भाकृ अनुप
ICAR

वार्षिक प्रतिवेदन
ANNUAL REPORT
2002-03

राष्ट्रीय खरपतवार विज्ञान अनुसंधान केन्द्र
National Research Centre for Weed Science
Jabalpur - 482 004, M.P.

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NATIONAL RESEARCH CENTRE FOR WEED SCIENCE
JABALPUR (M.P.)

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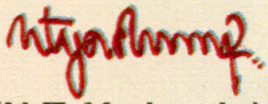
PREFACE

Weeds are ubiquitous and by virtue of their special traits pose a never-ending threat to agricultural production besides adversely impacting the management of all natural resources and environment. Appropriate and timely weed management in field crops can substantially contribute to enhancing agricultural production as uncontrolled weeds cause devastating yield losses in most crops inspite of using HYVs, improved crop management practices, application of adequate amounts of costly inputs like fertilizers, irrigation, insecticides etc. The NRCWS is unique and only Centre of its kind not only in India but the entire world, which is striving hard to solve the problems posed by weeds by a multi-disciplinary approach.

I have great pleasure in placing before you the major activities and accomplishments of the Centre during the year under report. The efforts of the scientists resulted in significant findings in the areas of identifying competitive crop cultivars, weed smothering intercrops, non-chemical and biological methods of weed control, weed dynamics in crops and cropping systems, management of parasitic weeds, allelopathic studies, testing of new herbicides and transfer of improved weed control technologies.

The year is significant in that for the first time a Winter School on 'Recent Advances in Weed Management' was organized which received exceptionally good response all over the country. A one-day training-cum-workshop on 'Role of Allelopathy in Weed Management' was conducted with a view to familiarize the scientists working in the area with the latest trends and techniques. A 'Kisan Samman Divas' was also organized which received overwhelming participation of about 300 farmers. Another significant trend is that the Centre is being increasingly recognized by different Universities of the country for training their students in research work.

I would like to place on record my sincere thanks to Dr. Mangala Rai, Secretary, DARE and Director General, ICAR for his unstinted support in the development of the Centre. Thanks are also due to Dr. J.S. Samra, Deputy Director General (NRM) and Dr. Gurbachan Singh, Assistant Director General (Agro), NRM for their valuable advice and guidance. The keen interest and suggestions by Dr. J.S. Kolar, Chairman and other members of the Research Advisory Committee in guiding the research activities of the Centre is greatly acknowledged. My sincere appreciation is due to the scientists of the Centre for their untiring enthusiasm in conducting the research and supplying the material for this report. I owe my heartfelt gratitude to the editorial committee comprising of Dr. BTS Moorthy, Dr. RP Dubey and Dr. MBB Prasad Babu for their painstaking and commendable efforts in compiling and editing the report. Thanks are also due to Dr. MS Raghuvanshi and Mr. Sandeep Dhagat and other technicals and administrative staff for helping in bringing out this publication.



(N.T. Yaduraju)
Director

EXECUTIVE SUMMARY

The research programmes at NRCWS during the year 2002-03 focused mainly on weed competitive crop cultivars, weed smothering intercrops, soil solarization, biological method of control, weed dynamics under cropping system, herbicide evaluation etc. The salient findings are as follows:

Weed competitive crop cultivars

Weed competitive crop cultivars could serve as useful component in integrated weed management. Vandana, Kalinga-III and RR-151-3 varieties of upland rice showed better weed competitive ability and reasonable yield potential under sub-optimal weed management system. Similarly, the chickpea variety-JG-16 had weed competitive capacity and was found promising under the same system.

Yield reduction due to the problem weed rice flatsedge (*Cyperus iria)* was higher in short statured upland rice varieties-Heera (30-60 per cent) and Annada (32-64 per cent) as compared to the semi-tall variety Vandana (27-50 per cent).

Weed smothering intercrops

In *kharif* maize, the adverse effect of weed competition could be minimized by growing cowpea (for grain) as an intercrop in between two normally-spaced rows of maize.

In upland direct-seeded rice, an integrated strategy of growing of cowpea or *dhaincha* as intercrop and pre-emergence application of pendimethalin (1.0 kg/ha) followed by a manual weeding at 20 days after sowing (DAS) was found appropriate for reducing weed competition.

Soil solarization-an effective approach for weed management

In soybean-wheat cropping system, soil solarization for a period of 5 weeks during the hot summer months with transparent polyethylene sheets decreased the emergence of dominant weeds viz. *Echinochloa colona*, *Phyllanthus niruri*, *Euphorbia hirta* and *E. geniculata* by over 85 per cent in soybean and *Phalaris minor*, *E. geniculata* and *Avena sterilis* by 100 per cent and *Chenopodium album*, *Medicago hispida* and *Convolvulus arvensis* by over 60 per cent in wheat. In both soybean and wheat, soil solarization combined either with reduced dose of herbicides (metolachlor in case of soybean and isoproturon in case of wheat each at 0.5 kg/ha) or a hand weeding provided season-long weed control and higher crop productivity.

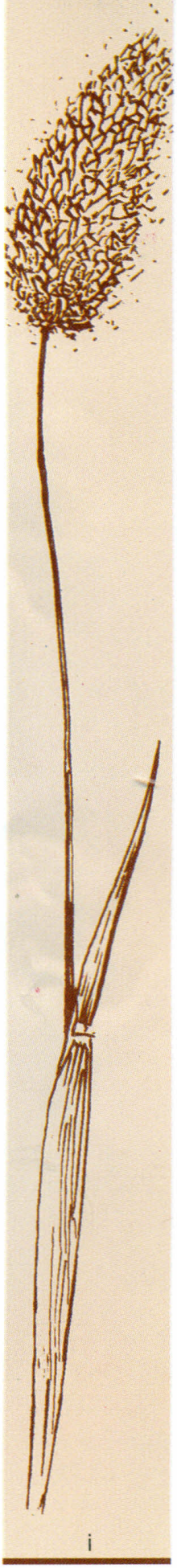
Water hyacinth as a mulch

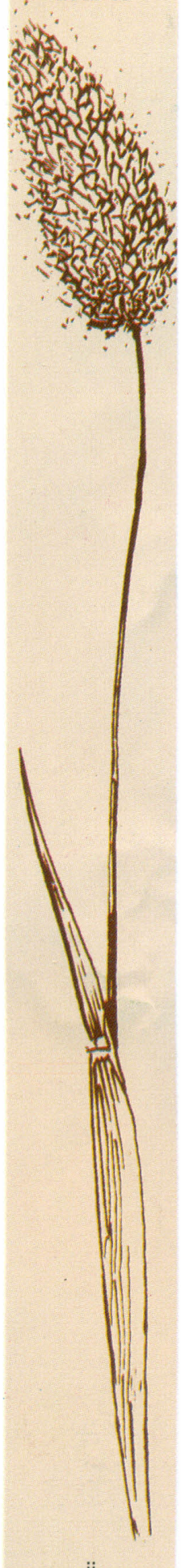
In potato, mulching with dry biomass of water hyacinth before or after emergence led to reducing the metribuzin requirement by half and improved the tuber yield substantially over weedy check.

Weed dynamics under cropping systems

In a seven year long-term field trial, it was found that continuous cropping of rice-wheat significantly reduced the infestation of problem weeds-*Cichorium intybus* and *Medicago hispida* in wheat while *Phalaris minor* was lowest in rice-lentil system.

In another similar trial, it was observed that the highest population of *Cichorium intybus*, *Medicago hispida* and *Chenopodium album* were observed under sorghum-chickpea system, whereas highest population of *Euphorbia geniculata* was observed under soybean-based systems and *Avena sterilis* under sorghum-based cropping systems.





The field trial carried out in the recent past has shown that zero-till planting of *rabi* crops is successful in rice-based cropping system even in deep balck cotton soils of Madhya Pradesh. No-till sowing of wheat reduced the infestation of *Phalaris minor*, but increased the problem of wild oat (*Avena sterillis* ssp. *ludoviciana*). Application of isoproturon at 1.0 kg/ha at 25 DAS effectively controlled all weeds except wild oats.

Competitiveness of weeds

Onion weed (*Asphodelus tenuifolius*) at densities of 25 800/m^2 caused yield reduction to the tune of 4.7 to 47 per cent in lentil and 5 to 19 per cent in chickpea. Wheat and mustard were highly tolerant to this weed, while pea was most susceptible. The broadleaved weed burclover (*Medicago hispida*) at densities of 10-640/m^2 caused yield reduction of 3 to 39 per cent in wheat.

Studies on parasitic weed *Cuscuta*

The field crops-chickpea, lentil and linseed were adversely affected by *Cuscuta* infestation while, *rajmash*; mustard and wheat were not affected. The density of this weed from 1 to 10 per m^2 caused yield reductions of 28 to 88 per cent in summer greengram and 39 to 98 per cent in niger.

Biological weed control

Turtle beetle (*Cassida* sp.) was found to damage alligator weed (*Alternanthera philoxeroides*) throughout the year virtually and is a potential bioagent for this problem weed.

New promising herbicides

In wheat, application of ready-mix formulation of flufenacet + metribuzin at 900 g/ha before irrigation reduced the weed growth effectively and improved grain yield. Application of carfentrazone ethyl at 20-25 g/ha was also effective in reducing the broad leaf weed population and higher grain yield of wheat.

In direct-seeded rice, post-emergence application of butanil (a ready-mix formulation of butachlor+propanil at 1.12+1.12 kg/ha), mixture of chlorimuron+ metsulfuron at 4 g/ha (as Almix), pyrazosulfuron at 25 g/ha performed better in reducing the weed population.

In soybean, the herbicide mixture of chlorimuron+fenoxaprop at 6+100 g/ha proved promising for broad-spectrum weed control and increasing seed yield.

Allelopathic studies

Among the allelo-chemicals tested, quercetin was lethal to floating (*Salvinia molesta* and *Azolla pinnata*) and submerged (*Najas graminea, Ceratophyllum demersum, Hydrilla verticillata* and *Chara* sp.) at 0.1 mM (30 ppm). Quinol was lethal to submerged aquatic weed *Chara* sp. at 0.1 mM (11ppm). Preliminary experimental results showed root dysfunction and resultant desiccation syndrome derived physiological changes involving cellular membrane integrity deterioration, loss of key enzymes and macromolecules resulting in the death of the treated plants.

The neem (*Azadirachta indica* A. Juss.) leaf residue caused root dysfunction and wilting and complete mortality of alligator weed (*Alternanthera philoxeroides*).

In field condition, there was significant reaction in height and dry weight of rice when grown in mixed culture with *Echinochloa colona* after 40 days onwards due to allelopathy. In wheat, decomposing rice straw leachates showed stronger adverse on in grain yield parameters and yield of wheat when grown mixed with *Phalaris minor* due to allelopathy.

effects on roots and shoot growth of wheat. Besides there was significant reduction in grain yield parameters and yield of wheat when grown mixed with *Phalaris minor* due to allelopathy.

On-farm demonstrations

Large-scale demonstrations conducted in farmers' fields proved the superiority of herbicides in controlling weeds in direct seeded rice. Pre-emergence application of butachlor 1.5 kg/ha followed by fenoxaprop 70 g/ha (25 DAS) or one hand weeding at 30 DAS provided effective control of weeds in upland direct-seeded rice.

Combination of isoproturon and 2,4-D each at 0.50 kg/ha applied at 30-35 DAS gave broad-spectrum weed control and higher yield of wheat. Application of clodinafop 60 g/ha was found very effective against wild oat in farmers' fields.

In chickpea and mustard, pendimethalin or isoproturon each at 1.0 kg/ha as pre-emergence sprays were found very effective. In pea, clodinafop at 60 g/ha as post emergence application was observed to be very effective. In non-cropped situation, parthenium was controlled effectively by metribuzin at 0.3 per cent without adversely affecting native grasses. Application of 2,4-D at 0.75 kg/ha controlled perennial weed *Ipomoea carnea*.

Strenuous efforts were made to create public awareness about noxious weed parthenium through lectures, demonstrations, workshops etc. Free distribution of bioagent Mexican beetles-*Zygogramma bicolorata* was made to the interested parties and AICRP-WC centres

AICRP on Weed Control

In Western Himalayas and Sub-humid region, continuous use of butachlor and anilophos in transplanted rice encouraged weeds like *Fimbristylis miliacea, Caesulia axillaris* and *Commelina benghalensis,* while in wheat, the use of isoproturon led to the prevalence of *Medicago denticulata, Lathyrus aphaca* and *Melilotus indica.*

In Western Ghats and Coastal Plains, the infestation of *Echinochloa* spp., and *Marsilea quadrifolia* are becoming dominant.

In direct-seeded rice, application of pretilachlor + safener 0.45 kg/ha followed by one manual weeding (35 DAS) registered lower weed dry matter accumulation in Eastern Ghats (T.N. uplands) and Deccan Plateau Eco-region.

In cotton, directed application of glufosinate ammonium at 0.75 kg/ha provided effective control of weeds including perennial one like *Cyperus rotundus*.

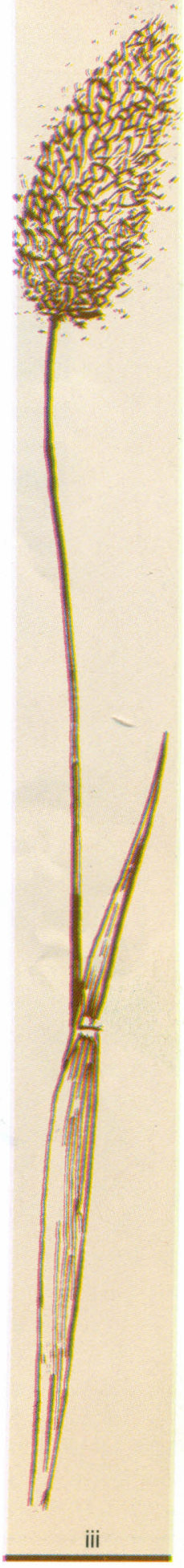
In wheat, post-emergence application of a mixture of metsulfuron and iodosulfuron (1.2 +1.4 g/ha) effectively controlled *Phalaris minor* and also non-grassy weeds in Northern Plains and Hot Sub-humid Eco-region. Application of trifluralin (0.75 & 1 kg/ha) either before or after first irrigation coupled with one hand weeding proved very effective against isoproturon-resistant populations of *P. minor* in wheat.

Effective control of the problem weed-*Oxalis latifolia* was recorded in farmers' fields with glyphosate (1 kg/ha). Spraying atrazine (1 kg/ha) with surfactant or broadcasting after mixing with sand (150 kg/ha) at 2-3 leaf stage was found to control *Ageratum houstonianum.*

In sunflower, pre-sowing application of glyphosate (2 kg/ha) alongwith activator, AG-F (0.5 l/ha) controlled the weeds effectively.

In potato, clomazone+pendimethalin (125+500 g/ha) provided effective control of weeds and increased tuber yield in Northern Plain Zone.

The parasitic weed Orobanche was found to infest tomato crop in dry belt of Karnataka.



INTRODUCTION

Since times immemorial weeds are considered to be an important factor in the management of all terrestrial and aquatic resources besdies agriculture. In view of the severity of the wed problems, a Coordinated Weed Control Scheme was initiated as early as 1952. Later in 1978, to intensify the research work All India Coordinated Research Program (AICRP) on Weed Control was launched.

To further consolidate the weed management research in India, the National Research Centre for Weed Science (NRCWS) was set up in 1989 as a nodal centre for basic as well as applied research under the aegis of ICAR. The Centre also coordinates the activities of the AICRP-WC with a network of 22 cooperating centres located in different agro-climatic zones covering the entire country. The Centre has a well-qualified and multidisciplinary team of scientists engaged in different aspects of weed management research.

MANDATE

- To undertake basic and applied researches for developing efficient weed management strategies in different agro-ecological zones;
- To provide leadership and coordinate the network research with State Agricultural Universities for generating location-specific technologies for weed management in different crops, cropping and farming systems;
- To act as a repository of information in weed science;
- To act as a centre for training on research methodologies in the areas of weed science and weed management;
- To collaborate with national and international agencies in achieving the above mentioned goal;
- To provide consultancy on matters related to weed science.

Location

The Centre is located between 22.49° and 24.8 ° North latitude, 78.21° and 80.58° East longitude and at an altitude of 411.78 metres above the mean sea level. Jabalpur comes under the agro climatic region of Kymore Plateau and Satpura Hills and lies in the rice-wheat cropping zone of the state.

Weather

The climate of Jabalpur region is typically sub-humid and subtropical. Rainy season usually begins from 15th June and extends up to early October. More than 80 per cent of the 1253 mm normal annual rainfall comes in southwest monsoon season. The post-rainy season (mid-October to January), also known as the post-

monsoon or *rabi* is dry and cool with short days. The hot dry-summer season starts from February and lasts until rains begin again in June.

Laboratories

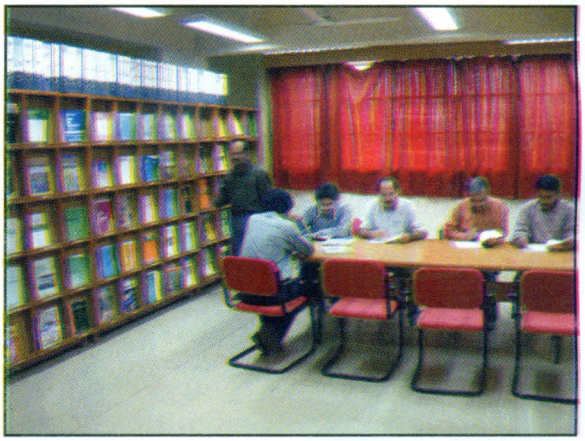
The Centre has well equipped laboratories having sophisticated instruments like HPLC, GLC, micro-processor based UV- visible spectrophotometer, universal resear-ch microscope with photographic attachme-nt, stereo zoom research microscope, high speed refrigerated centrifuge, Millipore filter assembly, besides other commonly used scientific equipments. A self-recording modular multi-channel automatic weather station.

ARIS Cell

Centre's ARIS cell is presently equipped with one server and four PCs, two scanners, three laser printers etc., with latest software. It has Internet facility at three nodes. In addition, all the scientist have also been provided with computer facilities. The Centre's website was launched by the then Hon'ble Minister for Agriculture Sh Nitish Kumar.

Library

At present the library is having a total collection of 1176 books. It has modern facilities such as CAB-PEST and CAB-SAC CD-ROMs and Current Contents on Diskette (CCOD) on biological sciences. The library subscribes to 65 Indian and 10 foreign journals. Reprographic and documentation facilities such as lamination and spiral binding machines are available for preparation of documents and reports. Digitization of library information under NATP funded project has been done and it is under operation.



Research farm

The Centre has a well-developed 61.5 ha land with adequate farm machines, irrigation systems both conventional and sprinkler and an automatic weather station. Three poly/net houses and a quarantine net house have been constructed to conduct pot culture experiments. The soil of the research farm is medium black (*Typic Haplustert*) and moderately alkaline.

Works

Construction of approach road to the lab-cum-office building and main gate are on the verge of completion. Besides this, the construction of overhead tank and quarant-ine insectory lab are also nearing completion and as per the target date given by the CPWD these works are to be completed by the end of December, 2003.

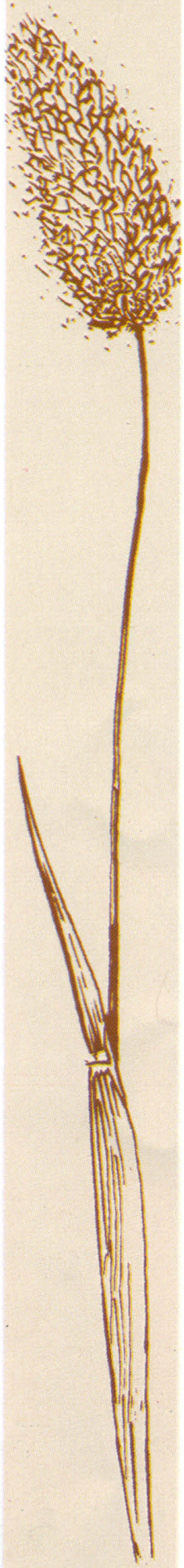
AICRP-Weed Control

NRCWS acts as the coordinating centre for the All India Coordinated Research Project on Weed control (AICRP-WC), which has 22 cooperating centres, located in various State Agricultural Universities to undertake applied research related to site-specific problems concerning weed manage-ment.

Organizational set up

ORGANOGRAM OF NRCWS

- **Research Advisory Committee**
- **DIRECTOR**
- **Quinquennial Review Team**
- **Staff Research Council**
- **Management Committee**
- **Sections**
  - Weed Management
  - Biology and Ecology of Weeds
  - Biological Weed Management
  - Weed Physiology, Residue Chemistry and Biotechnology
  - Mechanical Weed Management
  - Transfer of Technology
- **AICRP - WC Cell**
  - AICRP - WC Centres located at 22 different SAU's are :
  - Ludhiana, Hisar, Pusa, Anand, Palampur, Ranchi, Pantnagar, Raipur, Kanpur, Faizabad, Sriniketan, Jorhat, Gwalior, Dapoli, Bhubaneshwar, Bikaner, Parbhani, Bangalore, Dharwad, Thrissur, Coimbatore, Hyderabad
- **Administration Audit and Accounts**
- **Service Cell**
  - Director's Technical Cell
  - ARIS Cell
  - Library
  - Research Farm and Estate
  - Farm Machinery and Workshop
  - Security



Staff and finance

NRCWS has a sanctioned cadre strength of 27 scientists, 28 technical, 13 administrative and 23 supporting staff. The current staff position as on 31.03.2003 was 17 scientists including one post of RMP, 25 technical, 10 administrative and 23 supporting. The annual budget of the Centre for the year 2002-2003 is indicated in the table. The Centre also generates resources through the sale of farm produce and testing of new herbicide formulations provided by the industries.

