitate grading onion in five different grades i.e. <35mm , 35 - 50 mm, 50 - 60 mm, 60 - 80 mm and >80 mm. The grader has a capacity of grading 0.5 tonnes/hr. The grader has better grading precision than manual grading (Table 58).

Table 49 : Storage behaviour of *rabi* onion cv. N-2-4-1
Period storage : May to September 2001

Period of storage	% Losses during storage			
	Quantitative losses		Qualitative losses	
	PLW	Rotting	Sprouting	Black mold
60 days	0.4	5.4	0.1	8.0
90 days	17.7	6.6	0.4	12.0
120 day	28.6	7.7	1.1	14.7

Table 50 : Storage behaviour of *kharif* onion cv. Baswant-780
Period of storage : Oct. to Dec. 02

Period of storage	% Losses during storage			
	Quantitative losses		Qualitative losses	
	PLW	Rotting	Sprouting	Black mold
15 days	9.7	1.0	2.6	0.04
30 days	25.1	7.1	6.6	0.04
45 days	33.5	10.0	24.9	0.4
60 days	4.8	14.1	27.4	0.4

Table 51 : Storage behaviour of rangda (late *Kharif*) onion cv. Baswant-780
Period of Storage: Feb. -- March 02

Period of storage	% Losses during storage			
	Quantitative losses		Qualitative losses	
	PLW	Rotting	Sprouting	Black mold
15 days	9.7	2.1	1.0	0.3
30 days	15.2	4.0	1.2	2.2
45 days	15.8	4.5	1.2	2.4
60 days	19.4	4.8	1.4	2.8

Table 52 : Effect of size of bulb on storage life of *rabi* onion cv. N-2-4-1

Period of storage - May to September 2001

	Bulb Diameter (mm)											
	25-40			40-50			50-60			>60		
Period of Storage Day	60	90	120	60	90	120	60	90	120	60	90	120
Phy.wt. loss (%)	10.8	14.8	26.7	16.8	1 8.3	26.2	15.8	16.4	24.6	8.6	12.8	20.7
Rotting (%)	3.5	4.5	5.0	4.4	5.6	6.3	1.2	2.1	3.2	0.9	1.0	6.1
Black mould (%)	3.0	5.8	14.4	3.9	5.1	8.2	3.9	6.5	10.0	4.5	6.4	17.1
Sprouting (%)	1.7	2.1	2.1	0.1	1.3	6.7	0.3	1.3	2.1	1.3	2.1	3.8

Table 53 : Effect of neck thickness on storage life of rabi onion cv. N-2-4-1 during storage

Period of storage - May to September 2001

	Neck thickness (mm)								
	3.0			3.0-6.0			>6.0		
Period of Storage (Days)	60	90	120	60	90	120	60	90	120
Phy. wt. loss (%)	14.7	16.0	28.6	12.6	14.6	20.5	1.7	13.8	24.6
Rotting (%)	2.2	3.4	6.4	2.8	3.4	5.3	2.5	3.1	3.7
Total quantitative losses	6.9	9.4	5.0	3.4	18.0	25.8	13.2	16.9	28.3
Black mold (%)	3.3	4.2	9.9	3.6	5.2	12.8	4.6	8.6	14.6
Sprouting (%)	0.9	1.8	32	0.1	0.8	1.0	1.5	1.8	3.6
Total qualitative Losses (%)	4.2	6.0	13.1	3.7	6.0	13.8	6.1	10.4	18.2

Table 54 : Behaviour of onion after low temperature storage

Period of cold storage - May 2001 to Aug. 2001 Period of ambient storage - Aug. 2001 to Oct. 2001

Period of storage	Losses (%)			
	Quantitative losses		Qualitative losses	
	PLW	Rotting	Sprouting	Black mold
15 days	4.5	0.0	27.1	0.8
30 days	13.2	1.1	29.7	1:5
45 days	23.9	2.5	32.2	5.8
60 days	34.2	3.7	33.8	15.2

Table 55: Storage losses in Farmers' onion storage structures

Total losses (%)	Farmers surveyed (%)
Up to 10	3.20
10 to 25	22.17
25 to 50	70.83
> 50	3.80

Table 56 : Maturity indices and harvesting methods

A)	Maturity Indices:	Farmers (%)
	i) Neck fall	93.0
	ii) Yellowing of leaves	1.0
	iii) Both	6.0
B)	Harvesing Methods	
	i) Manual uprooting	80.5
	ii) With hand hoe	19.5

Table 57 : Survey of onion storage structures in Maharastra

A. Capacity of structures

Capacity (tonnes)	Permanent %	Semi-Permanent %	Temporary %
0-10	9.52	42.86	75.80
10-20	28.8	11.43	20.96
20-30	35.71	17.14	1.61
30-40	9.52	14.28	3.23
40-50	21.42	14.28	0.00

B. Building Material

Part of structure	Type of material	Permanent %	Semi permanent %	Temporary %
A. Roof	Grasses	0.0	0.0	24.9
	Grass with polyethylene sheet	0.0	11.42	75.8
	G.I. Sheet	73.8	8.57	0.0
	Asbestos sheet	21.4	2.85	0.0
	Mangalore Tiles	4.8	77.14	0.0

B. Side Walls				
	Wheat straw	0.0	0.0	54.51
	Pigeon pea stalks	0.0	57.14	30.64
	Bamboo sticks	19.04	5.71	14.83
	Wooden bantam	52.38	25.71	0.0
	Chain links	26.19	5.71	0.0
	Others	2.38	5.71	0.0
C. Floor				
i) without ventilated	Kuchcha	24.32	29.13	100.0
	Sand filled	24.32	50.0	0.0
	Cemented	13.56	8.3	0.0
	Others	37.84	12.5	0.0
ii) bottom ventilated	Bamboo	6.25	25.0	0.0
	Iron stripes	12.5	0.0	0.0
	Wooden bantam	75.0	75.0	100.0
	RCC Sieves	6.25	0.0	0.0

C. Type of Structure

Storage structures	Bottom ventilated	38.09	11.42	1.61
	Without bottom ventilation	61.9	88.47	98.28

Table 58 : Performance of onion grader

Particulars	Capacity (t/hr)	% A Gr (60-80 mm)	% Range Difference	% B Gr (50-60 mm)	% Range Difference	% C Gr (35-50 mm)	% Range Difference
Manual Grading	0.1	20.9	21.4	50.5	35.0	28.8	26.1
Onion Grader	0.5	6.9	1.8	56.7	9.8	36.2	10.0
C.D (0.05)	1.2	5.5	-	N.S.	-	7.5	-

ARIS CELL

MARKET INFORMATION SYSTEM FOR ONION & GARLIC : Onion & Garlic Arrivals and Price information

Year of Start : 01 Jan 2001

Onion and Garlic produce being perishable in nature have short shelf life and therefore have to be traded immediately. Excess supply than demand particularly in the peak harvest season causes glut in the market resulting crash in prices and lower per unit return to the producers. Lack of information on the marketing trend and prices prevailing in different wholesale market of the country is great disadvantage to producers in scheduling their cultivation plans for better returns.

- Benefit of instant market information system i.e, Prices and arrival of onion, garlic in various markets can be taken by producers by selling the produce in near by markets where price expected prevail higher than local markets.
- To analyse the market arrivals and price trend to determine peak, lean and stabilization period and to emphasize marketing strategies to be adopted by farmers for optimum return of their produce.
- To embed the price and arrival information with our institute website, to view through Internet.

Package environment ...

Programming Language	:	Visual Basic 6.0 as Front end
Database	:	Microsoft Access as back end
Operating System	:	Windows 98 / 2000

This MIS consists of onion & garlic arrivals and prices data of various markets in data grid along with different types of graphical charts since it is easy to absorb graphical information than character text. A graphical interface allows the user to set and execute commands by direct manipulation.

The main screen consists two icons, one for Onion and other for Garlic. Further it is subdivided in to four forms consists of following details. -

- Onion Data entry form : input form for Arrival, Price, Year, Month, Market etc.
- Onion Marketwise arrivals : Report form to view market wise arrivals at particular year
- Onion Year wise for all markets : Report form to view market wise arrivals at particular year
- Onion Marketwise price trend : Report form to view market wise arrivals at particular year

and similarly four forms for Garlic market information.

Data source for this project has been obtained from NHRDF, NHB and local markets.

This Market information system presently covers 52 markets in India, mainly major onion growing areas; Maharashtra has been covered maximum and this were be extended to other states of India, collection of data is time consuming and this is the major task of the project, presently this is being collected from NHRDF, NHB and whole sale markets.

Further, the website of our institute has been re-designed and optimized and launched with NIC, Pune on 14 Mar 2002. The price and arrival information of onion is embedded with the website and the users can view the market information through Internet. The website is available at the following URL path "http://nrcog.mah.nic.in " This project can be extended further to view other information of onion and garlic e.g., area, production and productivity etc.