Staff position as on 31.3.2003

Categories	Sanctioned	Filled
Research	01	01
Management Position (RMP)		
Scientific	26	16
Technical	28	25
Administrative	13	10
Supporting	23	23
Total	91	75

Budget and expenditure for the year of 2002 -2003

(Rs. in lakhs)

Head	2002-2003	
	Allocation	Expenditure
Plan		
Establishment charges	28.00	27.99
Traveling allowance	3.00	2.77
Other charges	66.00	65.17
Works	31.00	30.20
HRD	2.00	1.86
Total	**130.00**	**127.99**
Non-plan		
Establishment charges	100.00	75.64
OTA	0.03	0.03
Traveling allowance	1.20	1.20
Other charges incl. equipments	39.00	38.81
Works (repair & maintenance)	2.77	2.76
Total	**143.00**	**118.44**

RESEARCH HIGHLIGHTS

Competitive crop cultivars

Role of weed competitive crop cultivars in integrated weed management

Crop cultivars vary in their ability to compete with weeds because of their differential plant type, morphological characters and canopy formation besides their tolerance levels for competitive stresses. Growing of such varieties help in minimizing investment on direct weed control measures. Studies were initiated to screen and identify such varieties in different crops.

Upland rice

To test the weed competitiveness and relative performance of upland rice varieties under sub-optimal weed management practic-es, an experiment was conducted during *kharif* 2002. Ten upland rice varieties of early duration *viz.*, Kalinga-III, Vandana, Heera, JR-75, JR 199, JR-201, RR-51-1, RR-151-3, Annada, CR-749-20-2 were tested under 3 weed management practices unweeded control, single hand weeded and weed free conditions. The experimental site was infest-ed by the weeds *viz.*, *Alternanthera sessilis*, *Physalis minima, Caesulia auxillaris, Phylla-nthus niruri, Cynodon dactylon, Ageratum conyzoides, Corchorus sp., Echinochola colo-na* and *Cyperus iria* with a predominance of mostly broadleaf weeds. The results revealed that highest grain yield (1143 kg/ha) was recorded under single hand weeded condition in Kalinga-III followed by RR-151-3 (1173 kg/ha). The other promising varieties were JR-199 and Vandana. During this year because of severe drought in July month, the crop suffered a lot and the weed incidence in single-hand weeded condition also produced very high dry weight of weeds (3210 kg/ha) as against 4520 kg/ha under unweeded condition. During the previous year, Vandana and RR151-3 performed well under single hand weeded condition. Based on the two years' experiments, it can be inferred that the varieties RR151-3, Kalinga-III and Vandana have better weed competitive abilities and reasonable yield potential.

Another investigation was carried out to find out relative competitive abilities of different upland rice varieties against problem weed-rice flat sedge (*C. iria*). Three varieties of upland rice *viz.*, Vandana (semi-tall variety), Heera and Annada (dwarf varieties) were tested under 5 densities of *C. iria* i.e., 0 to 100/m^2. The results revealed that the grain yield reduction due to the weed was higher in short statured varieties Heera\ (30 to 60%) and Annada (32 to 64%) as compared to semi-tall variety Vandana (27 to 50%).

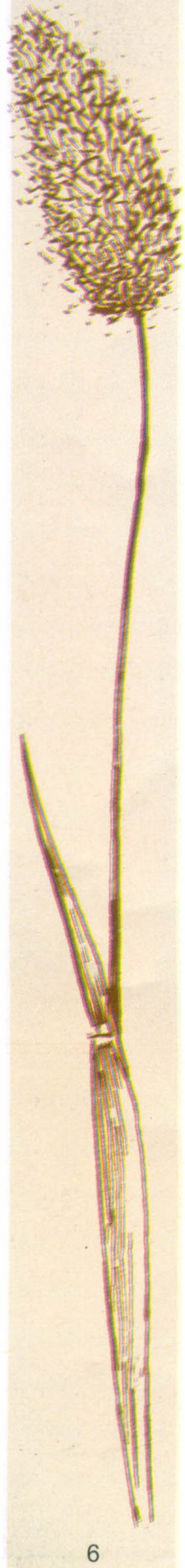
Effect of densities of *C. iria* on grain yield (g/m^2) of upland rice

Rice variety	Density of *C. iria* (no/m^2)				
	0	10	25	50	100
Annada	110	75	58	58	40
Heera	100	70	60	50	43
Vandana	120	88	80	70	60

LSD (P=0.05) for V:98.4; D:7.8; VxD:NS

Chickpea

In order to identify a suitable weed competitive chickpea cultivar, an experiment was conducted with 10 released and pre-release varieties, which were grown under unweeded, single hand weeded and weed free conditions during *rabi* 2001-02. The field was mainly infested by *Cynodon dactylon, Phalaris minor, Chenopodium album, Medi-cago hispida* and *Vicia sativa.* Results revealed that the lowest mean dry weight of weeds (1.2 t/ha) was recorded with the variety JG-16 followed by JG-11(1.2 t/ha) and JG-315 (1.4 t/ha). The variety JG-16 produced highest yield under single-hand weeded as well as unweeded condition. JG-218 produced highest yield under weedy



condition. It is postulated that certain varieties are more competitive with weeds because of their growth habits. Some varieties have higher tolerance level to weeds and produce better yields even under high weed competition stress. The varieties with both yield performance and moderate to high weed competition abilities are to be chosen.

Performance of chickpea genotypes under weed management practices

Variety	Weedy		HW once		Weed free
	Weed dry weight (t/ha)	Seed yield (t/ha)	Weed dry weight (t/ha)	Seed yield (t/ha)	Seed yield (t/ha)
JG1	3.62	1.08	3.41	1.47	1.46
JG7	2.12	1.47	1.74	1.78	2.44
JG11	1.55	1.36	0.84	1.77	1.96
JG16	1.04	1.43	1.28	2.23	2.36
JG63	3.75	1.50	1.00	1.93	2.15
JG130	1.78	1.71	2.16	1.97	2.81
JG218	2.20	1.77	0.57	1.84	1.85
JG315	1.70	1.64	1.19	1.87	1.72
JG322	3.42	1.46	1.01	1.84	1.76
JKG923	2.70	1.05	0.62	1.38	1.73

LSD(P=0.05)		DW of weeds	Seed yield
Weed	:	0.16	0.21
Variety	:	0.03	0.36
WiVi WiVj	:	0.04	NS
WiVi-WjVi	:	0.10	NS

Wheat

In order to find out a suitable wheat cultivar for sub-optimal weed management condition, a field experiment was conducted during *rabi* 2001-02 season in which 18 wheat varieties were tested under weedy, single hand weeded and weed free conditions. In general weed incidence in the fields was less even in unweeded condition and hence significant differences regarding grain yield among weed management practices were not observed. Among the different varieties, HI-8498 produced highest yield of 7.52 t/ha followed by GW-273 (7.2 t/ha) and HI-1077 (7.1 t/ha). This trial needs repetition during the coming *rabi* season.

Weed smothering intercrops

Effect of intercrops, weed control and nitrogen in maize - wheat

A field experiment was conducted during *kharif* season of 2002 to study the effect of intercrops, weed control and nitrogen on weed incidence and yield of maize. Three levels of cropping systems, two levels of weed management and three levels of nitrogen were arranged in a split-split plot design with three replications. The major weed flora observed were *Echinochloa colona*, *Euphorbia geniculata*, *Dinebra* sp., *Phyllanthus niruri*, *Cyperus iria*, *Ageratum conyzoides*, *Commelina communis* and *Physalis minima*. The adverse effects of weed incidence on grain yield of *kharif* maize crop could be minimized by growing cowpea for grain purpose as intercrop in between two rows of maize grown at 60 cm. An increase of 13% in maize grain yield could be obtained along with an additional cowpea yield of 211 kg/ha.

Treatments	Weeds* (no. & dry wt)		Yield (t/ha)	
	no/m²	g/m²	Maize	Intercrop
Intercropping systems				
Maize sole	9.4	6.8	3.40	
Maize+cowpea (G)	7.4	6.3	3.85	0.21
Maize+cowpea (F)	7.8	5.5	2.90	8.67#
LSD (P=0.05)	0.8	0.5	0.60	
Weed management				
Unweeded	11.1	8.9	2.38	
Pendimethalin 1.0 kg/ha+1HW	5.4	3.5	3.42	
LSD (P=0.05)	1.1	0.3	0.33	
Nitrogen levels (kg/ha)				
0	8.6	6.5	2.40	
50	7.9	5.7	3.39	
100	8.1	6.4	4.37	
LSD (P=0.05)	0.9	0.4	0.48	

* Data subjected to square root transformation;
G : grain; F : fodder; # Fresh biomass

Interaction effect on grain yield (t/ha) of maize

Treatments	Unweeded			Pendimethalin		
	N 0	N50	N100	N 0	N50	N100
Maize sole	1.72	2.71	3.75	3.09	4.31	4.84
Maize+ cowpea (G)	2.32	3.92	4.95	2.70	3.70	5.53
Maize+ cowpea (F)	2.18	2.25	2.70	2.36	2.91	4.99

LSD (P=0.05) for IC x W x N = 1.16 t/ha;

Maize sole (unweeded)

Maize + cowpea (unweeded)

In order to ascertain the residual effects of treatments i.e., intercropping (maize sole, maize + soybean, maize + cowpea), weed control (unweeded, pendimethalin 1 kg/ha +1 HW) and nitrogen levels (0, 50 and 100 kg/ha) in *kharif* maize, a wheat crop was grown in the same layout given in rabi season. The differences in weed flora and grain yield of wheat due to treatment were non- significant. However, some advantage in grain yield of wheat was noted under intercropping treatments i.e., maize + cowpea (3.0 t/ha), maize+soybean (2.9 t/ha) as compared to maize sole (2.5 t/ha).

Influence of intercrops and weed management on direct-seeded rice

Weed competition is the prime constraint reducing yields of direct seeded upland rice. Intercropping with weed suppressing crops may be one of the options for weed management in this crop.

A field experiment was therefore conducted during *kharif* 2002 to evaluate intercrops for weed suppression in direct-seeded rice. Three intercrops i.e., soybean, *dhaincha* (*Sesbania aculeata*) and cowpea (fodder) were grown with rice in paired rows (15/25cm) along with rice sole treatment in main plots. Three weed control practices *viz.*, pendimethalin 1.0 kg, pendimethalin 1.0 kg/ ha + 1HW 20DAS and unweeded, comprised the sub-plots arranged in a split-plot design with three replications.

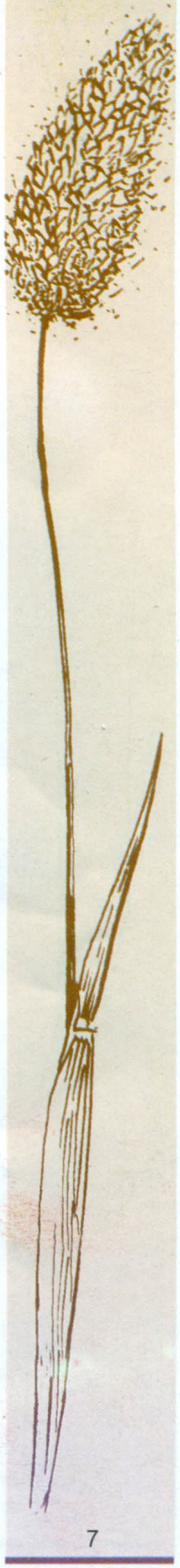
Treatments	Weeds* (no. & dry wt)		Yield (kg/ha)		WSE (%)
	no/m^2	g/m^2	Rice	inter crop	
Intercrops					
Rice sole	8.7	20.0	651		-
Rice + soybean	7.8	18.2	489	171	18.2
Rice + cowpea	7.5	15.5	847	5967	41.2 #
Rice + dhaincha	6.8	15.9	892	6767	37.7 #
LSD (P=0.05)	0.2	1.3	86		
Weed control					
Pendimethalin 1kg/ha	7.5	19.5	477		
Pendimethalin 1 kg/ha+1HW	5.4	12.6	1523		
Unweeded	10.2	20.2	159		
LSD (P=0.05)	0.2	1.6	52		

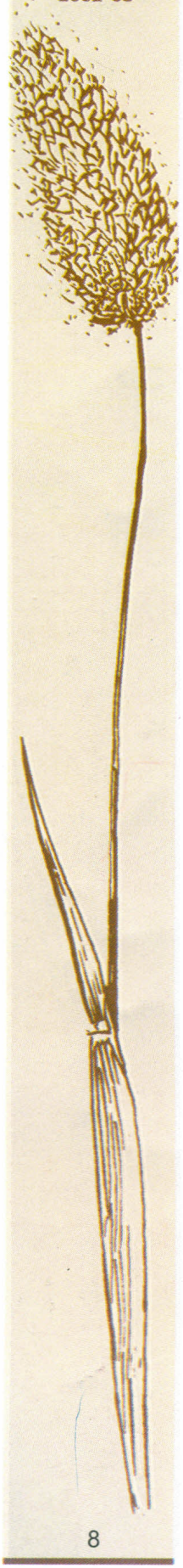
WSE - Weed smothering efficiency,

* Data subjected to square root transformation,

Fresh biomass

The major weed flora observed were *Echinochloa colona, Commelina communis, Dinebra* sp., *Cyperus iria, Phyllanthus niruri, Euphorbia geniculata*





and Physalis minima. It was observed that the crop encountered severe competitive weeds resulting in its almost failure under unweeded situation. Growing of intercrop such as cowpea or *dhaincha* for 30 days minimized the weed incidence considerably. An integrated weed control strategy by growing cowpea as intercrop and application of pendimethalin 1.0 kg + one HW at 20 days resulted in 10 % increase in rice yield and an additional green fodder yield of about 6.0 t/ha.

Interaction effects on grain yield (kg/ha) of rice

Treatments	Pendime-thalin	Pendime-thalin + 1HW	Unweeded
Rice sole	321	1588	44
Rice + soybean	309	1133	25
Rice + cowpea	535	1746	259
Rice + *dhaincha*	744	1626	306
LSD(P=0.05)		105	

Soil solarization

A field experiment was conducted to assess the effectiveness of soil solarization against weeds in crops in soybean-wheat cropping system under 2 tillage practices. Soil solarization for a period of 5 weeks during hot summer months with transparent polyethylene decreased the emergence of dominant weeds *viz. Echinochloa colona*, *Phyllanthus niruri*, *Euphorbia hirta* and *E. geniculata* by over 85% in soybean and *Phalaris minor*, *E. geniculata* and *Avena sterilis* by 100% and *Chenopodium album*, *Medicago hispida* and *Convolvulus arvensis* by over 60% in wheat. In soybean crop, soil solarization for a period of 5 weeks either with reduced dose of herbicide (metolachlor 0.5 kg/ha) or 1 hand weeding at 20 DAS significantly reduced the weed population and its dry matter production and gave maximum seed yield as compared to herbicide-treated plots and weedy check. The response of soil solarization was more promi-nent under tilled condition. No- till condition registered significantly higher weed populat-ion and its dry weight. Despite effective control of weeds either through soil solarizat-ion or its integration with herbicide and hand weeding under tilled condition, significantly higher seed yield of soybean was recorded under no- till condition. The reason could be due to severe infestation of yellow mosaic virus under tilled condition, which adversely affected the crop.

Treatments	Weeds*(no. & dry wt)				Seed yield	
	(no./m^2)*		(g/m^2)*		(kg/ha)	
	CT	ZT	CT	ZT	CT	ZT
Solarization	5.9	4.8	6.0	10.4	304	383
Metolachlor 0.5 kg/ha	10.3	15.3	58.0	20.1	122	238
Metolachlor 1.0 kg/ha	7.6	12.4	7.9	16.1	246	361
Metolachlor 1.5 kg/ha	6.6	10.3	7.8	15.5	212	413
SS+ Metolachlor 0.5 kg/ha	3.5	5.7	4.1	3.9	322	570
SS+ Metolachlor 1.0 kg/ha	3.4	2.9	3.2	4.9	306	592
SS+ 1HW at 20 DAS	1.8	4.2	3.1	2.6	337	615
2 HW at 20&40 DAS	4.3	5.4	2.9	4.6	269	694
Weedy Check	12.2	17.0	11.3	18.2	114	155
Mean	6.2	8.7	6.0	10.7	248	447
LSD (P=0.05)	1.12	2.39	0.68	1.82	74	156

* Data subjected to square root transformation;

HW- hand weeding, DAS- days after sowing, CT- Conventional tillage, ZT- zero-tillage, SS- soil solarization

In wheat, soil solarization supplemented with either herbicide or hand weeding gave effective control of weeds and maximum grain yield under tilled condition as compared to no-till condition. It may be concluded from this study that a season-long weed control and maximum grain yield of crops could be achieved through soil solarization for a period of 5 weeks during hot summer months either with reduced dose of herbicide or hand weeding at 20 DAS.

Treatments	Weeds* (no. & dry wt)		Grain yield
	(no./m^2)	(g/m^2)	(t/ha)
Tillage			
No-till	5.3	2.1	4.613
Conventional tillage	5.9	2.2	4.567
LSD (P=0.05)	NS	NS	NS
Weed Control			
SS 5 weeks	5.0	1.6	4.5
Isoproturon 0.5 kg/ha	6.4	2.8	3.9
Isoproturon 1.0 kg/ha	5.0	2.2	4.6
SS + Isoproturon 0.5 kg/ha	4.0	1.6	5.1
SS +Isoproturon 1.0 kg/ha	3.7	1.5	5.0
SS + 1 hand weeding	3.3	1.2	4.9
1 hand weeding	7.9	2.4	4.7
Weedy check	10.4	4.2	3.8
LSD (P = 0.05)	2.5	0.8	0.5

*Data subjected to square root transformation

SS- soil solarization

Mulching and weed management

Effect of water hyacinth mulching on weed infestation and yield of potato

A field experiment was conducted during *rabi* 2002 to study the feasibility of using water hyacinth mulch as a component of weed management in potato. Results revealed that compared to weedy check, weed population significantly was decreased in the plots that received only water hyacinth mulching and the values were comparable to those recorded under recommended dose of metribuzin (PE). The lowest weed population was recorded in the plots that received both mulching and herbicide application. Similar trend was noticed in case of weed dry matter.

Tuber yield increased significantly due to water hyacinth mulching over weedy check, but it was lower than that recorded under conventional practice of earthingup or recommended level of metribuzin. On the basis of tuber yield produced, the data showed that the water hyacinth mulching in potato could cut down the herbicide requirement by 50 %.

Cropping system and weed management

Effect of rice-based systems on the intensity and diversity of weed flora

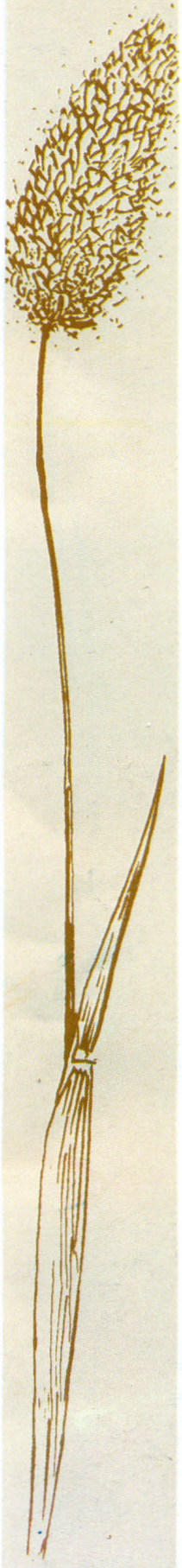
Distribution of weed flora under rice based cropping systems was studied in a long-term field experiment.

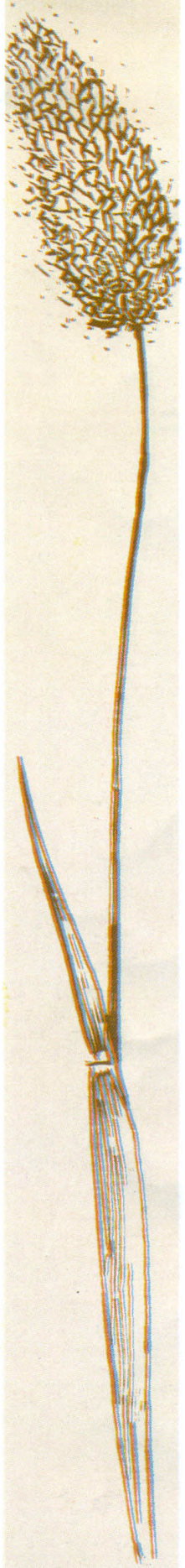
The lowest populations of *Cichorium intybus* and *Medicago hispida*, were recorded under continuous rice-wheat system while that of *P. minor* with continuous rice-lentil system. Significantly higher population of *Medicago hispida* and *Cichorium intybus* were recorded both under continuous rice-mustard and rice-lentil systems and also in the systems where mustard and lentil crops were grown in rotation.

Treatments	Weeds* (no. & dry wt)		Wheat equivalent yield (t/ha)
	(no./m^2)	(g/m^2)	
Cropping systems			
Rice-wheat	13.11	5.49	2.1
Rice-mustard	14.11	7.98	1.2
Rice-lentil	11.43	6.42	-
Rice-wheat	13.32	8.08	1.5
Rice-wheat	12.37	6.44	2.2
Rice-mustard	11.24	5.70	1.0
LSD (P=0.05)	NS	NS	0.7
Weed control			
Weedy check	16.49	9.97	1.1
HW *fb.* H	11.98	6.87	1.7
H *fb.* HW	9.94	4.43	1.9
H *fb.* H	11.98	5.48	1.7
LSD (P=0.05)	1.32	1.01	0.2

* Data subjected to square root transformation, fb.-followed by, H-herbicide, HW-Hand weeding

Inclusion of mustard and lentil in systems reduced the population of *Chenopodium album*. Although rice-based cropping systems did not influence the total weed population and its dry weight but lower weed population and weed dry weight were recorded with continuous rice-lentil or where lentil crop





was grown in rotation. All the weed control treatments gave significantly lower weed population and weed dry matter. Higher wheat equivalent yield was recorded under continuous rice-wheat or where lentil was grown in rotation.