III. EDUCATION AND TRAINING

SPECIAL LECTURES

Speaker	Title	Venue
K.E. Lawande	Vegetable Cultivation	Vanvasi Kalyan Ashram, Pune on 27.04.2001
K.E. Lawande	Kanda Utpadan Va Vyavasthapan	Shramshakti Krishi Vidyalaya, Maldad, Sangamner, Ahmad Nagar on 13.09.2001
K.E. Lawande	Kanda Pikanche Niyojan	Wadu Budruk, Shirur, Pune on 14.09.2001
K.E. Lawande	Modernization in the Field of Agriculture	Rajguru Mahavidyalaya, Rajgurunagar on 15.09.2001
K.E. Lawande	Onion	Sant Ramjibaba Shetkari Mandal, Chandkhed, Maval, Pune on 25.10.01
K.E. Lawande	Onion-Garlic Production	All India Radio, Pune on 30.10.01
Md. A.A. Qureshi & V. Mahajan	Importance of Soil Testing in Agriculture & Onion Production Technology	Wadu Budruk, Pune organized by College of Agriculture, Pune on 26.12.01

TRANSFER OF TECHNOLOGY

- Farmers day was organized in this centre on 14th March 2002 in collaboration with IFFCO, Pune. Dr. S.N. Puri, Vice-Chancellor, MPKV, Rahuri was the Chief-guest on this occasion. More than 500 farmers actively participated. The Director and the scientists imparted knowledge on recent technology in onion and garlic production. Dr. J.P. Mahalle, Director of Horticulture, Govt. of Maharashtra inaugurated the exhibition.

- The web-site of NRCOG was launched on 14th March 2002 by Dr. S.N. Puri, Vice-Chancellor, MPKV, Rahuri. The website designed and developed in-house is also optimized for quicker down loads. The site provides information regarding origination, mandate, research projects and extension activities of the centre. The website address is "http://nrcog.mah.nic.in"

- Three-day farmers training was organized for two batches of farmers at this centre on 19-21and 26-29 March 2002 in collaboration with NHRDF, Nashik. About 100 farmers from Karnataka and Madhya Pradesh were given training on improved varieties, production and protection technology and seed production of onion and garlic.

PARTICIPATION IN EXHIBITIONS

Dr. V. Mahajan, A.P. Trivedi and S.S. Dhumal participated in Jai Kisan Agri-Exhibition at API Company Ground, Aurangabad on 2-5 Nov., 2001.

Dr. V. Mahajan and M.K. Chandraprakash participated in Agricultural Exhibition 2001 organized by NHRDF, Nasik at Bikramganj, Patna on 2-3 Dec., 2001.

Dr. V. Mahajan, Aziz Qureshi, V. Sankar and A.P. Trivedi participated in Krishi 2001 organized by Global Exhibitors at Govt. Engg. College Ground, Pune from 27-30 Dec., 2001.

IV AWARDS/RECOGNITION

Sankar, V., Scientist (Hort.) received the Best Paper Presentation award from Prof. S. Kannaiyan, VC, TNAU in the National Seminar on Changing Scenario in the Production Systems of Horticultural Crops from August 28-30, 2001 at TNAU, Coimbatore organized by South Indian Horticultural Society.

V PUBLICATIONS/PRESENTATIONS

Sankar, V., P.C. Tripathi and K.E. Lawande (2001). Value added Products of Alliums (Onion & garlic). *Kisan World*, Vol.28(4), April 2001:49-50.

Sankar, V., K.E. Lawande, A. Qureshi and P.C. Tripathi (2001). Drip and sprinkler irrigation in garlic. *Spice India*. 14(11):22.

Sankar, V., P.C. Tripathi, Md. A. A. Qureshi and K.E. Lawande (2001). Effect of organic seaweed extract on growth and yield of onion var. N-2-4-1. *South Indian Horticulture*, 50th year Special Vol.49:247-248.

Sankar, V., Md. A. A. Qureshi, P.C. Tripathi and K.E. Lawande (2001). Micro irrigation studies in garlic. *South Indian Horticulture*, 50th year Special Vol.49:379-381.

Kirtane, S., K.E. Lawande and K.N. Dhumal (2001). Mutagenic effects in onion i) Effect of sodium azide on physiological and biochemical changes in onion (*Allium cepa* L.). In : *UGC sponsored National Conference Plant Biotechnology for India Agriculture*, Abstracts and Souvenir, organized by Botany Research Centre, Vasantrao Naik Mahavidyalaya, Aurangabad from October 7-8, 2001:26.

Kirtane, S., K.E. Lawande and K.N. Dhumal (2001). Effect of EMS on physiological and biochemical changes in onion (*Allium cepa* L.). Ibid, pp:95.

Srinivas, P.S. and K.E. Lawande (2001). Critical growth stages in onion for thrips management. In : *Proceedings of the Second National Symposium on Integrated Pest Management (IPM) in Horticultural Crops: New Molecules, Biopesticides and Environment*, IPM in Horticultural Crops: Emerging Trends in New Millennium, published by AAPMHE, IIHR, Bangalore from October 17-19, 2001:96.

Srinivas, P.S. and K.E. Lawande (2001). Seedling root dip for management of thrips in *rabi* onion. Ibid, pp:73.

Dhumal, K.N., S. Kirtane, S. Datir and K.E. Lawande (2001). Studies on gamma radiation in induced cytological and biochemical changes in onion (*Allium cepa* L.). In : National Seminar on *'Role of Plant Physiology for Sustaining Quantity and Quality of Food Production in Relation to Environment'* from December 5-7, 2001:90.

K.E. Lawande, Vijay Mahajan and P. Kulkarni (2002). Kanda niryat va prakriya. *Shetkari*, Jan-Feb 2002, 11-15.

VI ON-GOING RESEARCH PROJECTS

Institute Projects

	Project Title	PI	CoPI(s)
01.	Allium Biodiversity : Collection, Characterisation, Evaluation and Maintenance of tropical onion (*Allium cepa* L.) and garlic (*Allium sativum* L.) germplasm	Anil Khar	Asha Devi, V. Mahajan P.S. Srinivas
02.	Heterosis breeding programme in Short-Day Tropical onion (*Allium cepa* L.)	Anil Khar	Asha Devi, V. Mahajan
03.	Allium inbreds : In vitro haploid production in onion (*Allium cepa* L.)	Asha Devi	Anil Khar
04.	Studies on somaclonal variation in garlic (*Allium sativum* L.)	Asha Devi	Anil Khar
05.	Development of Integrated Nutrient Management Package for Onion and Garlic	A.A. Qureshi	V. Sankar
06.	Screening onion and garlic germplasm for resistance to thrips, eriophyid mite	P.S. Srinivas	Anil Khar, V. Mahajan
07.	Integrated Pest Management in Onion	P.S. Srinivas	A.A. Qureshi

08.	Breeding white onions for processing and desirable horticultural trait	V. Mahajan	Anil Khar, Asha Devi, P.C. Tripathi
09.	Breeding yellow onion for export	V. Mahajan	Anil Khar, Asha Devi
10.	Creation of variability in garlic through mutation	V. Mahajan	Anil Khar, Asha Devi
11.	Varietal evaluation trial on onion and garlic under AICVIP	V. Mahajan	Anil Khar
12.	Irrigation studies in onion and garlic	V. Sankar	A.A. Qureshi, P.C. Tripathi
13.	Onion based cropping system	V. Sankar	A.A. Qureshi, P.C. Tripathi
14.	Market Information System for Onion and Garlic	M.K. Chandraprakash	V. Sankar
15.	Production technology for *kharif* onion	P.C. Tripathi	A.A. Qureshi, V. Sankar
16.	Post Harvest Studies in onion	P.C. Tripathi	V. Mahajan, A.A. Qureshi, V. Sankar

NATP

01.	Development of vegetable hybrids (Onion)	K.E. Lawande	V. Mahajan, Anil Khar
02.	Reduction of post harvest losses in fruits and vegetables (onion)	P.C. Tripathi	

Central Sector Scheme

01.	Organic cultivation in onion	K.E. Lawande	P.C. Tripathi
02.	Studies on intercropping of onion and other vegetables in sugarcane with different methods of planting/irrigation	K.E. Lawande	P.C. Tripathi
03.	Comparison of chemical sprout suppressant and irradiation on storage life of onion under different storage conditions.	K.E. Lawande	P.C. Tripathi
04.	Breeder seed production of B-780	V. Mahajan	Anil Khar

Revolving Fund Scheme

01.	Onion seed production	K.E. Lawande	P.C. Tripathi

VII INSTITUTIONAL MEETINGS

- First QRT meeting of the centre was held from 4-9th February 2002 and the final meeting from 20-21st May 2002 at this centre under the chairmanship of Dr. M.R. Thakur, Ex-Vice-Chancellor, Dr. YSPUH&F, Solan. The member were Dr. H.S. Gill, Ex-Head, Division of Veg. Crops, IARI., Dr. Narendra Singh, Ex-Head, Division of Veg. Crops, IARI, New Delhi, Dr. B.B. Lal Kaushal, Professor & Head, Dr. YSPUH&F, Solan, Dr. C.D. Mayee, Director, CICR, Nagpur and Dr. U.B. Pandey, Director, NHRDF, Nasik and Member Secretary, QRT. The team reviewed ongoing work and expressed full satisfaction about the progress made by the centre and suggested measures for further strengthening of NRCOG.

- The III SRC meeting was convened on 25-26th May 2001 in which the scientists presented and finalized their research projects.

- The III & IV RAC meeting were held on 20th April 2001 & 20.10.01 under the chairmanship of Dr. M.L. Pandita. Dr. P.C. Tripathi and Dr. V. Mahajan, Senior Scientist (Hort.) of the centre proposed new projects and an appraisal of the research programmes undertaken by the scientists was discussed.