Weed dynamics as influenced by maize, sorghum and soybean-based systems

A field experiment (long-term) was conducted to study the changes in weed flora with soybean-wheat, soybean-chickpea, maize-wheat, maize chickpea, sorghum-wheat and sorghum chickpea cropping systems. All these cropping systems were superimposed with four weed control practices in a factorial randomized block design with three replications.

Treatments	Weeds* (no. & dry wt)		Wheat equvilant yield (t/ha)
	(no./m^2)	(g/m^2)	
Cropping system			
Maize-chickpea	7.93	4.49	1.52
Maize-wheat	8.45	6.89	3.6
Sorghum-chickpea	11.27	7.20	0.62
Sorghum-wheat	11.45	9.08	3.12
Soyabean-chickpea	7.68	4.57	2.22
Soyabean-wheat	8.04	5.46	3.80
LSD (P=0.05)	2.88	2.05	0.39
Weed control			
Weedy check	11.50	9.60	2.06
HW fb. H	8.11	5.02	2.57
H fb. HW	8.17	5.21	2.71
H fb. H	8.77	5.29	2.56
LSD (P=0.05)	1.49	1.10	0.26

* Data subjected to square root transformation

Density of *Cichorium intybus*, *Medicago hispida*, *Chenopodium album*, *Avena sterilis* ssp. *ludoviciana* and *Euphorbia geniculata* were influenced significantly under different cropping systems. Highest population of *Cichorium intybus*, *Medicago hispida*, *Chenopodium album* was noted with sorghum-chickpea system, whereas highest population of *Euphorbia geniculata* was observed under soybean-based system and *Avena sterilis* under sorghum-based cropping systems. Similarly, total weed population and weed dry weight were significantly influenced by different cropping systems. Soybean-based cropping systems being at par with maize-based cropping systems produced lowest weed population and dry weight as compared to sorghum-based cropping systems. The highest wheat equivalent grain yield was produced under soybean-based cropping systems followed by maize and sorghum based cropping systems

Influence of wheat-based systems and herbicide on weed dynamics in wheat

A field experiment was conducted to study the weed dynamics under three cropping systems *viz.* direct-seeded rice wheat, transplanted rice-wheat and soybean-wheat and 4 weed control treatment *viz.* weedy check, continuous application of isoproturon 1.0 kg/ha and metribuzin 0.3 kg/ha, and alternate use of clodinafop 60 g/ha *fb* 2, 4-D 0.5 kg/ha and sulfosulfuron 25 g/ha. Results revealed that none of the cropping systems influenced significantly the weed dynamics and weed dry weight, while the grain yield of wheat was significantly influenced under different cropping systems. The highest grain yield of wheat was recorded with soybean-wheat cropping system. Among the weed control treatments, all the herbicides influenced significantly the weed distribution, weed population and its dry matter production. Continuous application of metribuzin 0.3 kg /ha reduced significantly the population of *Medicago hispida*, *Chenopo-dium album* and *Phalaris minor* over the rest of the treatments, whereas the application of clodinafop 60 g/ha reduced the population of *Avena sterilis* over weedy check. In spite of significantly lower weed population and its dry weight, metribuzin 0.3 kg/ha produced significantly lower grain yield

of wheat. The highest grain yield of wheat was noted with clodinafop 60 g/ha and continuous application of isoproturon 1.0 kg/ha.

Treatments	Population/m²*				Grain yield (t/ha)
	Medicago hispida	*C. album*	*P. minor*	*Avena sterilis*	
Cropping systems					
Rice (DS) - wheat	4.5	3.6	2.4	3.1	3.6
Rice (Tr) - wheat	4.6	3.8	2.1	3.1	3.6
Soyabean - wheat	4.6	4.0	2.3	3.2	4.4
LSD (P=0.05)	NS	NS		NS	0.4
Weed control					
Isoproturon 1.0 kg/ha	4.5	0.9	2.4	3.1	4.4
Metribuzin 0.3 kg/ha	1.6	0.8	1.4	2.9	3.8
Clodinafop 60 g/ha	6.1	6.7	2.3	2.7	4.4
Weedy check	6.0	6.6	3.1	3.9	2.9
LSD (P=0.05)	1.5	1.7	0.7	0.7	0.4

* Data subjected to square root transformation
DS Direct seeded, Tr - Transplanted

Weed dynamics in rice-wheat systems

A field experiment was conducted to study the weed flora shift as influenced by continuous use of herbicides particularly on *Echinochloa colona* and *Cyperus iria* under rice (direct-seeded and transplanted) wheat cropping systems.

Results indicated that both direct seeded rice-wheat and transplanted rice-wheat cropping systems significantly influenced the emergence of *Echinochloa colona*, *Dinebra* sp. *Commelina communis*, *Phyllanthus niruri*, *Physalis minima* and *Cyperus iria*. Highest population of *E. colona*, *Dinebra*, *Cyperus iria* and *Physalis minima* were recorded under transplanted rice-wheat system whereas, that of *Phyllanthus niruri* was recorded under direct-seeded rice wheat system. Continuous application of butachlor 1.5 kg/ha, anilofos 0.4 kg/ha or alternate year use of both herbicides did not influence the weed distribution but all the herbicides reduced the emergence of weeds as compared to weedy check.

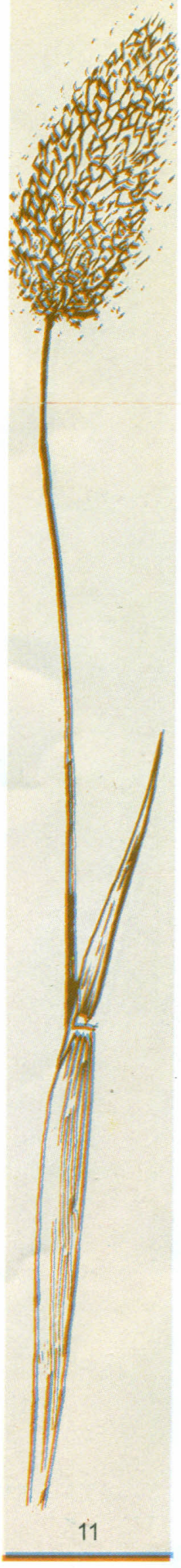
Treatments	Weed Population/m²*				
	E. colona	*Dinebra sp*	*P. niruri*	*P. minor*	*C.iria*
Cropping systems					
TR-wheat	6.13	14.15	4.94	2.96	5.56
DSR - wheat	3.77	3.24	11.43	1.75	3.73
LSD (P=0.05)	0.87	3.00	2.47	0.96	1.71
Herbicides					
Butachlor 1.5 kg/ha	4.80	8.99	8.85	1.79	4.28
Anilofos butachlor & anilofos	4.73	6.52	7.23	2.16	4.73
Weedy check	5.47	10.21	9.39	2.41	4.65
LSD (P=0.05)	1.23	NS	NS	NS	NS

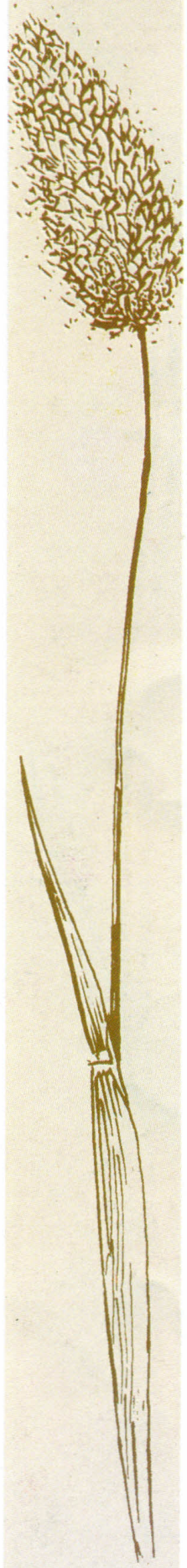
* Data subjected to square root transformation
DSR - Direct seeded rice, TR - Transplanted rice

Effect of cropping systems and weed control on wild oats

In order to find out the influence of different cropping systems and weed management practices on the seed production potential of wild oats, *Avena sterilis* ssp. *ludoviciana*, the weed plants from the long term experiments were collected and observations on panicle length, number of seeds/ panicle and seed weight/panicle were recorded. Among the cropping systems, significantly higher panicle length, number of seeds/ panicle and seed weight were observed under soybean wheat system.

However, transplanted and direct seeded rice-wheat system had no effect on number of seeds/panicle and seed weight/panicle. The length of panicle of *A. ludoviciana* was significantly lower under direct seeded rice-wheat system.





Treatment	Panicle length (cm)	Seeds (no/panicle)	Seed weight (g/panicle)
Cropping systems			
Soyabean-wheat	16.4	31.3	1.25
Transplanted rice-wheat	14.7	24.8	0.99
Rice (direct seeded)-wheat	13.4	21.8	0.87
LSD (P=0.05)	0.92	4.7	0.19
Weed control measures			
Weedy check	16.6	33.0	1.32
Metribuzin 0.3 kg/ha	16.0	30.3	1.22
Isoproturon 1.0 kg/ha	13.8	21.0	0.84
Clodinafop 60 g/ha and sulfosulfuron 25 g/ha (alternate use)	12.9	19.3	0.77
LSD (P=0.05)	0.90	3.8	0.24

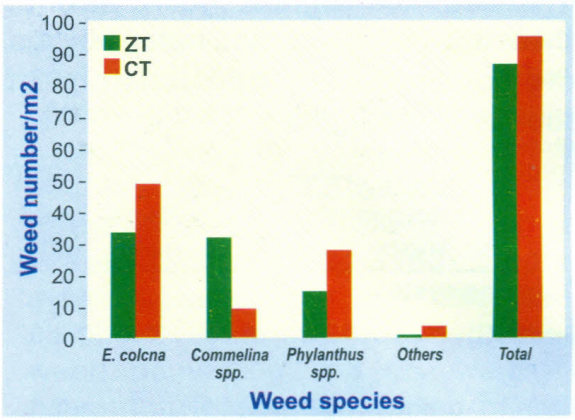
Among the weed control treatments, alternate application of clodinafop and sulfo-sulfuron in wheat significantly reduced the panicle length of the weed. Isoproturon and alternate application of clodinafop and sulfosulfuron significantly lowered the number of seeds/panicle and seed weight/panicle as compared to weedy check and metribuzin 0.3 kg/ha.

Tillage and weed management

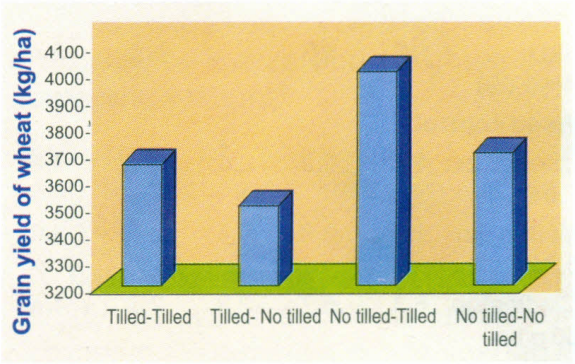
Effect of tillage and weed control measures in soybean-wheat and soybean-linseed system

A field experiment was conducted to find out the effect of zero and conventional tillage and weed control methods on weed dynamics and yield of soybean wheat and soybean-linseed systems. Results revealed that weed population was influenced by tillage practices in soybean.

Zero tillage decreased the population of *E. colona* and *Phyllanthus* spp., where as the population of *Commelina* spp. was increased.

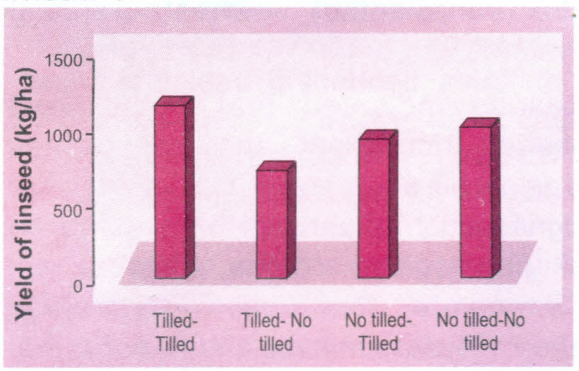


Effect of tillage on weed population in soybean



Effect of tillage in soybean-wheat system on grain yield of wheat

In general the yield of soybean was poor due to attack of yellow mosaic virus. Soybean grown after wheat yielded slightly better than that after linseed. Yield of no-tilled soybean after no tilled wheat or linseed was at par with that obtained with tilled soybean after tilled wheat or linseed. During winter season, tillage practices and weed control methods did not influence the yield of wheat.



Effect of tillage in soybean-linseed system on seed yield of linseed

However, the yield of linseed varied significantly due to different tillage operations but the difference between zero tilled and tilled crops was marginal.

Effect of tillage and weed control methods on weeds and yield of wheat

A field experiment was conducted to study the effect of various tillage practices and weed control measures on weed dynamics and grain yield of wheat.

Treatment	Weed population/m²*				Weed dry wt (g/m²)*
	C. album	*P. minima*	Others	Total	
Tillage					
Zero tillage	5.41	1.69	1.85	6.14	3.59
Conventional tillage	6.16	2.77	1.53	7.02	6.08
FIRBS	7.41	3.12	1.64	8.84	6.81
LSD (P=0.05)	NS	1.19	NS	NS	2.19
Weed control					
Weedy	10.12	3.25	2.04	11.56	7.64
Isoproturon	2.08	1.34	1.70	2.93	3.53
Hand weeding at 30 DAS	6.78	2.99	1.28	7.51	5.31
LSD (P=0.05)	2.65	0.89	0.70	1.81	1.83

* Data subjected to square root transformation

The field was infested mainly with *Chenopodium album* and *Physalis minima*. Results revealed that different tillage practices did not influence the population of *C. album* as well as total weeds. However, the population of *P. minima* and total weed dry weight were significantly reduced in zero tillage as compared to furrow irrigated raised bed system (FIRBS). Post-emergence applica-tion of isoproturon 1.0 kg/ha significantly reduced the population and dry-matter accumulation by weeds. Highest yield of wheat was recorded from zero tillage followed by conventional tillage and FIRBS.

Grain yield of wheat (t/ha) as influenced by tillage and weed control measures

Tillage	Weed control measures			Mean
	Weedy check	IPU1.0 kg/ha	HW 30 DAS	
ZT	4.74	4.94	4.61	4.76
CT	4.09	4.60	4.14	4.28
FIRBS	3.59	3.74	4.04	3.80
Mean	4.14	4.43	4.26	

LSD (P=0.05) - tillage- 0.23, weed control -NS
TxWC - NS

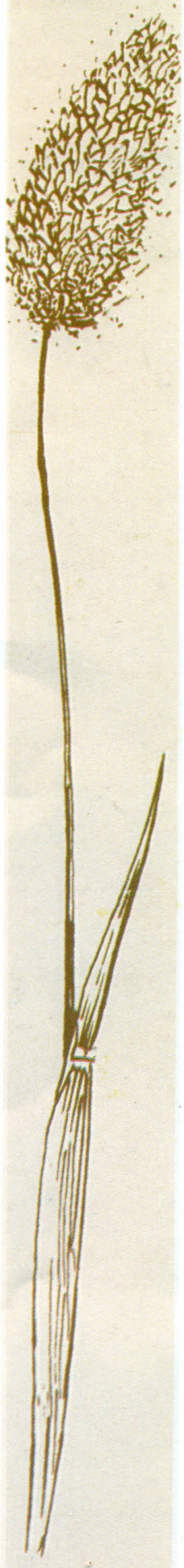
Effect of tillage and weed control methods on weed dynamics on wheat

A field experiment was conducted to study the effect of various tillage practices and herbicide use on weed dynamics and grain yield of wheat under transplanted rice-wheat system. The treatments consisted of three tillage systems (conventional-CT, minimum-MT and zero-till-ZT) in main-plots combined with two herbicides (isoproturon 1.0 kg/ha at 25 DAS and metribuzin 0.3 kg/ha at 35 DAS) along with a weedy check in sub-plots replicated four times in split-plot design. CT consisted of disc ploughing + disc harrowing + rotavator and sowing, the MT comprised of cultivator and sowing and ZT comprised of sowing with no-till seed drill. Sowing of wheat under ZT was done a week earlier than CT and MT.

Treatment	Weed dry matter/m² at 90 DAS				Grain yield (t/ha)
	P. minor	*A. ludovic-iana*	*M. hispida*	*C. album*	
Tillage					
ZT	4.24*	11.13	2.76	1.77	1.76
MT	6.28	6.13	3.36	3.26	2.01
CT	8.32	4.01	3.03	2.73	1.98
LSD (P=0.05)	1.94	4.48	NS	1.83	NS
Herbicides					
Weedy	7.20	6.56	3.72	4.30	1.71
Isoproturon 1.0 kg/ha	4.96	8.02	2.51	1.14	2.19
Metribuzin 0.3 kg/ha	6.68	7.10	2.92	2.31	1.84
LSD (P=0.05)	1.46	NS	1.04	0.92	0.26

* Values subjected to square root transformation
ZT : zero tillage,
MT : minimum tillage,
CT : conventional tillage

Results indicated that zero-till sowing reduced the infestation of *Phalaris minor* but increased the problem of wild oat (*Avena sterillis* ssp. *ludoviciana*). Grain yield of wheat was comparable in all the tillage systems. Isoproturon 1.0 kg/ha at 25 DAS effectively controlled all weeds except wild oat and produced significantly higher grain yield as



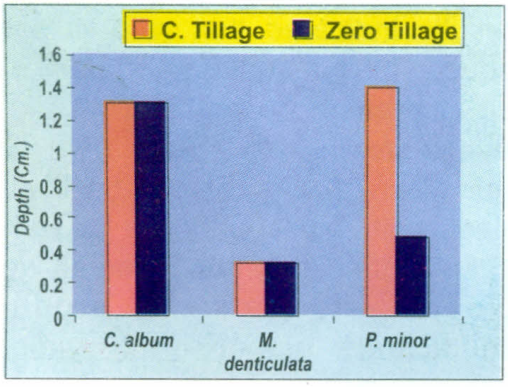
compared to metribuzin 0.30 kg/ha and weedy check. Metribuzin also did not control wild oat.

Seed production potential of *Phalaris minor* under zero tillage

Seed production potential of *Phalaris minor* under natural infestation in crops viz; lentil and wheat under zero tillage\ situation was recorded. Results indicated that the length of spike (4.9 cm) and number of seeds/spike (273) were more under lentil crop grown under zero tillage system in comparison to the wheat crop where the corresponding values were 3.8 cm and 154 seeds/spike. The total seed weight of *P. minor* was also higher (0.39 g) under lentil than *P. minor* grown with wheat (0.29 g/spike) under zero-tilled situations. It indicates that under zero tillage situation seed production potential of *P. minor* associated with wheat crop is greatly reduced in comparison to lentil.

Tillage and weed emergence

A field study was conducted to find the effect of tillage on depth of emergence of weeds during *rabi* season. Observations on 100 seedlings of the major weeds viz. *Chenopodium album*, *Phalaris minor* and *Medicago denticulata* under both conventional and zero tillage systems were taken. The depth of eme-rgence was recorded. Results indicated that in case of *Chenopodium album* and *Medicago denticulata* there was substantial variation in depth of seedling emergence.



However in case of *Phalaris minor*, the depth of emergence under zero tillage varied from 0.04 to 0.6 cm and under conventional tillage the depth ranged from 1.4 to 1.6 cm. It indica-tes that under zero tillage situation seeds of *Phalaris minor* below 0.6 cm failed to emerge in comparison to the conventional tillage system.

Crop-weed competition and yield losses

Effect of varying densities of *Medicago hispida* on wheat

Of late, burclover *Medicago hispida*, a broadleaf weed is becoming a problem in wheat crop in Jabalpur region. There are certain field situations where this weed alone is coming up in large numbers and causing growth reduction in wheat. In order to assessthe extent of yield losses caused by varying densities (0 to 640/m^2) of this weed on wheat (*cv.* Sujatha), an experiment was conducted in microplots of 1m^2 during *rabi* 2001-02.

M. hispida (no. & dry wt.)		Wheat	
(no/m^2)	(kg/ha)*	Panicles/ m^2	Grain yield (t/ha)
0		415	5.90
10	184	405	5.70
20	257	380	5.20
40	323	360	4.50
80	421	353	4.10
160	607	335	3.90
320	836	330	3.70
640	1227	320	3.60
LSD (P=0.05)	271	23.6	1.10

* Final dry weight

The results revealed that there was a progressive decline in grain yield of wheat with increasing densities of the weed from 10-to 640-weeds/ m^2 over weed free treatment. The yield losses ranged from 3% (under 10 weeds/ m^2) to 39% under highest weed infestation (640/m^2). The yield levels under the treatment of 10 weeds/m^2 and 20 weeds/m^2 were statistically comparable to that of weed free treatment indicating that 10 to 20 weeds/m^2 is considered to

be the threshold level for this weed beyond which control measures need to be taken.

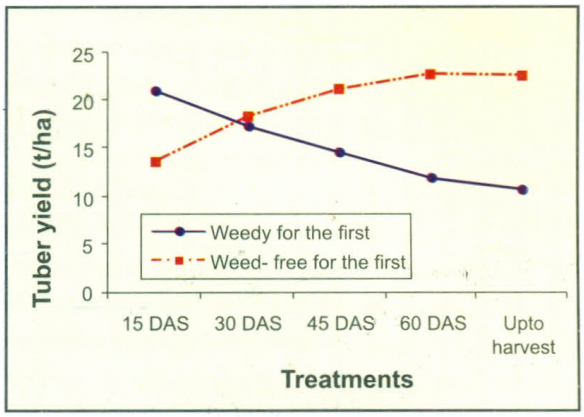
Effect of varying densities of ground cherry on onion

Ground cherry (*Physalis minima*) comes up during all the seasons of the year under Jabalpur condition and is a serious problem weed in onion crop. In order to find out its adverse effect on onion (*cv.* N53), an experiment was carried out with different densities of this weed ranging from 0-10/m^2 during spring season of 2002 in microplots of 1m^2. The results revealed that the highest bulb yield of 2.3 kg/m^2 was obtained under weed free condition. Increasing densities of *Physalis minima* from 1 to 10/m^2 caused bulb yield reduction ranging from 4 to 37%. A density of one plant of *Physalis minima*/m^2 can thus be considered to be as a threshold level of the weed as it caused minimum yield loss (4%).