- The IV IMC meeting took place on 19.10.01. Six new members were nominated viz., Dr. R.B. Deshmukh, Director of Research, MPKV, Rahuri, Dr. J.P. Mahalle, Director of Horticulture, Govt. of Maharashtra, Dr. N.M. Shah, Director of Horticulture, Govt. of Gujarat, Sh. Dhananjay Kumar, Patna, Prof. Rajendra Prasad Singh, Nalanda and F&AO, CIFE, Mumbai.

VIII PARTICIPATION IN CONFERENCES, SYMPOSIA, SEMINARS AND WORKSHOPS

K.E. Lawande, Director attended the International Conference on 'Sustainable development and sustainable Life system' at New Delhi organized by Bhoovigyan Vikas Foundation, New Delhi from 22-23rd April 2001.

P.C. Tripathi, Sr. Scientist (Hort.) attended NATP Technical Workshop from 3-4 July 2001 at CIPHET, Ludhiana.

V. Sankar, Scientist (Hort.) participated in National Seminar on Changing Scenario in the Production Systems of Horticultural Crops from August 28-30, 2001 at TNAU, Coimbatore.

K.E. Lawande, Director participated in workshop for NATP on development of hybrids in vegetable crops' at IIVR, Varanasi from September 25-26, 2001.

V. Mahajan, Sr. Scientist (Hort.) & M.K. Chandraprakash, Scienist (Computer Application in Agri.) participated in National Seminar on Production and Post Harvest Management of Vegetable Spices on December 2-3, 2001 at Bikramganj, Bihar organized by NAFED and NHRDF, Nasik.

K.E. Lawande, Director attended 'World Spice Congress 2002' at Cochin organized by AISEF and Spices Board of India, Cochin from 31st Jan to 2nd Feb 2002.

K.E. Lawande, Director attended National dialogue on 'Germplasm Management of Horticulture & Agro Forestry crops' from 27-28 Feb 2002 and acted as Panelist for session - IV organized by NBPGR, New Delhi.

K.E. Lawande, Director attended National seminar on 'Horticulture development in Chhattisgarh - Vision and Vikas' from 21-23 Jan 2002 organized by IGAU and Chhatisgarh Horticulture Society, Raipur and presented paper on 'Onion and Garlic Production - Potential and prospective in Chhatisgarh'.

K.E. Lawande, Director attended workshop organized by NCAP, New Delhi at IIVR, Varanasi from 1-2 March 2002 and presented paper on 'Impact of Vegetable Research in India'.

V. Mahajan, Sr. Scientist attended National workshop on 'Plant Variety Protection' held on 28 Feb - 1 March 2002 at Pune organized by Ministry of Agriculture, Govt. of India.

IX BRAIN STORMING SESSIONS

- A one-day Group Discussion on 'Post Harvest Management on Onion' was held at Rajgurunagar on September 21, 2001.
- A one-day Group Discussion on 'Management of Onion Thrips' was held at Rajgurunagar on October 6, 2001.

X SPORTS

A contingent of ten members from the Centre participated in the ICAR Inter-Institutional Zonal Sports Meet at CIAE, Bhopal from 3-6th Nov 2001.

XI PERSONNEL

Staff Position

S.No.	Category	Sanctioned Post	Filled	Vacant
1.	RMP	01	01	00
2.	Scientific	10	08	02
3.	Technical	08	07 + 01*	01
4.	Administrative	09	07 + 01*	02
5.	Supporting	07	07	00
	TOTAL	35	30 + 02*	05

* The above category-wise posts tranferred along with post from DWMR, Patna.

Name	Designation
Dr. K.E. Lawande	Director
Dr. P.C. Tripathi	Sr. Scientist (Horticulture)
Dr. V. Mahajan	Sr. Scientist (Horticulture)
Dr. A. A. Qureshi	Scientist (Soil Science)
Ms. Asha Devi, A	Scientist (Genetics/Cytogenetics)
Mr. Anil Khar	Scientist (Horticulture)
Dr. P.S. Srinivas	Scientist (Entomology)
Mr. V. Sankar	Scientist (Horticulture)
Mr. M.K. Chandraprakash	Scientist (Computer Application)
Mr. N. Gopal	Assistant Administrative Officer
Mrs. S.S. Joshi	Assistant
Mr. V.V. Patil	Technical Officer (T-5)
Mr. D.B. Mundharikar	PA to Director
Mr. N.L. Gore	T-4 Tech. Asstt. (Field/Farm)
Mr. A.P. Trivedi	T-4 Tech. Asstt. (Field/Farm)
Mr. H.S.C. Shaikh	T-4 (Computer Programmer)
Mr. S.P. Kandwal	Sr. Clerk
Mr. P.S. Tanwar	Sr. Clerk
Mrs. M.S. Salve	Sr. Clerk
Mrs. N.R. Gaikwad	Hindi Typist
Mr. R.K. Dedge	Jr. Clerk
Mr. D.M. Panchal	T-2 Tech. Asstt. (Field/Farm)

Mr. R.B. Baria	T-2 Tech. Asstt. (Field/Farm)
Mr. B.A. Dahale	T-2 Tractor Driver
Mr. S.P. Yeole	T-2 Jeep Driver
Mr. S.K. Said	S.S.Gr.III (Beldar)
Mr. P.R. Sonawane	S.S.Gr.II (Lab. Attendent)
Mr. P.E. Tadge	S.S.Gr.II (Lab. Attendent)
Mr. M.S. Kale	S.S.Gr.II (Lab. Attendent)
Mr. R.S. Kulkarni	S.S.Gr.I (Lab. Attendent)
Mr. S.D. Waghmare	S.S.Gr.I (Watchman)
Mr. N.H. Sheikh	S.S.Gr.I (Messenger)

TRANSFERS

Smt. M.S. Salve, Sr. Clerk and Shri V.V. Patil, T-5 (Farm) joined NRCOG on 06.05.2001 & 11.05.2001, respectively upon transfer from DWMR, PC Unit, Rahuri.

Sh. G.S.S.R. Krishnan, T-5 (Library) was transferred to NIANP, Bangalore on 18.08.01.

SUPERANNUATION

Dr. (Ms.) M.N. Maholay, Pr. Scientist (Pl. Pathology) retired on 31.03.2002.

HUMAN RESOURCE DEVELOPMENT

Mr. Anil Khar, Scientist (Horticulture) proceeded on Study Leave for pursuing Ph.D. at CCS Haryana Agricultural University, Hisar, Haryana.

TRAININGS

H.S.C. Shaikh, T-4 (Comp.) attended 'Java programming and Internet Technologies' at IASRI, New Delhi from 28.05.01 to 09.06.01.

R.B. Baria, T-2 attended short-term training course in 'Bee keeping' at CBRTI, Pune from 25.06.01 to 29.06.01.

M.K. Chandraprakash, Scientist (CA) attended '73 FOCARS' at NAARM, Hyderabad from June 1 - Sept., 28, 2001.

Asha Devi, Scientist (Genet.) attended 'NATP-TOE project on Human Resource Development in Plant Genetic Engineering and Molecular Breeding' at NRCPB, New Delhi from June 1 - Aug, 31, 2001.

K.E. Lawande, Director visited Egypt under 'Indo-Egypt work plan for studying onion and garlic production' at ARC, Egypt from July 6-12, 2001.

N. Gopal, AAO attended 'Refresher training course on O&M Reforms in Administrative and Financial Management' at NAARM, Hyderabad from July 23-31, 2001.

V. Mahajan, Sr. Scientist (Hort.) & Asha Devi, Scientist (Genet.) attended 'Training Programme on IPR and WTO Awareness' at CIFE, Mumbai from Sept, 18-20, 2001.

P.C. Tripathi, Sr. Scientist (Hort.) & V. Mahajan, Sr. Scientist (Hort.) attended 'Agricultural Research Prioritization and Impact Assessment' at NRCAP at TNAU, Coimbatore from Oct. 8-12, 2001.

M.K. Chandraprakash, Scientist (CA) attended 'Java Programming' at IASRI, New Delhi from Oct. 29 - Nov. 10, 2001.

XII DISTINGUISHED VISITORS

Name	Designation	Date of Visit
Mr. Paul Meyer	VP, John Deere with 10 member Team,	07.06.01
Dr. G.B. Raturi	Director, CIAH, Bikaner	13.06.01
Dr. P.L. Gautam	National Director, NATP, New Delhi	17.06.01
Mr. Purushottam Bhapkar	Registrar, MPKV, Rahuri	27.08.01
Mr. Phil Hancock	South Pacific Seeds, Griffith, Australia	25.09.01
Mr. U.C. Sarangi	Divisional Commissioner, Pune	02.10.01
Dr. S.A.H. Abidi	Member, ASRB, New Delhi	05.10.01
Dr. N.S. Talekar	Scientist, AVRDC, Taiwan	06.10.01
Dr. M.L. Pandita	Advisor, F&V Unit, NDDB, New Delhi	20.10.01
Dr. G. Kalloo	DDG (Hort.), ICAR, New Delhi	27.10.01
Dr. M.R. Thakur	Ex-Vice Chancellor, Dr. YSPUH&F, Solan	06.02.02
Total number of farmers visited		1238

XIII BUDGET

Allocation and Actual Expenditure of the Financial Year 2001-2002

(Rs. in Lakh)