Study on crop-weed competition in potato

A field experiment was conducted to find out the critical period of crop-weed competition in potato grown under vertisol. The field infested with *Chenopodium album*, *Medicago hispida*, *Lathyrus aphaca* among broadleaf and *Avena sterilis* ssp. *ludoviciana*, *Phalaris minor* among grasses which caused 52% reduction in tuber yield of potato under unchecked condition. Significantly highest weed population and its dry weight were recorded in the plots kept weedy up to harvest followed by weed free for the first 15 days after planting (DAP). Total weed dry matter production per unit area throughout the growing period increased with increasing duration of weedy period and vice-versa.

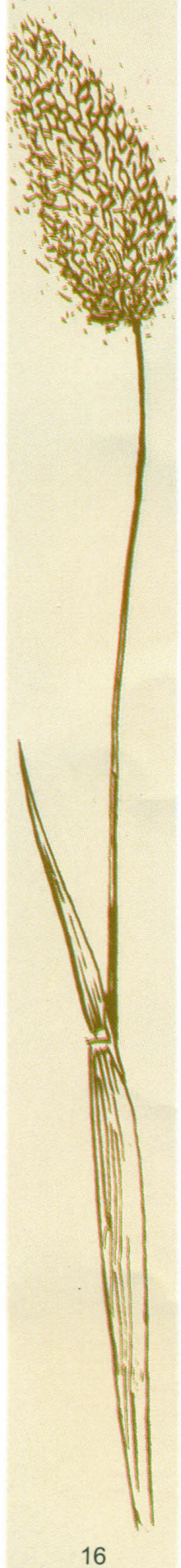
The tuber yield of potato significantly increased with increasing period of weed free conditions from 15 to 45 DAP. The highest tuber yield of potato was recorded with weed free up to harvest (22.6 t/ha). The tuber yield recorded in crop kept weed free for first 45 days was almost equal to the yield recorded with weedy for the first 15 days Therefore, it may be concluded that weed free maintenance from 15 to 45 DAP would be required for achieving maximum tuber yield of potato.



Critical period of crop-weed competition in potato

Influence of weed pressures on potato under fertilizer levels

High fertilizer application and irrigation causes luxuriant weed growth and reduces fertilizer use-efficiency in potato crop, if no adequate weed control measures are taken. Keeping this in view, an experiment was carried out to study the influence of different weed pressures and fertilizer levels on weed growth and tuber yield of potato. Results revealed that different levels of fertilizer did not influence significantly the weed density and its dry weight under all the weed pressures. However, higher weed dry weight was recorded with highest level of fetilizer. Different fertilizer levels and weed pressures influenced significantly the tuber yield of potato. The tuber yield increased with increasing levels of fertilizer under all the weed pressures but, the increase was more pronounced under low weed pressure follow-ed by medium and high weed pressures. Highest tuber yield of potato (18 t/ ha) was recorded with $N_{120}P_{60}K_{60}$ under low weed pressure while, lowest (4 t/ha) with $N_0P_0K_0$ under high weed pressure. $N_{60}P_{30}K_{30}$ level of fertilizer under low weed pressure produced tuber yield as high as with $N_{120}P_{60}K_{60}$ under high weed pressure. Results have indicated that maximum fertilizer use-efficiency could be obtained in the absence of weed competition.



Eco-physiology of onion weed

Onion weed (*Asphodelus tenuifolius* Cav.) is a winter season annual weed. It superficially resembles the cultivated onion, but has a fibrous root system without a bulb and lacks the characteristic onion odour. The weed is most competitive in light sandy soils in crops like mustard, lentil and chickpea. A field experiment was conducted to find out the competitive winter season crops against this weed.

Effect of onion weed on yield of different *rabi* crops

Crops	Seed yield (t/ha)		Seed yield reduction (%)
	weedy	weed free	
Pea	3.03	3.43	12
Lentil	2.88	3.35	14
Chickpiea	3.20	3.59	11
Linseed	1.94	2.25	11
Mustard	2.25	2.38	6
Wheat	5.42	5.68	5
Frenchbean	1.00	1.66	60

Results revealed that wheat (*cv.* Sujata) was the most tolerant winter season crop to this weed followed by mustard (*cv.*Pusa bold) whereas frenchbean (*cv.* Contender) was most susceptible. Pea (*cv.* JP-885) completely sup-pressed this weed at harvest time.

In another experiment, interference of onion weed in lentil and chickpea was studied. Results revealed that increasing densities of this weed from 25 to 800/m^2 progressively reduced the seed yield of both the crops. Reduction in yield due to increased densities of this weed was more pronounced in lentil than chickpea. A density of 100 weeds/m^2 in lentil and 200 weeds/m^2 in chickpea may be considered as critical levels above which, necessary weed control measures may be adopted.

Effect of varying densities of wetland amaranth on upland direct-seeded rice

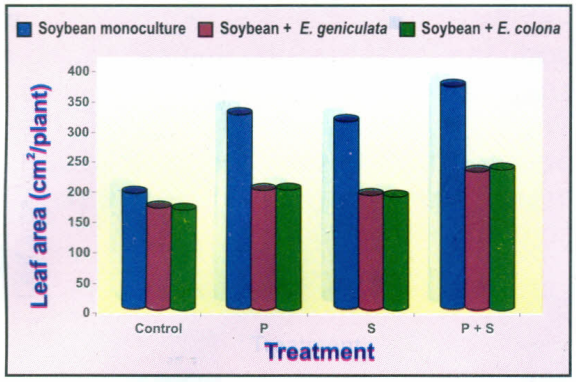
Of late, wetland amaranth *Alternanthera sessilis,* a broad leaf weed is becoming a serious problem in upland direct-seeded rice. In order to find out its damage potential, an experiment was conducted during *kharif* season of 2002. The treatments were 11 which included 5 levels of *Alternanthera* 2 to 32/m^2 with and without rice (*cv.* Annada). The results revealed that the increasing densities of the weed from 2 to 32/m^2 caused substantial grain yield reduction of upland rice to the tune of 64 to 94%. This indicates that even a low density of 2 weeds /m^2, because of its fast growth and horizontal spread can be harmful.

Density *A. sessilis* (no/m^2)	Dry weight of *A. sessilis* (g/m^2)		Grain yield of rice (g/m^2)
	with rice	without rice	
0	-	-	170.0
2	214.3	264.3	60.0
4	262.0	289.3	51.1
8	548.0	570.0	35.0
16	633.7	665.7	15.0
32	1193.0	1310.0	10.0
LSD (P=0.05)	-	84.0	28.7

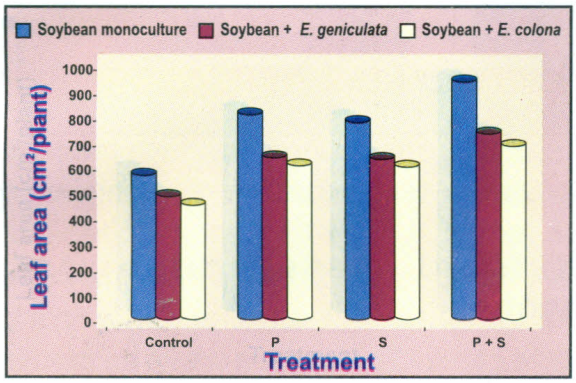
The weed produced 4 to 23% higher dry matter when grown alone as compared to that produced by the weed in association with the crop.

Effect of phosphorus and sulphur on competition between soybean and weeds

Field experiments were conducted in microplots to study the effects of phosphorus (P) and sulphur (S) supply on inter-specific competition between two weed species (*Euphorbia geniculata* and *Echinochloa colona*) and soybean.



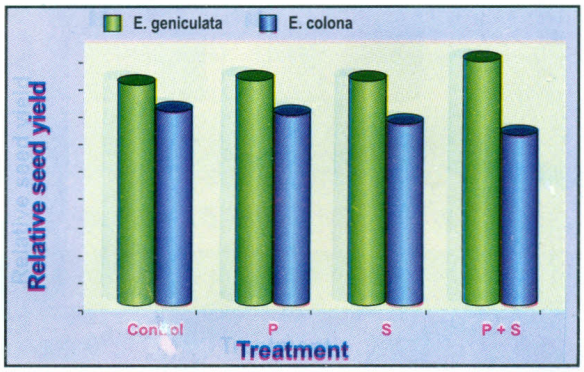
30 DAS

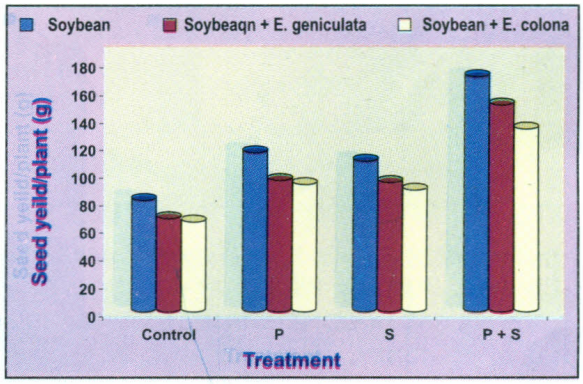


60 DAS

Application of phosphorus and sulphur increased the leaf area and plant height of soybean and weeds. At both the stages of crop growth *E. colona* maintained higher leaf area and plant height as compared to *E. geniculata*. Soybean in monoculture maintained highest leaf area as compared to mixtures. Initially at 30 DAS, leaf area of soybean in mixture with either weed was more or less similar while at 60 DAS it was higher in mixture with *E. geniculata* as compared to that with *E. colona*.

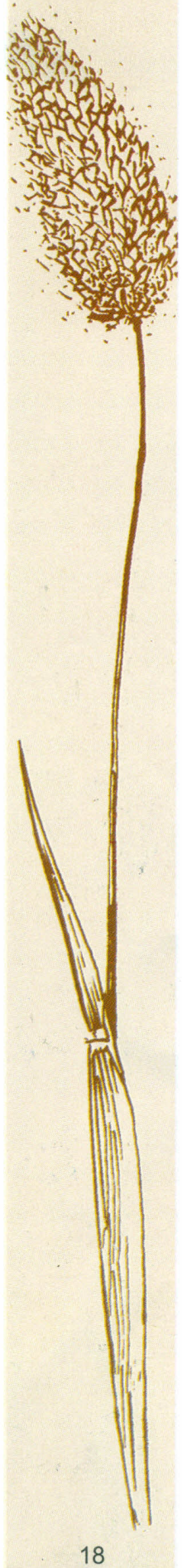
Seed yield of soybean increased with the application P and S as by 101% over control with 80 kg P_2O_5/ha + 40 kg S/ha. The reduction in seed yield was higher with *E. colona* (12% to 25%) as compared to *E. geniculata* (10% to 15%). The effects of P and S supply on competitive ability were examined by calculating relative seed yield of soybean. The relative seed yield of soybean was <1 in both the experiments, indicating that for this species the effects of inter-specific competition were greater than the effects of intraspecific competition. A comparison of the relative yields of soybean shows that *E. colona* was more competitive than *E. geniculata* as it has recorded lower relative seed yield of soybean. The present study revealed that between the two weed species *E. colona* is more competitive with soybean as compared to *E. geniculata*.



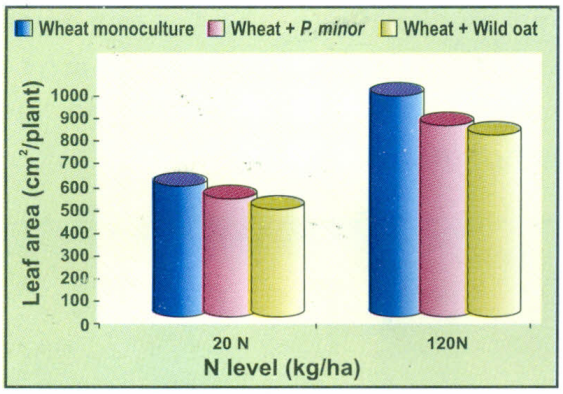


Effect of nitrogen on inter-specific competition between wheat and weeds

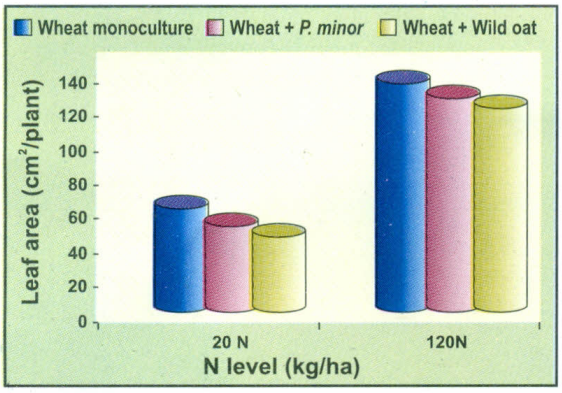
Two field experiments were conducted in microplots to study the effect of nitrogen (N) supply on inters-pecific competition between two weed species (*Phalaris minor and Avena sterilis* ssp *ludoviciana*) and wheat.



Application of 120 kg N/ha increased the plant height and leaf area of both wheat as well as weeds as compared to that of 20 kg N/ha. Plant height of wheat in mixture with *A.sterilis* ssp. *ludoviciana* was lower than that of *P. minor*. Plant height of *A.ludoviciana* was lower than that of wheat at 30 DAS while at later stages it has crossed that of wheat. The height of *P. minor* was lower than that of wheat and *A. sterilis* ssp. *ludoviciana* upto 60 DAS while at 90 DAS it has crossed the height of wheat.

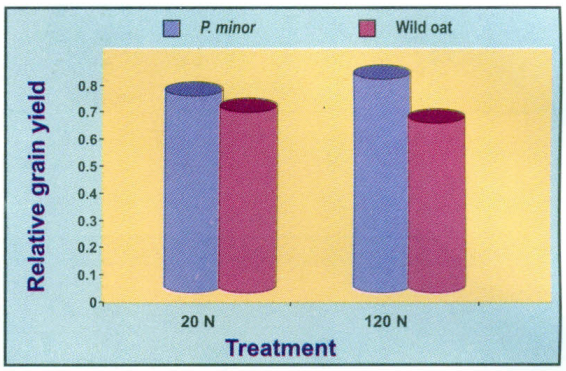


30 DAS



60 DAS

The leaf area of wheat in mixture with *A.sterilis* ssp. *ludoviciana* was lower than that in *P. minor*. The leaf area of wheat was initially higher than that of both weeds but at later stages *A. sterilis* ssp. *ludoviciana* crossed that of wheat as well as *P. minor*. The present study revealed that between the two weed species *A. sterilis* ssp. *ludoviciana* was found to be more competitive than *P. minor*. Grain yield of wheat increased by 98% with the application of 120 kg N/ha over 20 kg N/ha. The reduction in yield was higher with wild oat (37%) ascompared to *P. minor* (24%). The relative grain yield of wheat was <1 in both the experiments, indicating inter specific competition for these species. The present study revealed that between the two weed species wild oat is more competitive with wheat as compared to *P.minor*.



Effect of N on the relative grain yield of wheat

Nutrient management-weed control

Effect of nitrogen application methods and weed management on maize

A field experiment was conducted during *kharif* 2002 to study the feasibility of managing weeds in maize through appropriate fertilizer application methods to give comparatively better advantage to the crop.

Compared to weedy plots, significant reduction in weed dry matter production was recorded when atrazine was applied. Increasing the N dose significantly increased the weed dry matter. However, the rate of increase in weed dry matter production was higher under broadcast than placement method.

Interaction effects fertilizer and weed management on grain yield of maize (t/ha)

Weed control	Fertilizer applied							
	F1		F2		F3		F4	
measure	B	P	B	P	B	P	B	P
Weedy	2.5	2.7	2.5	3.0	2.5	3.0	2.4	3.00
Atrazine	2.7	2.7	3.3	3.7	3.8	4.3	4.2	4.5
LSD (P=0.05)	0.36							

F1=$N_0P_{26}K_{50}$, F2=$N_{60}P_{26}K_{50}$,
F3=$N_{90}P_{26}K_{50}$, F4=$N_{120}P_{26}K_{50}$,
B=Broadcast, P= Placement

Compared to broadcast, fertilizer placement significantly decreased weed dry matter production at F3 ($N_{90}+P_{26}+K_{50}$ kg/ha) and F4 ($N_{120}+P_{26}+K_{50}$ kg/ha) levels.

The results thus indicated that the placement method could be a better weed management approach over broadcast method especially when fertilizer dose consists of relatively high amount of N.

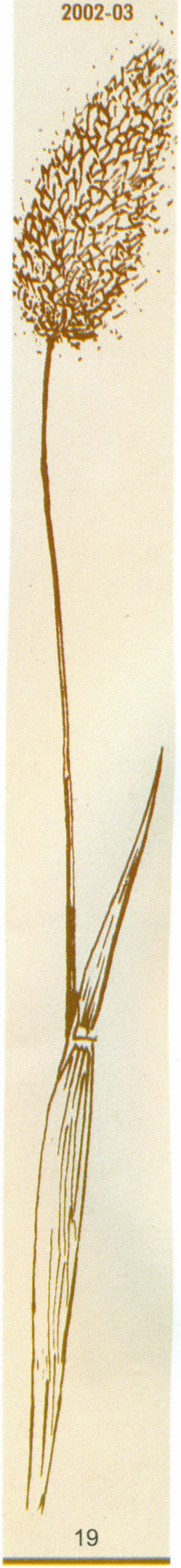
Grain yield increased with placement of fertilizer and application of atrazine. At each level of fertilizer application the highest grain yield was recorded when the treatment combination included both placement of fertilizer and atrazine application. Except F1 ($N_0P_{26}K_{50}$kg/ha) at all other levels of fertilizer application the grain yield from its lowest level, as recorded when the fertilizer was broadcasted without atrazine application, increased significantly either when the fertilizer application method was changed, i.e. it was placed below seeds, or when atrazine was applied. Between these two options, the grain yield production in the later one was significantly higher than that as obtained in the former one. This indicates that the herbicide application was more effective than the additional burden involved in placement of fertilizer in increasing the benefit of applied nutrient. Non-application of N at F1 ($N_0P_{26}K_{50}$ kg/ha) level could be the limiting factor and as a consequence, neither placement of other nutrients nor application of atrazine could increase the grain yield. The mean grain yields obtained at different fertilizer doses did not differ significantly under weed condition, while with atrazine, the yield increased significantly with the increase in fertilizer level. The data thus indicated that without proper weed control no benefit in terms of grain yield could be obtained for increasing the amount of N in the fertilizer dose.

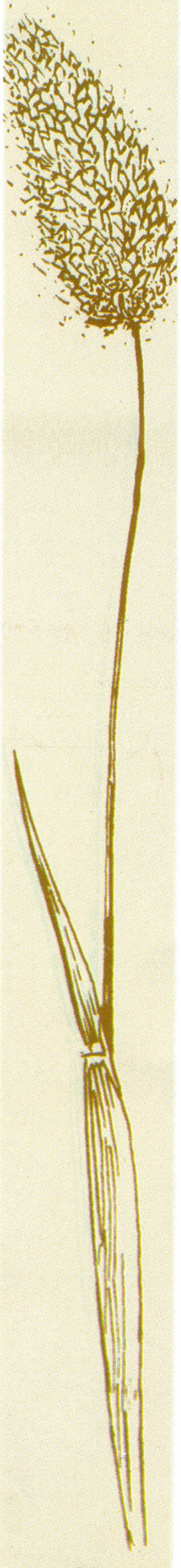
It was concluded that nitrogen placement alone was not sufficient to restrict the weed growth below a limit desirable for maximizing the benefit of applied nutrient in terms of grain yield. However, since placement of nitrogen reduced the weed infestation at higher level of its application, it may be considered as a component of weed management in maize. Besides placement of nitrogen, direct control of weeds was essential to maximize the benefit of applied N.

Conjunctive use of organic and chemical fertilizers on weeds in rice wheat system

A field experiment was laid out with eight treatments comprising of four main (120 kg N through urea (U), *dhaincha* (*Sesbania aculenta*) green manure, U60+D60 and control and two subplot-treatments (weedy and weed free i.e butachlor at 1.5 kg/ha +1 HW) with three replications in a split-plot design. The dominant weed flora observed was *Cyperus iria, Echinochloa colona, Alternathera sessilis* and *Commelina communis*. Among the different sources of nitrogen, organic and chemical N combination (U60+D60) reduced the weed population and recorded lowest weed dry matter at 30 days. However, the weed population could not be reduced by the same treatment at 60 days. Butachlor at 1.5 kg/ha +1 H.W. at 30 days was effective in controlling weeds in transplanted rice. The interaction effect of N sources and weed control practices was significant on weed dry matter at 30 days in transplanted rice. Grain yield of rice obtained with urea alone was at par with N applied through combination of urea with *dhaincha* (U60 + D60).

The residual effect of the treatments applied in rice was not observed on the total weed population in wheat.





However, population of *Phalaris minor* was significantly lower in case of 120 kg N/ha applied either through *dhaincha* alone or *dhaincha* in combination with urea in comparison to other treatments. Herbicidal treatments applied in rice during *kharif* could not reduce weed population over weedy check.

Biology of weeds

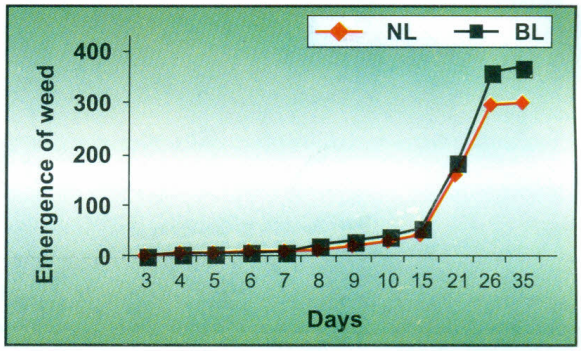
Studies on growth and seed production of *Phalaris minor*

A study on growth parameters *viz.* plant height, number of leaves and leaf area, dry weight of leaf, stem, root and spike, spike length and seed production of *P.minor* naturally infested grown with chickpea, lentil, linseed, pea and mustard in association with other *rabi* weeds revealed that highest plant height (102 cm) was observed in association with lentil crop. Maximum leaf area (27.3 cm^2) was observed where *P.minor* was grown with pea. Longer spike length (5.1 cm) was also observed in association with pea crop. Maximum number of seeds/spike (43) and test weight (0.07 g/spike) were observed in association with mustard crop, but maxi-mum number of seeds/ spike (437) was observed in association with chickpea.

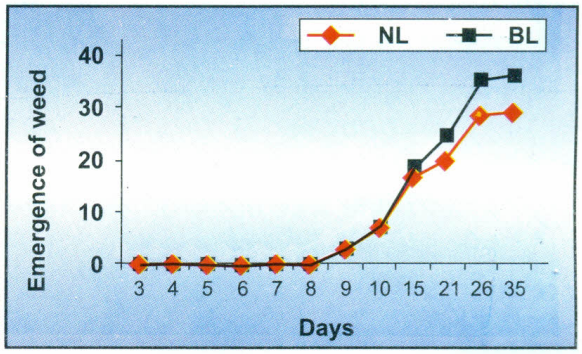
Emergence of weeds from different depths of soil

Soil samples were collected from 50 cm^2 area under different depths (0-5 cm, 5-10 cm, 10-15 cm) during the month of June 2002. The collected soil samples were placed on a platform by making a thin layer (2.0 cm) and watering was done as and when necessary. Weed emergence was recorded up to 35 days. The first emergence of narrow leaved weeds (NLW) was observed from the surface layer of the soil after 3 days while broad leaved weeds (BLW) were emerged on 8th day. In middle layer (5-10 cm) the NLW emergence began on 9th day and BLW only emerged on 14th day. However, in lower depths of soil profile (10-15cm) both NLW and BLW emerged on 10th day.

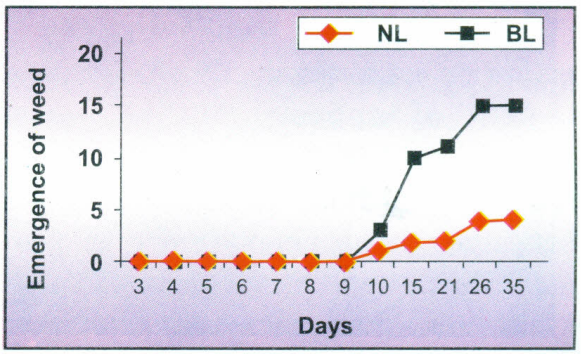
The NLW and BLW were maximum in upper layer of soil in comparison to the lower layer of soil. Maximum number of NLW (300) and BLW (70) was recorded from upper layer of soil profile up to 35 days, while the total emergence in middle (5-10 cm) and lower soil profile (10-15 cm) was 35 and 15, respectively.



0-5 cm.



5-10 cm.



10-15 cm.

Ageing of weed seeds

The seeds of the weeds - *P. hysterophorus*, *Cassia sericea*, *P. minor*, *E. glabrascence*, *E. crusgalli*, *M. denticulata* and *Rumex dentatus* kept in a liquid preservative continued to show germination in yearly viability

assessment test. The germination of the seeds of 1992-93 lots was 94.31.5% in *P. hysterophorus*, 88.35.7% in *C. sericea*, 80.33.0% in *P.minor*, 52.37.0% in *E. glabrascence*, 91.34.1% in *M. denticulata*, 93.63.7% in *E. crusgalli*, and 86.62.5% in *R. dentatus*.

Management of *Cuscuta* in field crops

Cuscuta (dodder) is an obnoxious stem parasitic weed causing considerable losses in different field crops. Field experiments were conducted to find out the damage potential of this weed in various field crops.

Host tolerance to *Cuscuta* infestation

In order to find out relative tolerance /susceptibility of different field crops *viz.*, cereals, pulses and oilseeds, a field experiment was conducted during *rabi* 2001-02. The crops *viz.*, chickpea (cv. JG-315), lentil (*cv.* JL-1), pea (cv. JP 885), *rajmash* (cv. Contender), linseed (cv. JL-17), mustard (*cv.* Pusa Bold) and wheat (cv. WH-147) were tested under *Cuscuta*-infested and *Cuscuta*-free conditions. It was revealed that the crops *rajmash*, mustard and wheat were not affected by *Cuscuta* infestation as evidenced by zero yield reduction. The crops chickpea and lentil were highly affected by *Cuscuta* while pea and linseed were moderately affected.

Yield loss due to *Cuscuta* in field

Crop	Seed yield (kg/ha) with *Cuscuta*	Seed yield (kg/ha) without *Cuscuta*	Yield loss (%)
Chickpea	239	1656	86
Lentil	45	345	87
Pea	694	1288	46
Rajmash	171	173	0
Linseed	539	1072	50
Mustard	1617	1616	0
Wheat	4010	4016	0

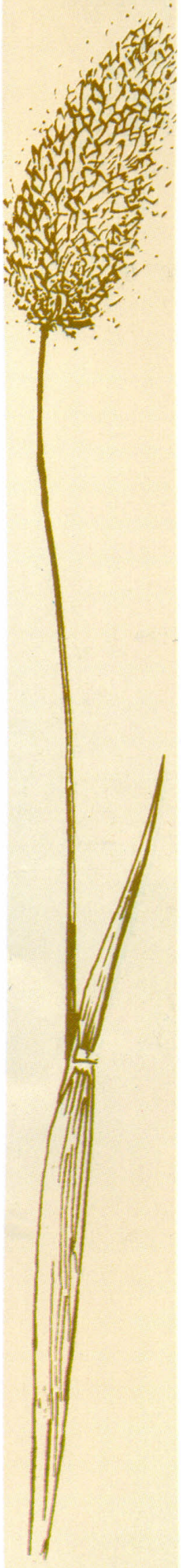
Study of *Cuscuta* infestation on linseed

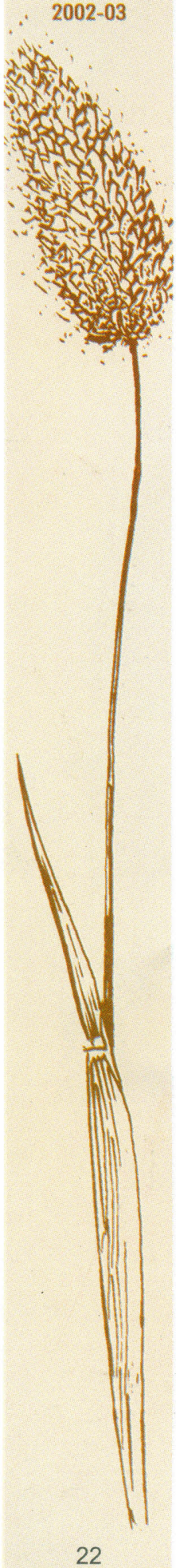
In order to find out the effect of depth of sowing of *Cuscuta* and proximity of *Cuscuta* seedlings after germination to the crop (linseed) on the extent of infestation on the crop, a field trial was conducted during *rabi* 2001-02. *Cuscuta* seed was sown on surface and at a depth of 5 cm and also at different distances (0, 5, 10 and 15 cm) from the crop rows. Results revealed that the depth of sowing did not influence significantly *Cuscuta* infestation and ultimately the yield of crop. With regard to different distances, *Cuscuta* seed sown nearer to the crop seed caused higher infestation of this weed on the crop because of the proximity of the emerged seedlings, which resulted in lowering the crop yield. When the *Cuscuta* seed was sown at 10 and 15 cm distance from the crop rows, the infestation of this weed was less and hence higher yields of linseed were obtained.

Yield loss due to *Cuscuta* in greengram and niger

Two separate field experiments in two different seasons were conducted to find out the yield loss due to the parasitic weed *Cuscuta* in greengram (*cv.* K851) crop grown during summer season of 2002 and niger (cv. JNC6) grown during late *kharif* season of 2002. The crops were infested with *Cuscuta* plants at densities of 0 to 10/m^2 in microplots of 1 m^2. The loss in seed yield of the crop due to *Cuscuta* from 1 to 10/m^2 ranged from 28 to 88% in case of summer greengram and 39 to 98% in case of niger indicating that even a single plant of *Cuscuta* can cause substantial reduction in yield of the test crops.

The yield attributing characters in case of summer greengram also showed a similar trend of decrease with increasing densities of *Cuscuta*. *In niger experiment, the seed producing ability of Cuscuta showed increase with increasing densities of Cuscuta.*





Effect of *Cuscuta* on the performance of summer greengram and niger

Cuscuta Plants (no/m²)	Seed yield (g/m²)		Yield loss due to *Cuscuta* (%)		*Cuscuta* seeds (1000s) in niger
	green-gram	niger	green-gram	niger	
0	83.0	277.1			
1	60.0	168.2	27.7	39.3	55.7
2	45.9	160.0	44.7	42.3	183.6
3	35.8	103.5	56.8	62.6	205.8
4	21.2	118.9	74.5	57.1	208.6
5	20.0	70.0	75.9	74.7	212.4
6	16.8	68.0	79.7	75.5	218.9
7	16.0	63.6	80.7	77.0	231.8
8	12.9	8.6	84.5	96.9	244.6
9	12.0	6.6	85.5	97.6	286.3
10	9.7	4.3	88.3	98.4	307.6
LSD (P=0.05)	8.7	38.4			

Relative tolerance of niger varieties to *Cuscuta*

In order to find out relative tolerance of five varieties of niger *viz.*, JNC1, JNC6, Ootacamand, IGP76 and GA10 to *Cuscuta* infestation, a field experiment was conducted during late *kharif* season of 2002. All the varieties were grown under *Cuscuta*-infested and *Cuscuta* free conditions.

Variety	Seed yield (g/m²)		Yield loss (%)
	Cuscuta free	*Cuscuta* infested	
JNC1	208	65	69
JNC6	210	54	75
Ootacamand	140	46	67
IGP76	172	22	88
GA10	171	31	82

The results revealed that highest yield under *Cuscuta*-infested and *Cuscuta* free conditions was produced by the variety JNC1. The loss in yield in this variety due to *Cuscuta* infestation was worked out to be 69%. However, the variety Ootacamand recorded the least reduction in yield due to *Cuscuta* infestation (67%) even though the general yield levels are lower in this variety. The seed production capacity of *Cuscuta* ranged from 164 to 258 g/m² in different varieties.

Weed management by herbicides

Herbicide mixture in soybean

Of late, the spectrum of weed species in soybean has widened due to variation in agro-ecological situation. Therefore, it is essential to find out some broad spectrum, selective and effective post emergence herbicide mixture for weed control in soybean. In the present investigation six herbicide combinations *viz.* imezethapyr, bentazone + acifluorfen, chlorimuron+fenoxaprop, chlorimuron, bentazone and imazaquinine + pendimethalin (PE) were evaluated. The major weed species were *E. hyssopifolia*, *E. crus galli*, *C. communis*, *C. rotundus*, *P.niruri* and *P.minima*. Amongst the herbicidal mixture chlorimuron + fenoxaprop (6+100g /ha) resulted in the highest seed yield which was at par with imezethapyr (100 g/ha) and bentazone (1250 g/ha). The lowest weed intensity and biomass were observed with the same treatment.

Post-emergence herbicides for direct-seeded rice

In direct-seeded rice, application of butachlor + propanil (1.12+1.12kg/ha) (buta-nil) at 15 DAS, mixture of chlorimuron + metsulfuron (Almix) 4 g/ha, pyrazosulfuron 25g/ ha performed better in reducing the weed population.

Efficacy of carfentrazone-ethyl in wheat

In wheat, application of a new herbicide-carfentrazone-ethyl (20 -25 g/ha) (sole) at 35 DAS was found to decrease weed population and weed biomass and was at par with carfentrazone in combination with 2,4-D (10+125g/ha). This combination was found effective with regard to control of broad-leaved weeds.

The grain yield was the highest under weed free treatment followed by Carfentrazone-ethyl at 10 g/ha in combination with 2,4-D 125 g/ha and carfentrazone (sole) at 20-25g /ha. It indicated that carfentrazone-ethyl could

be a substitute of 2,4-D and metsulfuron methyl for the control of broad-leaved weeds to a greater extent.

There was no phytotoxic effect of carfentrazone-ethyl in wheat. When used as combination, it was found as very effective for the control of broad-spectrum of weeds. Another study revealed that there was no phytotoxic effect of carfentrazone-ethyl+isoproturon (Affinity) on wheat.

Effect of carfentrazone-ethyl in wheat

Treatment	Dose (g/ha)	Weeds* (no/m^2)	Weeds* (g/m^2)	Grain yield (t/ha)
Weedy check	-	9.4	37.3	2.2
Weed free treatment	-	0.7	-	4.6
2,4-D sodium salt	500	8.0	18.3	4.0
Metsulfuron-methyl	4	8.0	16.1	4.0
Carfentrazone-ethyl	15	8.0	14.2	4.1
Carfentrazone-ethyl	20	8.0	11.2	4.3
Carfentrazone-ethyl	25	7.9	9.2	4.3
Carfentrazone-ethyl + 2,4-D sodium salt	10 + 125	6.2	7.2	4.5
LSD (P=0.05)		0.6	2.8	0.3

* Data subjected to square root transformation

Flufenacet+metribuzin in wheat

In wheat, application of a mixture of flufenacet + metribuzin at 900 g/ha as pre-irrigation treatment was found better for reducing weed biomass and registered higher grain yield. Application of triasulfuron at 20 g/ha was superior to 15 g/ha in reducing the broad leaf weed population and registered higher grain yield over other treatments.

Testing of herbicides against alligator weed

Based on studies in small water tanks, 2,4-D and glyphosate at different doses were tested in ponds severely infested with the alligator weed.

A pond cleared of alligator weed by 2,4-D

As per visual observations 2,4-D (2.5 kg/ha) and glyphosate (2.0 kg/ha) showed effective control in ponds while the terrestrial form of this weed required higher doses of 2,4-D (2.5 kg/ha), glyphosate (3.5 kg/ha) and metsulfuron methyl (24 g/ha).

Effect of herbicides on quality of drinking water in alligator weed control

In a study on chemical control of alligator weed, glyphosate followed by 2,4-D and metsulfuron-methyl significantly decreased pH and alkalinity. The effect lasted upto 4 days after application beyond which they started to restore. Dissolved oxygen was found to decrease than in control with all the herbicides. There was pronounced increase in chloride in 2,4-D treatment followed by glyphosate and metsulfuron methyl in the first 4 days which gradually restored towards normal as in control.

Chemical control of lotus in fish culture ponds

Lotus (*Nelumbo nucifera*) (Family: Nymph-aceae) a rooted floating weed, infested more than 30% area in a fish culture pond of JNKVV at Jabalpur. It covered water surface as a dense mat hampering fish harvest as fish took shelter beneath the lotus mat.

Glyphosate, 2,4-D and metsulfuron methyl were tested at 2.0, 2.0 kg/ha and 12 g/ha, respectively, initially in a small area. The herbicides were sprayed with the help of a power sprayer at the rate of 500 l/ha volume with adjustable nozzle from a boat where sprayer was installed. Surfactant was added in herbicide due to smooth leaf surface of lotus. Though maximum mortality of lotus was observed with 2,4-D followed by glyphosate and metsulfuron-methyl, but there was a sharp decrease of dissolved

oxygen in water due to 2,4-D. Glyphosate was selected for the final treatment of lotus in the pond @ 2.0 kg/ha which resulted in 98% control by 20 days. The dissolved oxygen, alkanity, hardness and pH decreased while COD increased after treatment. This study suggests that herbicides can be of great help in safely managing lotus infested aquatic bodies having fish production value.

A pond infested by lotus

Lotus damaged by glyphosate

Chemical control of water hyacinth and water quality

Chemical control by herbicide may provide effective measures, but create extensive problems especially in relation to the water quality as well as aquatic life. Fish die indirectly from suffocation rather than herbicide poisoning because masses of rotting water weeds killed by the herbicide decom-pose, reducing oxygen level. Testing of reco-mmended doses of paraquat, 2,4-D and glyphosate on water hyacinth revealed that all the treatments reduced the pH than control. Hardness and chloride of treated water samples increased than control while alkalinity and dissolved oxygen decreased. COD and BOD increased corresponding to days after treatment. Control showed less BOD and COD than treatments. Among the above three herbicides, glyphosate was found safest in context of water quality changes besides providing good control of water hyacinth.

Allelopathic studies

In rice-wheat cropping system, the crops are subjected to different allelopathic influences like that due to the decomposition of crop and weed residue of the previous crop on the germination and growth of the subsequent crop and the mutual allelopathic influences between the crop and its weed flora throughout the period of its growth and reproduction. It was evaluated that wheat and *P.minor* residue showed significant inhibitory effect, in the form of leachates on germina-tion and root and shoot growth of rice 'Heera' seedlings in petri dish culture and also inhibited the plant height and dry weight accumulation when incorporated in pots. In field experiments, it was evaluated that there was significant reduction of height and dry weight of rice when grown in mixed culture (rice and *E. colona* 1:1=100 plants/m^2) with *E. colona* after\ 40 days onwards.

It was further observed that, plant relative yield (PRY) values for both rice and *E. colona* were less than unit (1) suggesting that the inter-specific interferences between them were more severe than their respective intra specific interferences. Their relative yield total (RYT) values for 20, 30, 40 and 60 DAS were also less than unit which showed that the interactions between rice and *E. colona* were antagonistic in nature and may be due to allelopathy. As the density of weed increased, theadverse effect on rice growth also showed an increase, which further enhanced with increasing age of the weed and maximum adverse effect was noted at 60 DAS.

The allelopathic effect of *E. colona* on yield parameters of rice like grain test weight, weight/panicle, total biomass yield/plant and grain yield/m^2 showed that there was significant reduction in all these yield parameters. There was direct

relationship in yield losses with increasing density of the weed.

In the case of wheat, it was noted that decomposing rice straw leachates showed stronger adverse effect on root and shoot growth of wheat. *E.colona* residue had highest adverse effect on plant height and dry weight of wheat in pots. Mutual allelopathic influences between wheat 'WH-147' and *P. minor* were evaluated in field experiments and their PRY and RYT values calculated at different periods of growth which showed that the inter-specific interference between wheat and P. *minor* was antagonistic and allelopathic one.

Allelopathic effect of *E. colona* and *P. minor* on yield of rice and wheat

Crop: Weed (plants/m^2)	Grain weight (g/m^2)	
	rice	wheat
100:0	143	543
50:50	127	495
34:66	120	440
20:80	83	460
LSD (P=0.05)	10	50

There was significant reduction in yield parameters of wheat (like grain test weight, weight of grains/ panicle, total biomass /plant and grain yield/m$^{2)}$ when grown in association with *P. minor* due to allelopathy. Manage-ment practices like soil solarization (for 45 days), green manuring with summer *moong* (*Vigna radiata*) and *dhaincha* (*Sesbania aculeata*) and summer, could nullify the toxic allelopathic effect on wheat and increased its yield significantly in the order of summer *moong*, solarization, *dhaincha* green manuring and summer tillage as compared to control.

Bio-herbicidal effect of neem on *E. colona* and alligator weed

It was found out that the allelochemics present in neem tissues showed stronger toxic effect on *E.colona* germination and seedling growth but the effect on rice was much less.

Another experiment was conducted to find out the phytotoxicity of different plant parts (leaf, petiole, stem bark, stem wood, root bark, root wood, green fruit, ripe fruit pulp, seed, defaulted seeds, un-defaulted) on alligator weed (*Alternanthera philoxeroides*). The leaf residue was lethal to the weed at 1.5-2.5% (w/v). The neem leaf has thus herbicidal potential for the aquatic weed. The neem leaf residue killed the treated weed plants by causing root dysfunction and wilting of shoots immediately after initiation of the treatment. Further studies are underway to explore use of neem leaf residue as a natural herbicide. The experiment showed that the various plant parts of neem also had inhibitory effects on other aquatic weeds. Among the plant parts *viz.*, leaf, petiole, stem, stem bark, root, root bark, pulp, seed defatted and unfitted powders, fruit pulp and raw fruit powders, the leaf and fruit pulp powders had high phytotoxicity on the aquatic weeds tested. Further studies to verify the results are underway. The results established that the neem plant parts have herbicidal potential.