Sr. No.	Head	Plan		Non-Plan		Total	
		Allocation	Actual	Allocation	Actual	Allocation	Actual
01.	Estt. Charges	27.50	33.95	14.44	11.29	41.94	45.24
02.	T.A.	2.25	3.85	2.00	0.45	4.25	4.30
03.	Other Charges	43.00	44.15	25.00	8.70	68.00	52.85
04.	Works	76.00	174.13	Nil	0.96	76.00	175.09
	Total	148.75	256.08	41.44	21.40	190.19	277.48

REVENUE GENERATION : Rs. 4,15,187/-

कार्यकारी सारांश

अपनी स्थापना से ही राष्ट्रीय प्याज एवं लहसुन अनुसंधान केन्द्र, प्याज एवं लहसुन के उन्नयन हेतु सक्रिय अनुसंधान कार्यो में जुटा है तथा वांछनीय औद्यागिक गुणों वाले पर्यावरण - मैत्रीय, कीट नाशक-पीड़क नाशक मुक्त उत्पाद प्राप्त करने के लिए उपयुक्त विधियाँ विकसित करने में सतत प्रयासरत है । अनुसंधान गतिविधियाँ मोटे तौर पर चार वर्गो में विभाजित हैं यथा - फसल उन्नयन, फसल उत्पादन, फसल संरक्षण तथा सस्योत्तर प्रौद्यौगिकी ।

फसल उन्नयन में अनुसंधान कार्य मुख्य तौर पर खरीफ तथा पछेती खरीफ मौसमों के लिए गहरे लाल रंग के तथा रबी मौसम के लिए गोलाभ आकार वाले हल्के लाल रंग के प्याज विकसित करने पर केन्द्रित है । इस वर्ष के दौरान गहरे लाल प्याज की १७ लाइनें खरीफ तथा १०३ लाइनें पछेती खरीफ मौसम में मूल्याकिंत की गयी । इसके अतिरिक्त २६ विदेशी संकर, स्थानीय अनूकूलित व्यावसायिक किस्मों तथा २ भारतीय संकरों का मूल्यांकन भी किया गया । सफेद प्याज की ३७० लाइनें महाराष्ट्र, गुजरात तथा मध्यप्रदेश राज्यों से एकत्रित की गयी । इनमें से ५२ लाइनें खरीफ, ५३ लाइनें पछेती खरीफ तथा ५१ लाइनें रबी मौसम में मूल्यांकित की गयी । दो नयी परियोजनाएं, निर्यात के लिए पीले प्याज का प्रजनन तथा उत्परिवर्तन से प्याज में विभिन्नताएं लाना, भी आरम्भ की गयी । अ. भा. स. स. वि. प. के अन्तर्गत, आठ प्रवेशिकाओं का मूल्यांकन किया गया ।

लहसुन की १३४ लाइनों तथा ३५ जनन द्रव्वों का मूल्यांकन किया गया । एसे. न. ६४,२०० तथा ३३६, स्थानीय चेक किस्म जी-४१ से अच्छे पाये गये । कायिक विधि से प्रवर्धित होने के कारण, लहसुन में विभिन्नताओं का उपयोग कन्द से पंक्ति चयन से किया जा सकता है । अत: ४० जनन द्रव्यों की २९४ कन्द से पंक्ति सन्ततियों का मूल्यांकन किया गया तथा इनसे उत्साहवर्धक परिणाम प्राप्त हुए । इसके अतिरिक्त लहसुन में उत्परिवर्तन द्वारा विभिन्नताएं लाने का कार्य भी आरम्भ किया गया ।

हिटरोसिस प्रजनन कार्यक्रम में एमएम ६५ के साथ बनाये गये संकर, एम एस ४०ए के साथ बनाये गये संकरों से अधिक उत्तम पाये गये । अगले वर्ष इन संकरों का पुन: बनाया जायेगा तथा इस वर्ष प्राप्त परिणामों की पुष्टि की जायेगी । उत्तक सम्वर्धन के क्षेत्र में हेप्लॉइड उत्पादन के लिए पुष्प कलिका के आकार का मानकीकरण किया गया तथा प्याज व लहसुन के सूक्ष्म प्रवर्धन में उत्साहवर्धक परिणाम प्राप्त हुए तथा लहसुन के सोमाक्लोनल विभिन्न बनाये गये ।

फसल उत्पादन में जैव उर्वरकों जैसे - एजटोबेक्टर तथा एजोस्पायरिलियम का प्याज तथा लहसुन का उपज तथा अन्य कारकों पर प्रभाव का अध्ययन किया जा रहा है । प्याज व लहसुन में पोटाश तथा जस्ते के प्रयोग से उपज बढाने पर भी प्रयोग किये जा रहे हैं । जैविक खेती के बढते महत्त्व को देखते हुए, जैविक खादों तथा रसायनिक उर्वरकों के तुलनात्मक अध्ययन के लिए प्रयोग आरम्भ किये गये हैं ।