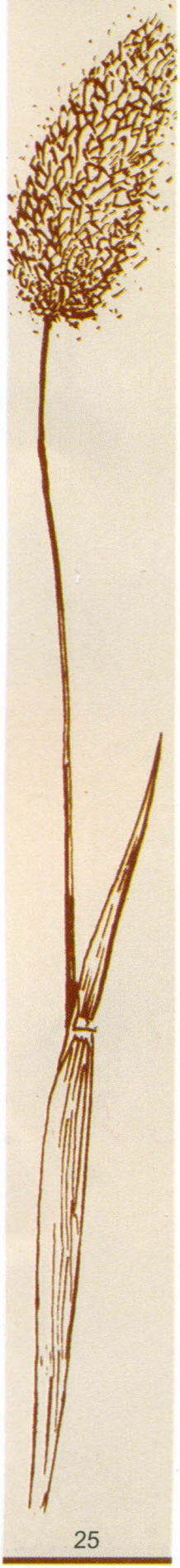
Phytotoxicity of *parthenium* and *lantana* residue under field conditions

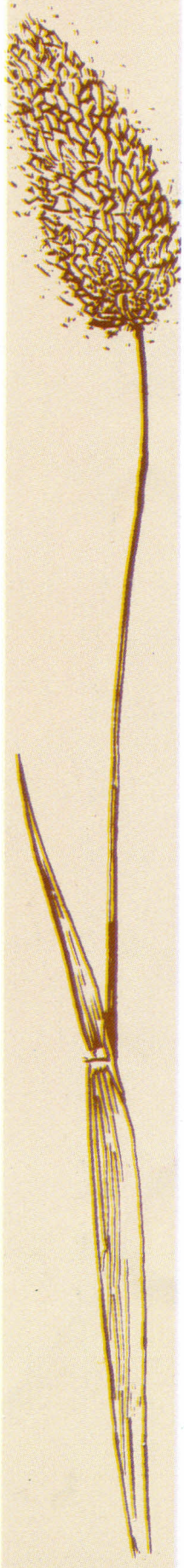
Parthenium residues (PR)

Application of the PR at 0.5-13.3 t dry biomass /ha was not toxic to field crops and rather it improved crop growth and yields of crops marginally. The treatment of field with the PR did not affect weed incidence including species-wise weed distribution, their number and biomass. Hence allelopathic inhibition of the field crops by the weed appears to be a remote possibility.

Lantana residues (LR)

Seasonal biomass production of lantana was 1.3 t/ ha (dry). The LR (dry) had 1.5% terpenoids and 2.2 per cent phenolics.





Various crops wheat, chickpea, pea, linseed, mustrad, barley, frenchbean, cowpea and okra were sown during 2002-2003-winter season in micro-plots (1x2 or $1m^2$) in the experimental field without or with LR powder (>80 mesh) at 3.3, 6.6, 9.9 and 13.3 t/ha. The LR levels were so chosen to exceed seasonal leaf biomass production of the weed, The recommended dose of fertilizers for different crops were ($N:P_2O_5:K_2O$) with or without LR were also applied. Weed incidence (species, number and biomass) and crop yields were recorded. The soil was bioassayed for inhibitory activity using lamna (*Lemna pausicostata* Hegelm.) bioassay. Soil pH and conductivity were also measured.

The results showed that the LR marginally reduced number of weeds in some of the crops. However, it did not reduce weed biomass appreciably. The LR reduced crop yields marginally though the data were not statistically significant in most of the crops. The LR levels applied in the experiments were very high as compared to the seasonal biomass production of the weed. The weed residue was unable to inhibit the crop even at the highest level of its application. Thus inhibition of field crops by lantana through allelopathy under field conditions is ruled out. The terpenoids and phenolics at LR at 3.33 t /ha estimate at 49.9 and 73.2 kg/ha, respectively. The terpenoids and phenolics at the highest level of LR (at 13.3 t/ha) estimate at 199.6 and 292.8 kg/ha, respectively. Lemna bioassay for inhibitors did not test the soil positive for inhibitory activity. The LR did not to change soil pH or conductivity significantly. Thus, it is apparent that under field conditions the soil has tremendous potential for detoxification of the phenolics and terpenoids produced. Therefore, it is postulated that the LR constituents are not converted to more phytotoxic constituents under field conditions. Since the LR failed to improve crop growth performance, it is obvious that the weed residue is not suitable for use as a source of fertilizer in field crop production.

Phytotoxicity of allelochemicals on aquatic weeds

Phytotoxicity of allelochemicals *viz.* ellagic acid, quercetin, quinol, putrescine, resorcinol and phloroglucinol on representative aquatic weeds was investigated. The phenolic and related allelochemicals were toxic at different concentrations to different species. The most phytotoxic ones were quinol and quercetin. Quercetin was lethal to floating (*Salvinia molesta* and *Azolla pinnata*) and submerged (*Najas graminea*, *Ceratophyllum demersum*, *Hydrilla verticillata* and *Chara* sp.) at 0.1 mM (30 ppm). Quinol was lethal to submerged aquatic weed *Chara* sp. weeds at 0.1 mM (11 ppm). The chemical appears to have potential for use as a natural herbicide in aquatic ecosystems. Preliminary experimental results showed root dysfunction and resultant desiccation syndrome-derived physiological changes involving cellular membrane integrity deterioration, loss of key enzymes and macromolecules resulting in death of the treated plants. The mechanism of action of the phytotoxicity is being investigated.

Biological management of weeds

Effect of *Trichoderma* on *Phalaris minor*

A field experiment was carried out in *rabi* season to evaluate different doses of fungi *Trichoderma viride* and *Trichoderma virens* (*Gliocladium virens*) for the management of *Phalaris minor* in wheat crop. Both the bioagents were applied through different combinations of seed+soil treatment. Maximum inhibition (40%) of seed germination of *Phalaris minor* was observed with the application of *T. viride* at 4 g/kg as seed treatment + 8 g/m^2 as soil treatment. However, the application of these bioagents did not show any adverse effect on seed germination of wheat.

Effect of nutrients on bioherbicidal efficacy of *Trichoderma*

A field experiment was conducted to know the effect of N, P and K and compost on the efficacy of bioagents for controlling *Phalaris minor.* Application of bioagents with compost significantly increased their activity. Maximum inhibition (41.8%) of seed germination of *Phalaris minor* in wheat was found with *T. viride* seed treatment at 4 g/kg + soil treatment at 4 g/m^2 and recommended dose of compost without affecting the seed germination of wheat. While application of N, P and K at recommended dose little bit inhibited the activity of bioagent.

Management of alligator weed

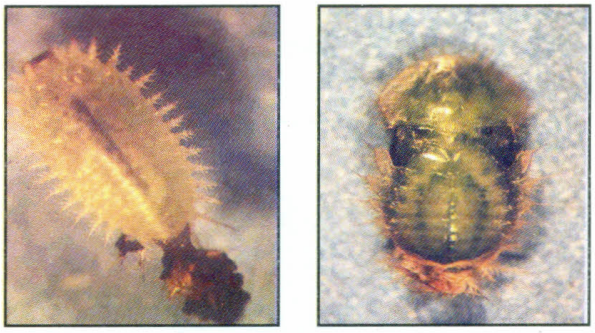
Alligator weed *Alternanthera philoxeroides* (Family: Amaranthaceae) is a native of the Parana River System in north-eastern Argentina and is believed to have been introduced to India from Indonesia and Burma. The weed has a parasitic growth potential and is likely to become a serious threat in future in India.

Survey of insect fauna, their damage potential

Five insect speices *viz. Dicracia oblique, Helicoverpa armigera, Prodenia litura*, leaf roller *Pachyzancla stultalis* (*Pasara stutalis*) (all from order - Lepidoptera) and turtle beetle *Cassida* sp. nr *enervis* (order- Coleoptera) were observed to be feeding on alligator weed in nature. Among these, the turtle beetle was found promising as its population was recorded throughout the year except a few months causing appreciable damage to this weed. The average attack of the turtle beetle on the weed varied from a maximum of 97% in August to a minimum of 22% in February. The maximum leaf area damage (44%) was observed during August while minimum (5%) during June 2002. The damage also varied in aquatic and terrestrial form of weed. Biomass study of attacked and non-attacked plants revealed 43% reduction in biomass by beetle attack.

Host-specificity of turtle beetle

The larvae and adults of turtle beetle- *Cassida sp. nr enervis* were tested on many plant species including economic plants and weeds but it could not survive on any except *Ipomoea aquatica*, an aquatic weed, However, the survival rate was very poor on this weed also. Thus, the insect seems to be host-specific.



Pupa and adult of *Cassida* sp.

Symptoms of damage due to *Cassida sp.*

Impact of herbicides on turtle beetle

To find out the possibilities of integration of biological and chemical control, common herbicides were tested for their harmful effects on bioagents. 2,4-D caused greater mortality of adults, while glyphosate caused highest mortality of larvae. Larvae and adults of turtle beetle were found least susceptible to metsulfuron-methyl followed by glyphosate and 2,4-D. The study suggeseds that for integrated management of alligator weed, higher

concentrations of herbicides should be avoided to prevent mortality of the bio-agent.

Impact of *Neochetina* spp. on water hyacinth

The bioagent *Neochetina* spp. was released in 1995 in five ponds out of which two ponds namely *Mahanadda* and *Guloua tal* got completely were cleared while the rest were partially cleared (50 to 90%). The population of water hyacinth was found to reduce when population build-up of *Neochetina* spp. in the pond was higher.

Pond cleared of water hyacinth by *Neochetina* spp

Impact of *Z. bicolorata* on parthenium

In the year 2000, about 6000 Mexican beetles were released at 15 different sites of Jabalpur at the rate of 400 beetles in an area of about 100 m^2 at each site. In the subsequent years, monitoring of establishment of beetles' and their damage potential were carried out. Good establishment of the beetles was observed at 13 places where 50 to 100 % damage on parthenium was noticed by the second fortnight of September 2002. At another location, in a contiguous area of about 100 ha, parthenium stands were completely killed.

Population build-up of the beetles was so high at this site that beetles devoured parthenium even among the *kharif* crops in the adjoining area. Severe damage to parthenium by the beetle was also observed in western Uttar Pradesh and Uttaranchal at places like Saharanpur, Bijnor, Dehra Dun, Haridawar, Roorki and Chutmalpur.

Damaged *Parthenium* patches amidst the sorghum crop

Experiments were also conducted to see the impact of the beetle on parthenium plants of varying height (15 cm, 30 cm and 60 cm) at 27±1C and 70±5 percent humidity in laboratory conditions as well as on the natural growing population bound by mosquito-nets. Four adults were found to completely defoliate the parthenium plants having the height of 15, 30, 60 cm within 7, 12 and 18 days, respectively. Adults released by the middle of June in mosquito nets started to lay eggs on parthenium plants. Though good number of larvae was hatched and development commenced, heavy mortality of larvae and adults occurred due to dry spell in July and August. But where soil was kept wet by irrigation, good population build-up leading to severe defoliation of parthenium. This showed that regular rains are imperative for proper population build-up of the bettles.

Rearing and supply of Mexican beetles

About 4000 beetles were supplied to different AICRP-WC centres during this year. Beetles were also supplied free of

cost to variuous municipalities, NGOs, farmers and interested people.

Public awareness programme on parthenium

In view of the problems caused by parthenium, farmers, school children, NGOs, officials from State Agricultural Departments and members of residential associations were given training on biological control of parthenium using Mexican beetle and other biological approaches. Practical demonstra-tions on making compost with parthenium were also held. A token gift of Mexican beetles was given to each participant for release in their areas. Meetings were also held in villages to make the farmers aware of the parthenium menace and the ways of its control.

Mechanical weed management

Design improvements and prototype development of tools and implements

Suitable improvements in the design of weeding tools to improve their functional ability, working efficiency and to reduce the manufacturing cost were carried out. Different designs of weeding tools and implements for working in different soil and crop conditions have also been developed. Prototypes of selected weeding tools and implements namely twin wheel hoe weeder, NRCWS herbicide wick applicator were developed after incorporating the suitable design improvements and were evaluated in actual field conditions.

Design improvement and prototype development of twin wheel hoe weeder was carried out for narrow crop row spacing of 22.5 and 15 cm for example in case of upland drilled rice crop in *kharif* season and irrigated wheat and chickpea crop in *rabi* season. At present the twin wheel hoe weeders are being used for wide row spaced crops like soybean, maize, pigeonpea, chickpea, mustard etc., where crop row spacing are 30 cm and above. The designed blade width for such wide spaced crops is 22.5 to 25 cm.

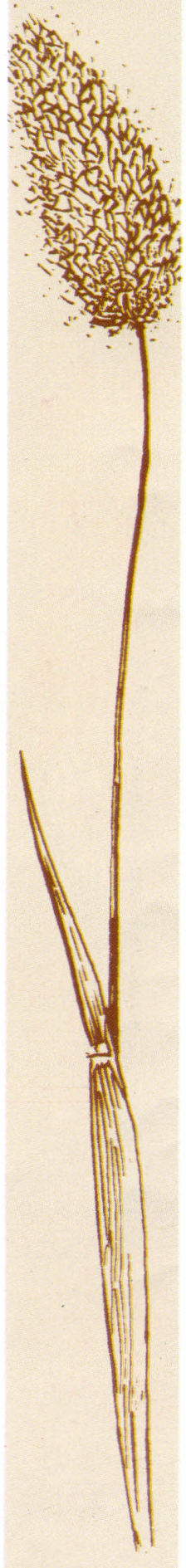
The twin wheel hoe weeder has been improved with a working blade width of 15 cm and 10 cm respectively for use in crops namely upland drilled rice in *kharif* season and irrigated wheat and gram crop in r*abi* season. The developed twin wheel hoes were demonstrated in NRCWS farm and two farmers field in nearby villages during *kharif* and *rabi* seasons in the line-sown upland drilled rice, irrigated wheat and chickpea crops.

Performance evaluation of improved twin wheel hoe weeder, and comparison of its performance with chemical control practices such as herbicide application by knapsack sprayer with shield application and herbicide application by NRCWS wick applicator was made in field condition in summer greengram and *kharif* soybean crops. The field experiment was laid out in randomized block design with five treatments and four replications. The treatments tried were non-selective herbicide application by NRCWS wick applicator , weed control by twin wheel hoe, application of non-selective herbicide application by Knapsack sprayer, no weed control treatment, and weed free treatment.

Weed control efficiency of improved weeding tools

Treatments	Weed control efficiency (%)	
	greengram	soybean
NRCWS wick applicator	52	44
Twin wheel hoe	72	56
Knapsack sprayer using shield	64	39
Weedy	-	-
Weed free	93	100.0

The highest weed control efficiency based on weed population achieved was 56% in case of improved twin wheel hoe followed by 44% with application of non-selective herbicide by NRCWS herbicide wick applicator and 39% control with application of non-selective herbicide by



Knapsack sprayer in soybean crop. In summer greengram crop, the highest weed control efficiency of 72% was achieved in case of using improved twin wheel hoe weeder followed by 64.4% in non-selective herbicide application by Knapsack sprayer and 52% by NRCWS herbicide wick applicator.

Development and evaluation of powered aquatic weed cutter

Design, development and testing of engine-powered aquatic weed cutter/harvester for small water-bodies and ponds were carried out. This machine consisted of main frame, two hull structures, cutting unit, power transmission from engine to cutter bar, a Mitsubhishi AD-8 engine, steering system, engaging/disengaging levers for power to cutter bar, propeller fan, rudder plate, ground transport wheels. The unit was tested in actual aquatic condition in Adhartal pond, Jabalpur during the month of April 02 and December 02. Certain problems have been noticed in preliminary testing of the engine-powered aquatic weed cutter/harvester *viz.* slipping of 'V' belts causing loss of transmission of power, lower speed of operation, splashing-up of water due to moving components of the machine, heavy transport wheel arrangement of the unit requiring more time for its removal.

Based on the deficiencies noticed in actual testing of the unit, certain modifications were carried out in different components of the developed machine to rectify the problems and improve the efficiency of operation. The following improvements were made during the year.

- The propeller rotor used was replaced from 10 cm diameter to 12.5 cm diameter. The performance of machine in respect of speedy movement was not satisfactory earlier. Therefore, two fans are being installed in the unit to obtain the desirable speed of the unit. The propelling system at the rear end has also been modified accordingly.
- The 'V' belt power transmission from engine to propeller rotor was replaced by positive drive sprocket and chain system to avoid slipping of 'V' belts. Similarly the power transmission to cutter bar was also replaced from 'V' belt system to sprocket and chain system to achieve positive drive and avoid slipping of 'V' belts. The idle shaft with bearing and housing has been incorporated to adjust the tension in chain drive system for the propeller rotor and cutter bar power transmission system.
- In order to increase the speed of rotation of propeller rotor, a smaller sprocket wheel has been fitted in place of big sprocket.
- To reduce the weight of the machine, the transport wheel brackets were made light in weight and easy for its removal.
- To reduce the weight of the machine, the angle and braces of higher dimensions were replaced by lower sizes in frame of the machine.
- The engine foundation was raised by 15 cm incorporating wooden planks on the rigid engine base to avoid splash of water due to lower engine foundation.
- The belt adjustment levers, which were operated by hand and were projected upwards, are modified to foot operated belt/chain operated adjustment lever and system was modified.
- The operation of rudder plate was through steering wheel which was giving trouble in its movement have been replaced by a hand lever system. The position of the rudder plate was also changed in order to accommodate the two propeller rotor fans.

National database on weeds

Development of national database on weeds

Information on weeds of major crops of 20 states comprising 415 districts was collected and entered in the database programme. The invasive weed species of the different states are also included. Computer software was developed in Visual Basic and MS Access.

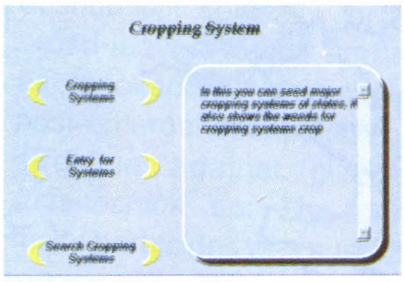
Software on database on weeds

The database offers not only information on each individual weed species but also provides with eight different ways of looking at the information. Database searches can be made as follows:

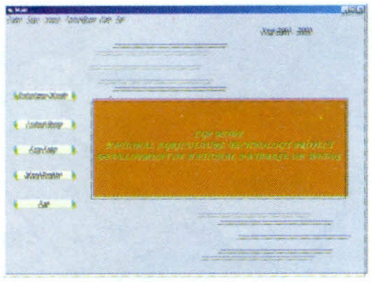
State	This search provides a list of states for the user to choose form.
District	Total number of districts in the state.
Crop	Major crops of the district.
Season	Season of the crop in the district and state.
Weed	Five major weeds of crop of the district
Infestation	Degree of infestation of five weeds in the major crops of the district.
Distribution	Weed species and crops in different districts of the state & country based on their occurrence and degree of infestation.
Ranking	The user can select a weed species in different crops of district, state and country. Ranking of degree of infestation identified with a number is as follows:
	5- Very high infestation (> 80 percent)
	4- High infestation (60-80 Percent)
	3- Moderate infestation (40-60 percent)
	2- Low infestation (20-40 percent)
	1- Very low infestation (< 20 percent)
Languages	Different language names of weed
Visual query	Viewing/querying weed maps of different district
Invasive weeds	State's Invasive weed information

Some screen shots of the menus

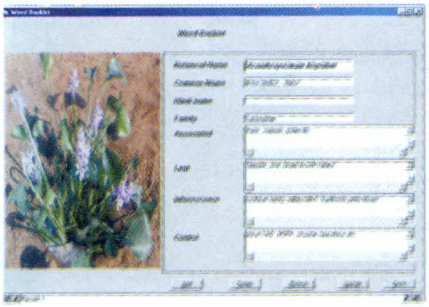
Cropping System



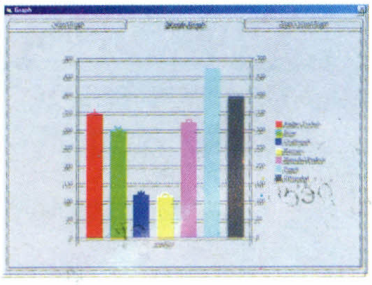
Textual Query



Weed Booklet



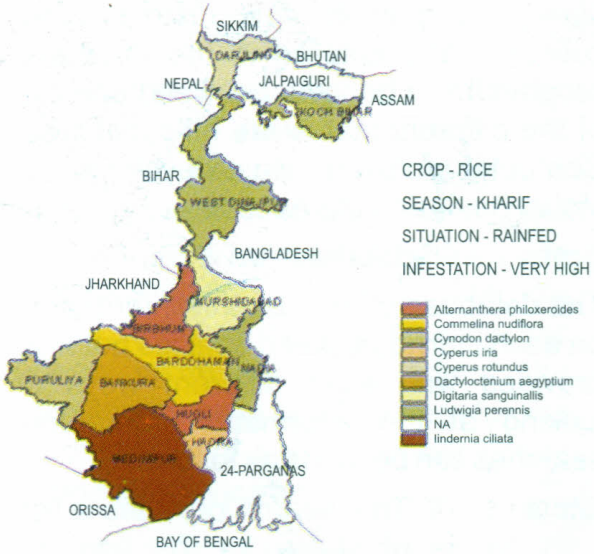
Weed Diversity

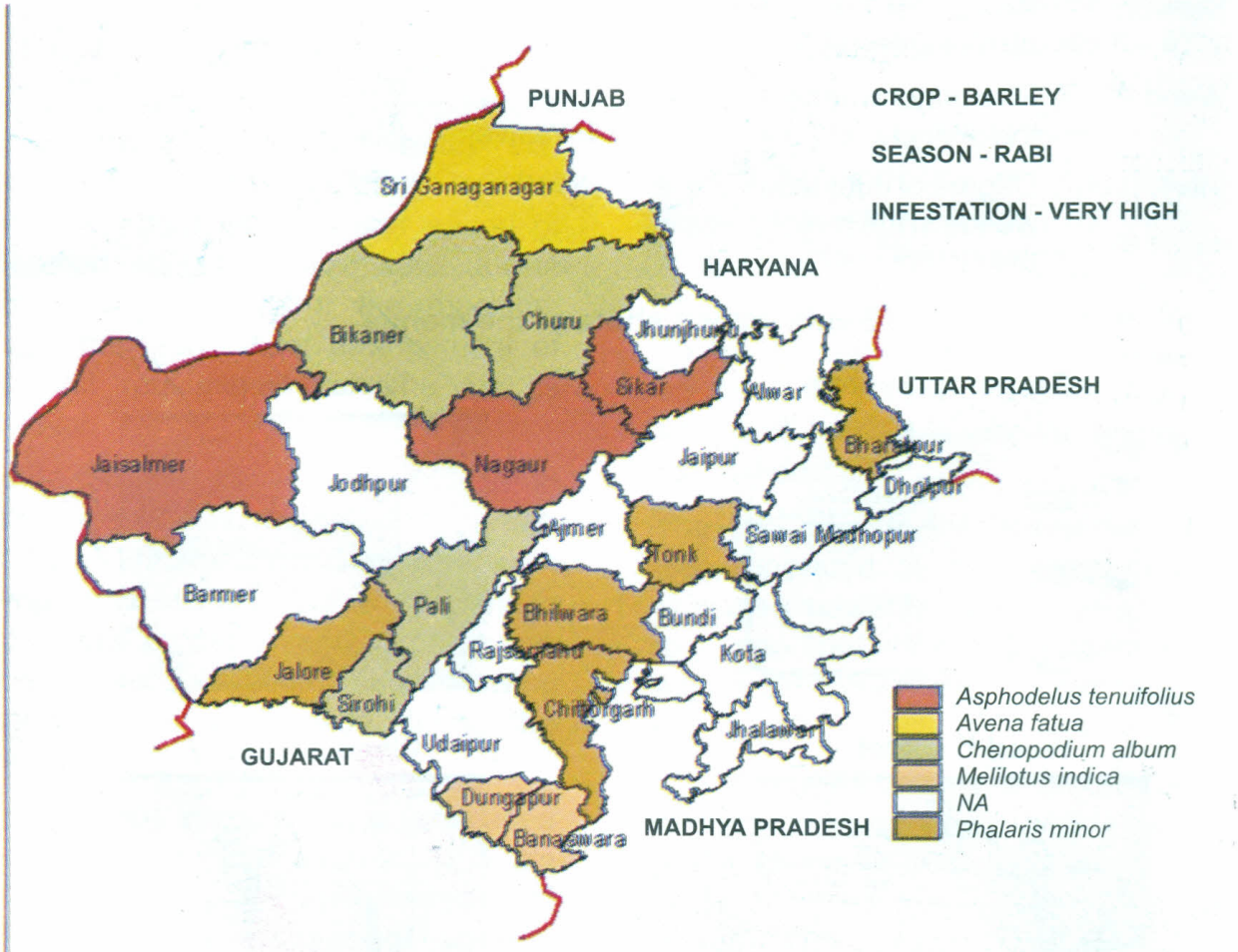


Weed atlas

Weed atlas of 10 states has been prepared. It contains weed distribution maps of different crops of the respective states alongwith all the key information on weeds. The maps are prepared based on the degree of infestation of weeds in a particular crop considering season and situation using arc view GIS software. Weed maps show the following information:

- Crops in district of a state
- Season and situation of the crop
- Weed name with degree of infestation in the crop
- Different legends are given for uniqueness of infestation
- Labels are provided for states/districts
- Full view of map, which contains a single map in a single page
- 541 maps were prepared for 10 states





TRANSFER OF TECHNOLOGY

Evaluation of improved weed control technologies on farmers' fields

Rice (drilled)

Five field demonstrations on upland direct-seeded rice were conducted at farmers' fields in Sehora tehsil of Jabalpur to know the extent of yield improvement with improved weed manage-ment technology over farmer's practice. Application of butachlor 1.5 kg/ha (PE) *fb* fenoxaprop 70 g/ha (PO-25 DAS) or one hand weeding at 30 DAS provided effective control of weeds and increased the grain yield of both improved as well as local varieties over farmers practice. Local tall variety (Lalli-14) of rice was found more competitive to weeds than improved short statured variety (JR-201).

Twenty-five demonstrations on drilled rice were conducted in various farmers' fields in Khamaria, Katara, Panchkundi and Deori villages of Jabalpur. Results indicated that pretilachlor+safener (Sofit) 0.75 kg./ha as pre-emergence performed better in control-ling weeds and was safe to the crop. The postemergence spray application of chlorimuron+ metsulfuron (Almix) 4g/ha proved effective and economical specially for the control of broad leaved weeds and sedges where as, fenoxaprop (Whip super) 75 g/ha as post-emergence application was found effective against grasses specially *Echinochloa* sp. The performance of these herbicides was superior to butachlor 1. 5 kg/ha as a pre-emergence application.

Director visiting a demonstration site

Wheat

Twenty-three demonstrations on wheat were conducted at farmers' fields during 2002 to create awareness to the farmers about improved weed management technology involving herbicides. Combination of isoproturon + 2,4-D (0.50+0.50 kg/ha) applied at 30-35 DAS gave broad-spectrum weed control and higher yield of wheat. However, 2,4-D alone was less effective against leguminous weeds like *Lathyrus aphaca* and *Vicia sativa*. Almix 20 WP (20 g/ha) also gave effective control of broad leaf weeds. Application of clodinafop 60 g/ha was found very effective against *Avena ludoviciana* and *Phalaris minor* but failed to control broadleaved weeds. Fenoxaprop 70 g/ha and sulfosulfuron 40 g/ha were also effective against grasses and provided some control of broad leaf weeds too.

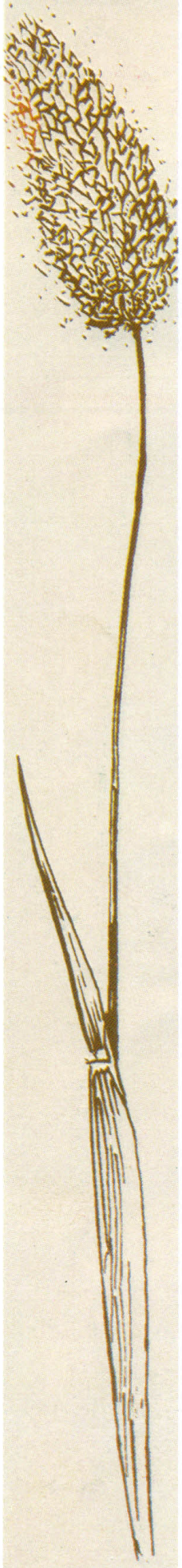
Herbicides	Demon-stration	Grain yield (t/ha)		Benefit (Rs./ha)
		FP	IP	
Sulfosulfuron (25 g/ha)	3	2.7	3.7	3990
2,4-D (750 g/ha)	4	2.9	3.8	5559
2,4-D+IPU (500+500 g/ha)	8	2.3	3.3	5344
Chlorimuron ethyl + metsu-lfuron methyl (4 g/ha)	8	2.5	3.3	4879
Clodinafop (60 g/ha)	3	2.4	3.7	5918

FP-Farmers' practice; IP- Improved practice;

PO- Post emergence, IPU-Isoproturon

Chickpea/pea/mustard

Similarly in chickpea, pea and mustard, four on-farm demonstrations in each crop were laid out. In chickpea and



mustard, pendimethalin *or* isoproturon as a pre-emergence application was found very effective, while in pea, clodinafop at 60 g/ha as post emergence application showed better efficacy.

On-farm demonstrations in different crops

Crops	Treatments	Cost (Rs/ha)	Benefit (Rs/ha)
Wheat	Sulfosulfuron 25 g/ha PO	1800	1845
	Isoproturon 1000 g/ha PO	485	3006
	Farmers practice	1600	1735
Chickpea	Pendimethalin 1000g/ha PE	1617	5703
	Isoproturon 1000 g/ha PE	485	6225
	Farmers practice	1600	2207
Pea	Pendimethalin 1000g/ha PE	1617	453
	Clodinifop 60g/ha PO	1875	827
	Farmers practice	1600	045
Mustard	Pendimethalin 1000g/ha PE	1617	1109
	Isoproturon 1000 g/ha PE	485	2082
	Farmers practice	1600	461

Performance of winter crops under zero tillage

Large scale field demonstrations were undertaken in two villages of Panager block to evaluate the performance of four winter season crops *viz.*,. wheat, chickpea, pea and mustard under zero tillage (ZT) condition after the harvest of rice. Results revealed that all the crops produced higher or comparable yields in ZT and conventional tillage (CT). This indicated that not only wheat but other crops could also be grown under ZT in vertisols successfully. Results also revealed that ZT practices are more economical as compared to CT in terms of saving fuel and time. Beside the fields were less infested with weed flora specially *Phalaris minor* under zero tillage.

Control of *Ipomoea carnea*

Considering perennial nature and fast multiplication of *Ipomoea carnea,* a problem weed of low lying non-cropped areas, a demonstration was conducted with 2,4-D and glyphosate for its control. Results revealed that application of 2,4-D 0.75 kg/ha before flowering controlled the *Ipomoea carnea* very effectively.

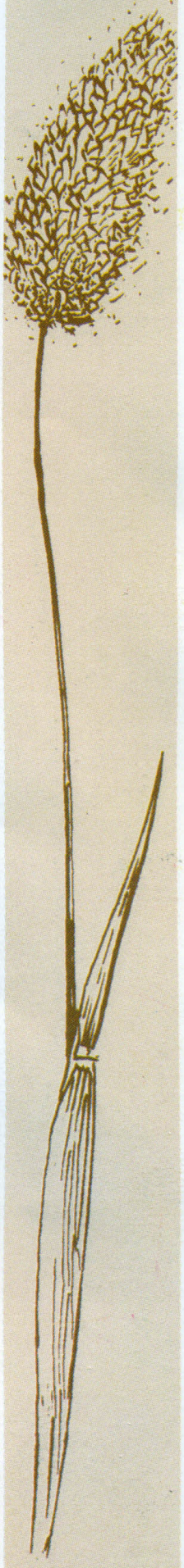
Control of Parthenium

Parthenium has become a big menace everywhere in non-cropped situations and housing colonies. A herbicide, very successful in potato and other crops *viz.*, metribuzin was tested and compared with glyphosate against this obnoxious weed. It was found that metribuzin 0.3% solution applied at active foliage stage effectively controlled parthenium without affecting the native grasses like *Cynodon dactylon,* whereas glyphosate controlled all the vegetation non-selectively.

EDUCATION AND TRAINING

Training programme attended by the scientists and other staff

Participants	Title of the programme	Venue and duration
Dr. J. S. Mishra	21-day training programme on "Organic Agriculture-A Paragon for Sustainability"	JNKVV, Jabalpur March 26-April 15 2002
Mr. B. P. Uria and **Mr. Xavier Francis**	Intensive Hindi Training	NAARM, Hyderabad June 18-22 2002
Dr. K. K. Barman and **Mr. K. K Vishwakarma**	Training on Analysis of Herbicide Residues in Soil and Plant	FIPPAT, Chennai July 1-7, 2002
Dr. V.S.G.R. Naidu	75th Foundation Course for Agricultural Research Service	NAARM, Hyderabad August 1 November 28 2002
Mr. Sandeep Dhagat and **Mr. T. Lakhera**	Training on NATP, FMS Package	IISR, Lucknow August 8-9, 2002
Dr. V. P. Singh and **Dr. P. K. Singh**	Training on Planning and Management of Training for Western zone	Nagpur September24-25, 2002
Dr. M. S. Raghuvanshi, Sh. R.S. Upadhyay and **Sh. S. K. Parey**	Winter school on "Recent Advances in Weed Management"	NRCWS, Jabalpur October 21 to November 10, 2002
Dr. A. K. Gogoi	7th Management Development Programme in Agricultural Research.	NAARM Hyderabad November 21-27 2002
Dr. K.K. Barman	Short-term training course on Pesticide Residue Analysis	Pesticide Referral Laboratory, Division of Agricultural Chemicals, IARI, New Delhi



AWARDS AND RECOGNITION

Dr. J.S. Mishra, Sr. Scientist (Agronomy) of the Centre was awarded with Dr. P.S. Deshmukh Young Agronomist Award for the year 1999 by the Indian Society of Agronomy for his significant research contribution in the field of Agronomy. The award consisting of a gold medal, a citation and cash of Rs. 5000 was conferred on him at the inaugural session of 2nd International Agronomy Congress held at New Delhi during 26-30 November 2002.

Dr. Adel El-Beltagi, D.G., ICARDA honouring Dr. J.S. Mishra. Also seen in the picture are Dr. Panjab Singh, D.G., ICAR and Dr. M.S. Swaminathan, Chairman, M.S. Swaminathan Research Foundation.

Visits abroad

Dr. (Mrs) Shobha Sondhia, Scientist (Residue chemistry) attended 3rd World Congress on Allelopathy-Challenges for the New Millennium held at Tsukaba, Japan during 26-30 August 2002 and presented a paper on Isolation and Identification of Allelochemicals from *Xanthium strumarium*.

राजभाषा

केन्द्र की राजभाषा कार्यान्वयन समिति के तत्वावधान में 14 सितम्बर से 28 सितम्बर 2002 तक राजभाषा पखवाड़ा मनाया गया । इस कार्यक्रम में सभी वैज्ञानिकों/अधिकारियों एवं कर्मचारियों को हिन्दी में अधिकाधिक कार्य करने हेतु प्रेरित किया गया । इसके अंतर्गत विभिन्न प्रतियोगिताओं जैसे निबंध, शुद्धलेखन, टंकण, वाद-विवाद आदि का आयोजन किया गया जिसमें केन्द्र के सभी वर्गो के कर्मचारियों ने भाग लिया तथा विजताओं को पारितोषिक वितरण किया गया ।

Promotions

- Mr. M.K.Bhatt, T-6 w.e.f. 01-01-2002
- Mr. V.K.S.Meshram, T-5 w.e.f. 05-11-2000
- Mr. G. R. Dongre, T-5 w.e.f. 19-9-2001
- Mr. Sabasteen Das, T-1 w.e.f. 21-5-2002
- Mr. Francis Xavier, Jr. Clerk w.e.f. 21-5-2002
- Mr. Chhote Lal, SSG-III w.e.f. 21-5-2002

ALL INDIA COORDINATED RESEARCH PROGRAMME ON WEED CONTROL

AICRP-Weed Control has been operating in 22 cooperating centers with NRCWS as coordinating centre to undertake researches on location specific problems. The salient findings of the project during the year are as follows:

Weed survey, surveillance and weed shift

The cooperating centres are regularly monitoring the weed shifts in different crops and cropping systems. In Western Himalayas and Sub-humid region, due to the continuous use of butachlor and anilophos in transplanted rice, *Fimbristylis milliacea, Caesulia axillaris* and *Commelina benghalensis* were found dominating while in wheat the use of isoproturon, is leading to increased occurrence of *Medicago denticulata, Lathyrus aphaca* and *Melilotus indica.* In the Western Ghats and Coastal plains, the infestation of *Echinochloa* spp., and *Marsilea quadrifolia* are becoming dominant.

Yield loss estimation

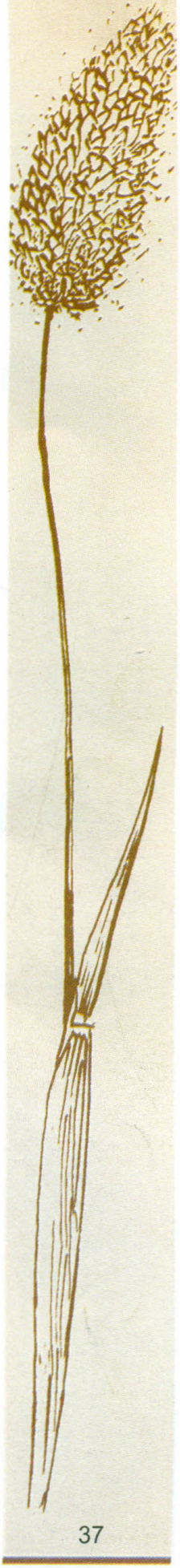
The crop yield losses due to weeds in farmers' fields in different agro-eco regions varied from 10 to 60%. This wide variation can be attributed to the differences in the awareness and adoption rate of recommended technologies, impact of the environmental parameters and the degree and composition of weed incidence in the respective regions.

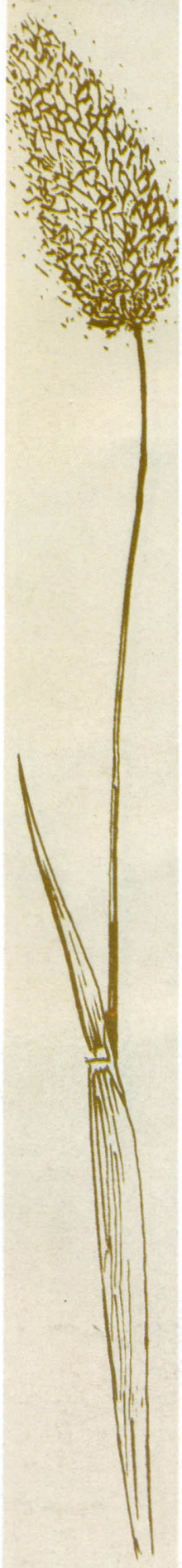
Agro-ecologiocal region	Crop	Yield loss (%)
AER-9 (Northern Plains)	Transplanted rice	40-50
	Wheat	40-60
AER-13(Eastern plateau and Ghats)	Transplanted rice	50-60
	Groundnut	35-40
	Maize	15-20
AER-14 (Eastern Plains)	Wheat	10-20
	Transplanted rice	15-20
	Maize (*rabi*)	25-30
AER-15 (Western Himalayas)	Wheat	40-45
	Maize	35-40
	Transplanted rice	20-25
AER-16 (Assam and Bengal Plains)	Upland rice	40-50
	Mustard	20-25
	Transplanted rice	15-20

IWM in crops

Integrated weed management packages (IWM) for a majority of crops including rice, wheat, maize, sorghum, millet, groundnut, soybean, mustard, cotton, safflower, vegetable crops and spices and plantation crops has been developed. In direct-seeded rice, application of pretilachlor + safener 0.45 kg/ha followed by one manual weeding (35 DAS) registered lower weed dry matter accumulation in Eastern Ghats (T.N. uplands) and Deccan plateau eco-region. In cotton, directed application of glufosinate ammonium 0.75 and 0.90 kg/ha provided effective control of weeds including perennial ones like *Cyperus rotundus*.

In wheat, post-emergence application of mixture of metsulfuron and iodosulfuron (1.2 +1.4 g/ha) effectively controlled *P.*





minor and non-grassy weeds in Northern plains and hot sub-humid eco-region. The application of trifluralin (0.75 & 1 kg/ha) either before or after first irrigation coupled with one hand weeding proved very effective against isoproturon resistant populations of *P. minor* in wheat.

Effective control of *Oxalis latifolia* was observed in farmers' fields with glyphosate (1 kg/ha). Spraying atrazine (1 kg/ha) with surfactant or broadcasting after mixing with sand (150 kg/ha) at 2-3 leaf stage was found to control *Ageratum houstonianum.* In sunflower, pre-sowing application of glyphosate (2 kg/ha) alongwith activator, AG-F (0.5 l/ha) controlled established weeds. Clomazone+pendimethalin (125+500 g/ha) provided effective control of weeds and increased tuber yield of potato in Northern plain zone.

Testing of new herbicides

A number of new herbicides are evaluated for their bio-efficicacy in different crops and cropping systems. The results are compiled and necessary information required for registration and other purposes is supplied to the herbicide manufacturers. The following are some of the new herbicides tested.

Crop	New herbicides	Cooperating centers
Rice nursery	Pyrazosulfuron-ethyl, Cyhalofop-butyl	Ludhiana and Hisar
Transplanted rice	Pyrazosulfuron-ethyl	Ludhiana, Coimbatore, Bangalore, Pantnagar, Palampur, Sriniketan and Pusa
	Chlorimuron Clomazone+2,4-D Ethoxysulfuron	Thrissur, Coimbatore, Palampur and Hisar
Wheat	Triasulfuron	Gwalior
	Metsulfuron	Jorhat
	Clodinafop	Faizabad, Ludhiana, Pantnagar and Hisar
	Oryzalin	Hisar

Research on parasitic weeds

The parasitic weeds are one of the major production constraints in the rainfed areas of the country. Intensive research is being carried out on this aspect. Some of the major parasitic weeds are *Striga, Loranthus, Cuscuta, Dendropthae* spp. *Orobanche* a common parasitic weed of mustard and tobacco, was also noticed to infest tomato and

Orobanche problem in tomato

Parthenium hysterophorus serves as an alternative host in the dry belt of Karnataka. *Cuscuta* sp., which is widely found in niger-growing areas of Orissa, Chattisgarh and Madhya Pradesh, has been reported to cause a high seed yield loss of 70-80%.

Cooperating centres of AICRP - Weed Control in India

Role of Women in Weed Management

Employment of women constitutes an important component of the organized sector specially in agriculture. As a household activities, women have played a significant role in agriculture and related enterprises. At present, almost 50 % of rural female workers are agricultural laborers and 37 % are cultivators. The green revolution with its mechanization and intensive input use generated a host of problems for small and marginal farmers. Consequently women in order to support their families are forced to become casual labourers in many cases. The modernization process including introduction of HYV's, quality seeds, pesticides and modern implements displaced the farmers from traditional activities and has pushed women to less skilled jobs and as support agents rather than major handlers of pesticides and equipments.

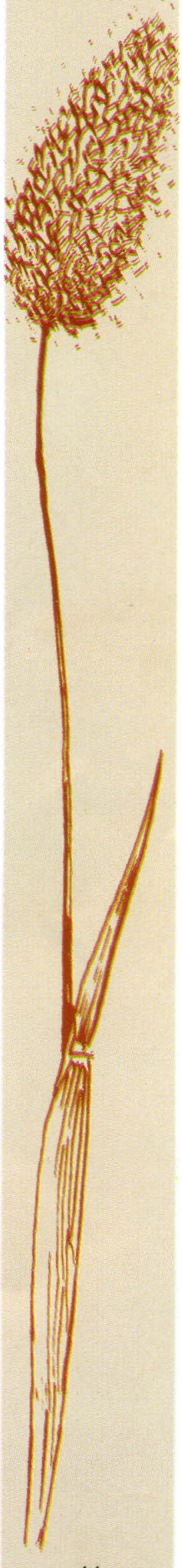
In crop culture, manual and mechanical practises are still the most commonly-used methods of weed control in the country. Hand weeding is highly laborious, drudgery causing, time taking and is mostly performed by women. According to a conservative estimate, a

whopping 4 billion person-days are engaged for weed control operation on an annual basis. That means every child; man and woman of republic of India are

involved in weeding operation for about 4 days in a year! Therefore, appropriate cost-effective improved weed management technologies may enhance their efficiency and productivity and reduce their workload and drudgery. Appropriate technologies in the area of

weed management make the farmwomen's overall tasks easier, more enjoyable, less burdensome, more profitable and productive without displacing them from the labour market. The only way we can make the best use of the actual and potential capacities of farmwomen who are mostly illiterate, is to provide them opportunities for their empowerment through training in modern weed management technologies. The capability of farmwomen and their contribution to agricultural development can be enhanced significantly through effective participatory approach.