हाल के वर्षो में मृदा उर्वरकता - उर्वरक उपभोग अनुसंधान, फसल क्रम पर केन्द्रित हुई है । अच्छी तरह निर्धारित कृषि परिस्थितिकीय क्षेत्रों में फसल क्रमों पर अध्ययन पोषक तत्वों के इस्तेमाल को इष्टतम करने तथा उपज को अधिकतम स्तर पर

ले जाने में सहायक सिध्द होगा । प्याज आधारित फसल क्रमों पर खरीफ, पछेती खरीफ तथा रबी मौसमों में अध्ययन किये गये । रोपाई विरुध्द सीधी बुवाई तथा बीज गोलिकाओं पर भी प्रयोग कर प्याज की उपजपर इनका प्रभाव देखा गया । सिंचाई की न्यूनतम मात्रा पर अधिकतम उत्पाद प्राप्त करने के लिए प्याज तथा लहसुन में सिंचाई विधियों पर प्रयोग किये जा रहे हैं । टपक सिंचाई विधि द्वारा १०० प्रतिशत वाष्पन (पैन इवेपोरेशन) स्तर पर परिणाम अन्य विधियों की तुलना में उत्तम पाये गये । खरीफ मौसम के लिए उत्पादन प्रौद्योगिकी की विकसित करने के लिए पौधशाला के लिए विभिन्न छाया करने वाली सामग्रियों, विभिन्न रोपण पध्दतियों, कटाई-पूर्व उपचार तथा विभिन्न उपचार की विधियों पर अनुसंधान कार्य जारी है ।

फसल संरक्षण में थ्रिप्स की जनसंख्या गतिकी पर शोध कार्य चल रहे हैं । केन्द्र द्वारा नाका फसल विधि द्वारा थ्रिप्स के प्रबन्धन की विधि विकसित की जा रही है । रोपाई से पूर्व जडों को डुबाकर उपचारित करने, उपचार की अवधि, तथा सिंचाई विधियों से थ्रिप्स के प्रबन्धन पर अनुसंधान कार्य किये जा रहे हैं । थ्रिप्स के प्रति अवरोधी / सहनशील जनन द्रव्यों की पहिचान के लिए एल सी आर (पत्ती वक्रता दर) तथा एल आई आर (पत्ती क्षति दर) विधियों पर प्रयोग किया जा रहा है । अब तक कोई भी जनन द्रव्य थ्रिप्स के लिए अवरोधी नही पाया गया हैं हालांकि कुछ जननद्रव्यों में इनके प्रति कुछ प्रक्षेत्र सहनशीलता पायी गयी है ।

सस्योत्तर प्रयोगो में, मौसमानुसार विभिन्नताओं, कन्द के आकार, ग्रीवा की मोटाई आदि कारकों का भण्डारण नुकसानों पर अध्ययन किया जा रहा है। किसानों द्वारा अपनायी जा रही प्याज के सस्योत्तर प्रबन्धन विधियों के बारे में जानने के लिए कृषक की पूर्व सस्योत्तर, तथा भण्डारण विधियों का अध्ययन किया जा रहा हैं । केन्द्र पर बनाये गये विभिन्न भण्डारगृहों का मूल्यांकन भी जारी है । इस केन्द्र ने एक रोलर आधारित हस्त चालित प्याज श्रेणीकरण यंत्र का विकास किया है जो प्याज को ५ वर्गो में वर्गीकृत करता है । यह यंत्र द्वारा मजदूरों द्वारा श्रेणीकरण की तुलना में पाँच गुना अधिक तीव्रता से ९५ प्रतिशत अचूकता तक कार्य करता है जब कि मजदूरों द्वारा श्रेणीकरण में अचूकता ७५ प्रतिशत तकही रहती है ।

इस वर्ष केन्द्र की अपनी वेब साइट विकसित कर, एन आई सी, पुणे द्वारा जारी गयी । यह वेब साइट यू. आर. एल. एच टी टी पी : /एन आर सी ओ जी. एम ए एच. एन आई सी. आई एन पर उपलब्ध है ।

ANNEXURE I

Common Abbreviations used

AGr	A Grade Bulbs
BBF	Broad based furrow
Blt.	Bolters
BGr	B Grade Bulbs
C	Colour
CGr	C Grade Bulbs
D	Doubles
DAP	Days After Planting
DAS	Days After Sowing
Dbls	Doubles
DM	Days of Maturity
DOH	Date of Harvesting
DOP	Date of Planting
DOS	Date of sowing
DOT	Date of Transplanting
E	Equatorial Diameter
FYM	Farm Yard Manure
NOC	No. of Cloves
NoClv	Average number of Cloves
NOL	No. of leaves
N	Neck Thickness
P	Polar Diameter
PE	Pan Evaporation
RBD	Randomised Block Design
RDF	Recommended dose of fertiliser
TSS	Total Soluble Solids