Publications - 2003



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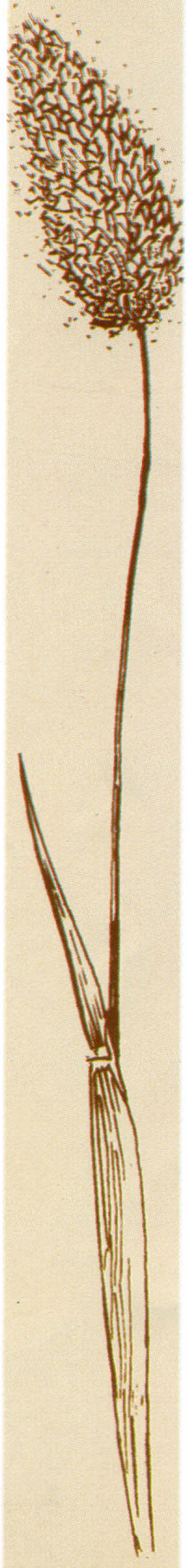

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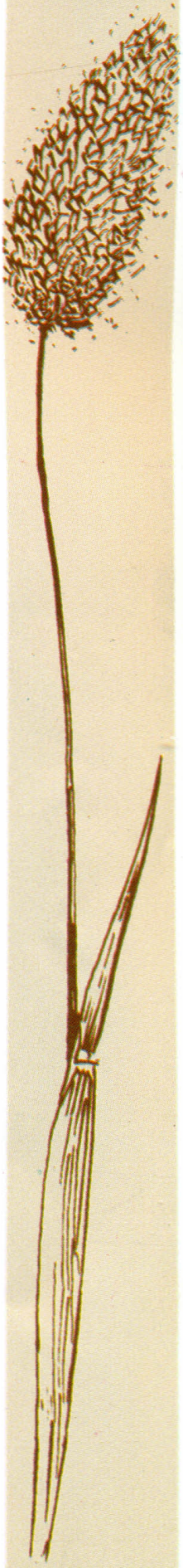

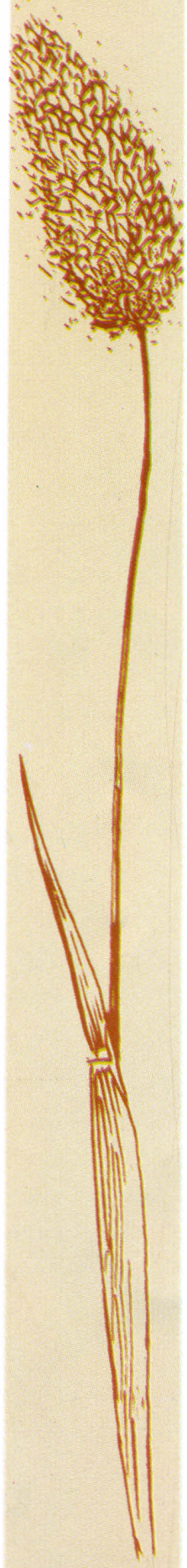

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(F) Bulletins

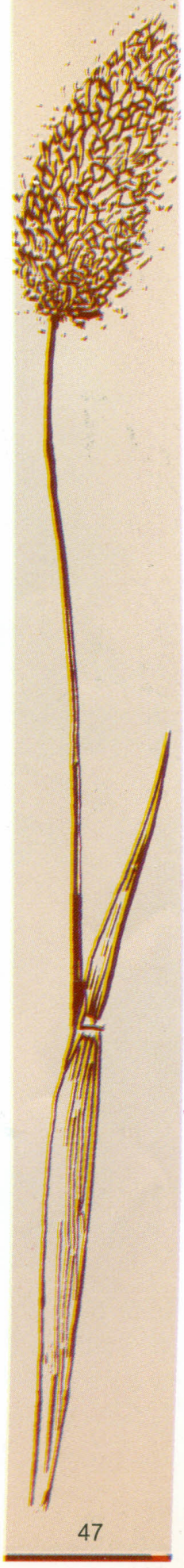
NRCWS (2002) Weed management in the new millennium: 10 p

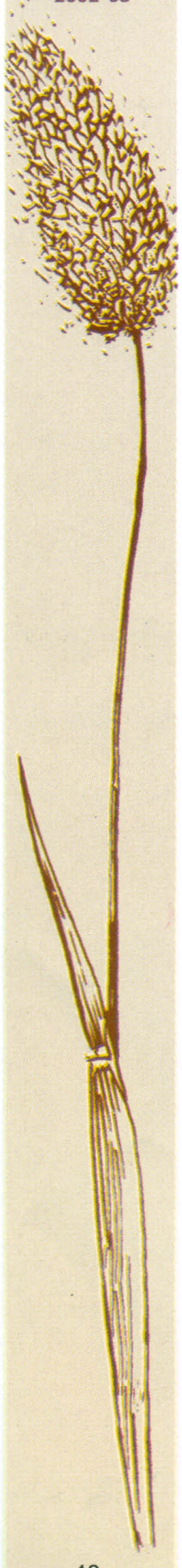
During the year, the Centre has published he following 26 extension folders on specific crops, technologies as well as on problem weeds.

- Faslon mein kharpatwar niyantran
- Rabi avam kharif Faslon mein kharpatwar niyantran
- Nidai ke unnat auzar avam yantra
- Khet ka bin bulaya mehman-gajarghans
- Gajar ghans ka mexican beetle dwara jaivakiya niyantran
- Kans-ek khatarnak kharpatwar avam iska prabandhan
- Water hyacinth-an obnoxious aquatic weed and its management
- Parthenium- a noxious weed and its management
- Soil solarization-an eco-friendly method of weed control
- Rai-sarson ki faslon mein kharpatwar niyantran
- Ganne ke pramukh kharpatwar avam unki roktham
- Aloo ki fasal ko kharpatwaro se bachaye
- Jayad ki parmukh faslon mein kharpatwar niyantran
- Dhan ke pramukh kharpatwar avam unka prabandhan
- Soybean ke pramukh kharpatwar avam unka prabandhan
- Dalhani faslon ke pramukh kharpatwar avam unki roktham
- Tilhani faslon ke pramukh kharpatwar avam unki roktham
- Lantana ka vagyanik vidhi dwara niyantran
- Genhu ki fasal mein needa niyantran ki taknik
- Weed management in vegetable crops
- Mrada suryikaran-kharpatwar niyantran ki ek labhdayak arasainik taknik
- Weed management in wheat
- Herbicidal weed control in soybean
- Weed management in rice
- Weed management in rainfed direct-seeded upland rice
- Bina jutai (zero tillage): genhu utpadan ki unnat taknik

APPROVED RESEARCH PROJECTS DURING 2002-03

Code	Projects	Principal Investigator
1	**Herbicide as a tool in weed management**	
1.1	Testing of new molecules	Dr. N. T. Yaduraju
1.2	Long term effects of herbicides in cropping systems	Dr. V.P. Singh
1.3	Influence of herbicides on soil micro-flora, soil fertility and productivity	Dr. K.K. Barman
1.4	Improving efficacy of herbicides through herbicide mixture, adjuvant etc	Dr. Anil Dixit
2	**Weed biology and eco-physiology**	
2.1	Biology of major weeds	Dr. AK Gogoi
2.2	Weed flora shift in cropping systems	Dr. VP Singh
2.3	Eco-physiology of crop-weed competition	Dr. J.S. Mishra
2.4	Germination, dormancy and ageing of weed seeds	Dr. DK Pandey
2.5	Weed herbarium and collection, conservation and utilization of weed biodiversity	Dr. D. Swain
2.6	Effect of nutrient supply on crop-weed competition	Dr. M.B.B. Prasad Babu
3	**Development and evaluation of integrated weed management techniques / practices**	
3.1	Role of weed competitive crop cultivars in IWM	Dr. B.T.S. Moorthy
3.2	Management of parasitic weed-*Cuscuta*	Dr. B.T.S. Moorthy
3.3	Design, development and evaluation of mechanical weeding tool as a component of integrated weed management techniques and practices	Er. H.S. Bisen
3.4	Effect of tillage and weed control measures on weed dynamics in different cropping systems	Dr. J.S. Mishra
3.5	Role of intercrops and cover crops in weed management	Dr. R.P. Dubey
3.6	Evaluation of improved weed control technologies on farmers' fields	Dr. P.K. Singh
3.7	Studies on effect of crop residue management on weeds in rice-wheat cropping system	Dr. P.J. Khankhane
4	**Bio-pesticides and biocontrol of weeds**	
4.1	Herbicidal activity of plants and their constituents	Dr. D.K. Pandey
4.2	Optimizing *Z. bicolorata* release as an augmentative measure for the control of *Parthenium hysterophorus*.	Dr. Sushilkumar





LINKAGES AND COLLABORATION IN INDIA AND ABROAD INCLUDING EXTERNALLY FUNDED PROJECTS

NRC-WS, being the nodal agency for research and training in the field of weed science and a repository of information in weed science in the country, offers facilities for research and training, provides expertise and consultancy to staff and students of SAUs, ICAR Instts, NGOs, herbicide industries etc.

It has an effective collaboration with SAUs through AICRP-WC program operating at 22 centres. With regular group meetings workshops and visits, it helps in identifying weed problems in different agro-climatic zones in the country and suggests a plan of action for their management.

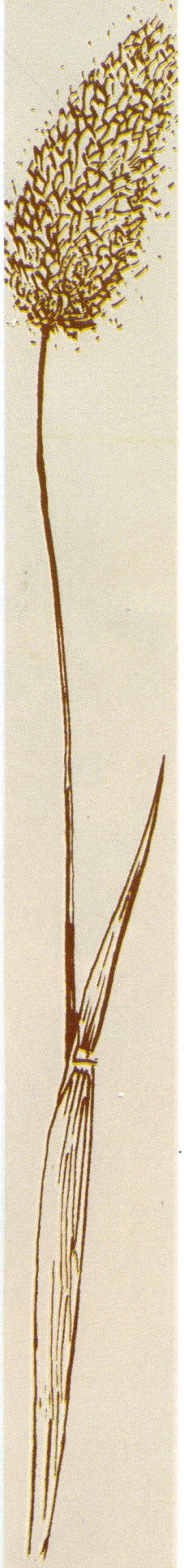
The problems and issues related to weeds and their management are referred to the NRCWS by ICAR, Ministry of Agriculture, other Ministries, Govt Agencies, NGOs etc. for their solutions.

It has effective collaboration with several ICAR Instts such as CIAE, Bhopal, IARI, New Delhi, PDBC, Bangalore, PDCSR, Modipuram, NBSS&LUP, Nagpur, NCAP, New Delhi etc. It is proposing to strengthen international collaboration with CABI, IRRI, CIMMYT and other universities in USA, UK and Australia.

Externally funded projects at the Centre

Projects	Funding agency	Period From	Period To	Budget (Rs. in lakhs)
Molecular characterization and field trials of mustard transgenic for hybrid seed production and resistance to herbicides *(In* collabo-ration with Delhi University and IARI, New Delhi)	DBT, New Delhi	2002	2005	19.06
Development of national database on weeds.	NATP (CGP)	2001	December 2003	20.57
Integrated management of *Cuscuta sp. in field crops.*	NATP (CGP)	2002	March 2004	3.78
Organization and management (PME) (in collaboration with NCAP)	NATP	2002	December 2003	4.00
Biological control of *Echinochloa crus-galli* in rice and *Phalaris minor in wheat* crop	ICAR	September 2000	August 2003	5.00

Projects	Funding agency	Period From	Period To	Budget (Rs. in lakhs)
Fate and phytotoxic efficacy of herbicides and their impact on nutrient cycle in relation to soil properties	ICAR	May 2001	April 2004	11.69
Phytotoxicity of allelochemicals to aquatic weeds Role of insects in suppression of problematic allegator weed	ICAR	September 2000	August 2003	17.50
Alternanthera philoxiroides and testing of herbicides for integrated weed management	ICAR	September 2000	August 2003	7.50
Evaluation and management of allelopathic influence of crops and weeds of rice-wheat cropping system	ICAR	May 2001	April 2004	11.19
Systematic study on weed seeds of India (In collaboration with AAU Jorhat)	ICAR	2002	2005	8.75



RAC, SRC AND IMC MEETINGS

Staff Research Council (SRC)

The SRC meeting was convened on June 27-28, 2002, under the chairmanship of Dr. N.T. Yaduraju, Director to review the results of the on-going research projects and to discuss the new project proposals. There were four multidisciplinary projects, which were effective from July 2002. All the scientists of the Centre participated in the SRC meeting.

Research Advisory Committee (RAC)

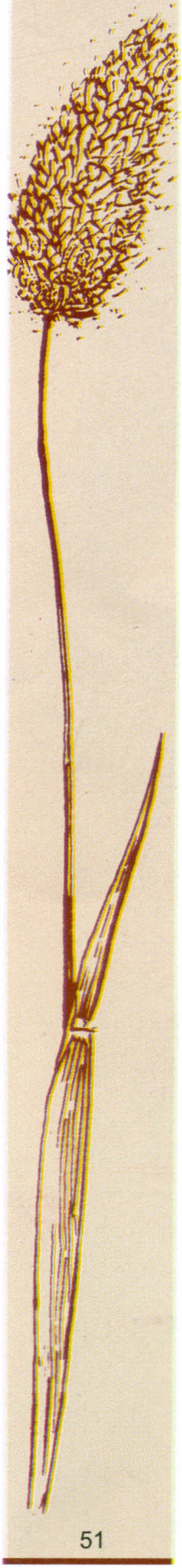
A meeting of the RAC for the Centre comprising of Dr. J.S. Kolar (Chairman), Dr. V.M.Bhan, Dr. N.T.Yaduraju, Dr. David N. Sen , Dr.R.E. Dhanraj, Shri Raj Kumar Prasad and Shri Kishori Mahto (all members) and Dr. B.T.S. Moorthy (Member Secretary) was held on 24th February 2003. Dr. B.T.S. Moorthy presented the action taken report and research highlights of the Centre. The committee critically evaluated the research activities of the Centre and gave valuable suggestions for improvement of the programmes for the coming year. The committee members also visited various laboratories and field trials and appreciated the work being done at the Centre.

Institute Management Committee (IMC)

The meeting of the IMC was held on 12 December 2002 at NRCWS, Jabalpur under the chairmanship of Dr. N.T. Yaduraju, Director. The members present were Dr. R.K. Gupta, Director Research, JNKVV, Jabalpur; Shri Raj Kumar Prasad and Shri Kishori Mahto (non-official members), Dr. B.T.S. Moorthy, Pr. Scientist; Shri. O.N. Tiwari, IJSC Secretary; Shri. A.K. Shrivastava, AF&AO and Shri. Balwant Rai, AAO. The progress of development activities and infrastructure build-up was reviewed. Approval were accorded for various new items to be executed/procured during the financial year.

PARTICIPATION IN WORKSHOPS, CONFERENCES, MEETINGS AND SYMPOSIA

Participants	Conference / Symposium	Venue & Date
Dr. N.T. Yaduraju	ICAR-CWC Joint Panel Meeting	New Delhi, June 18, 2002
	Biennial Conference of ISWS	UAS, Bangalore, May 23 24, 2001
	NATP Workshop on IPM	NCIPM, New Delhi, February 26, 2003
	Seminar by the West Bengal chapter of ISWS and gave a key note address on "Challenges in weed science"	BCKVV, Kalyani, July 4, 2002
	All India Wheat Workshop	Indore, August 2002
	National Seminar on Oilseeds	DOR, Hyderabad, January 27, 2003
Dr. B.T.S. Moorthy	37th Annual All India Rice Research Workers Group Meeting	DRR, Hyderabad, April 7-10, 2002.
	National Symposium on Priorities and Strategies for Rice Research in High Rainfall Tropics .	RARS, Pattambi, October 10-11, 2002
Dr. A.K. Gogoi	Workshop on Development of Sustainable Direct Seeded Rice-Wheat System	GBPUA&T, Pantnagar, Oct 3-5, 2002
	Review Meeting of PME Cells, NATP	KAU, Thrissur, January 16-17, 2003
Dr. J.S. Mishra	3rd Annual NATP Workshop on Conservation Tillage in Rice-Wheat Cropping System"	" BHU, Varanasi, October 28, 2002
	3rd Annual NATP Workshop on Accelerating the Adoption of Resource Conservation Technologies for Farm Impact on Sustainability of Rice-Wheat System in the Indo-Gangetic Plains"	" ICAR Research Complex for Eastern Region Patna, October 29-30, 2002.
	Group Meeting of Rapeseed-Mustard, Linseed and Safflower	DOR, Hyderabad, August 1-4, 2002
Dr. P.J. Khankhane	Workshop on Sustainable Development	Environmental Planning and Co-ordination Organization (EPCP)Bhopal on January 21, 2002
Mr. B. Mishra	Workshop on Scientific and Wildlife Photography	Jabalpur, February 19 and Kanha National Park, February 20-23, 2002
	20th IIPC International Workshop and Conference on Photography	New Delhi, December 26-29, 2002.



Participants	Conference / Symposium	Venue & Date
Dr(s) N. T. Yaduraju, B.T.S. Moorthy, A.K. Gogoi, D.K. Pandey, D. Swain, P.K. Singh, V.P. Singh, R.P. Dubey, J.S. Mishra, A.Dixit, Mr. N. Mishra, Ms. Poonam Chandla and Ms. N. Ansari	2nd International Agronomy Congress	IARI, New Delhi, November 26-30, 2002
Dr. N.T. Yaduraju and Dr. B.T.S. Moorthy	Brainstorming Session on Organic Farming and National Seminar on Indigenous Nutrient Management Practices followed in India	IISS, Bhopal, January 30-31, 2002
Dr(s) N. T. Yaduraju, AK Gogoi and Sushilkumar	Modular Workshop on Documentation of Biological Resources in MP	SFRI, Jabalpur, July 20, 2002
Dr(s) P.K. Singh and M.S. Raghuvanshi	Sensitization Workshop for Coordinators of PME Cell	NCAP, New Delhi, September 5-6, 2002
Dr(s) K.K. Barman and P.J. Khankhane	67th Annual Convention of Indian Society of Soil Science	JNKVV, Jabalpur, November. 11-15, 2002
Dr(s). N.T. Yaduraju, D.K. Pandey and V.S.G.R. Naidu	International Conference on Plant Physiology	IARI, New Delhi, January 8-12, 2003
Dr(s) N.T. Yaduraju and Sushilkumar	Agricultural Science Congress of NAAS	IISS Bhopal, February 13-15, 2003
Dr. J.S. Mishra and Mr. K. Vishwakarma	National Symposium on Resource Management for Eco-Friendly Crop Production	Kanpur, February 26-28, 2003
Mr. B. Rai	Workshop on Administrative Vigilance	New Delhi from February 26-28, 2003
Dr(s). B.T.S. Moorthy, V.P. Singh, J.S. Mishra, A. Dixit, Sushilkumar, RP Dubey, and V.S.G.R. Naidu	Biennial Conference of ISWS	GBPUA&T, Pantnagar, March 12-14, 2003

WORKSHOPS, SEMINARS, TRAINING PROGRAMMES ORGANIZED

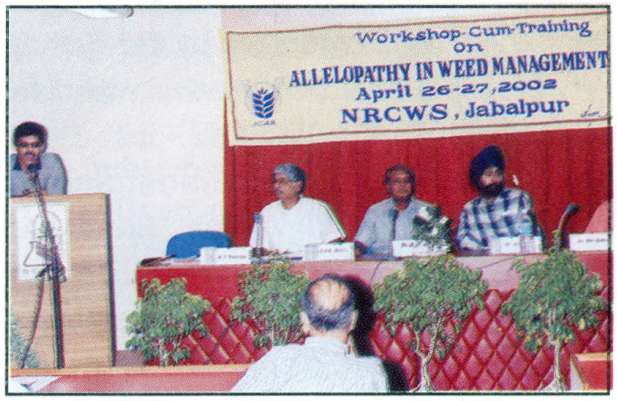
Biennial workshop of AICRP-WC

A three-day workshop of All India Coordinated Research Programme on Weed Control was held at the NRCWS, Jabalpur from 23-25 April 2002. About 100 weed scientists besides personnel from pesticide industry participated in the deliberations. During the inauguration, Dr. A.S. Tiwari, Vice Chancellor, JNKVV Jabalpur, opined that weed problems have increased due to crop intensification and their effective control is essential. Dr. N. T. Yaduraju, Director, NRCWS, presented the salient research highlights of the AICRP-WC for the year 2001. Newly published annual reports of AICRP-WC (2000-01 and 2001-02) and NRCWS (2001) were also released on the occasion. The Principal Investigators (PIs) of different AICRP-WC centres

presented their research achievements and the research agenda for the coming year was finalized. Dr. Gurbachan Singh, ADG (Agro.), ICAR, New Delhi, during the discussion mentioned that the research should be demand-driven and suited to the end user's needs. Dr. S.V.R. Shetty, Sr. Consultant, IARSD, Bangalore, Dr. (Mrs.) Gita Kulshrestha, Professor, IARI, New Delhi and Dr. V.M. Bhan gave valuable suggestions in formulation of the technical programme of AICRP-WC. At the end, Dr. Gurbachan Singh, ADG (Agro.) distributed certificates to PIs for the best annual reports and presentation during the session.

Training-cum-workshop on allelopathy

A two-day training-cum-workshop on "Role of allelopathy in weed management" was organized by NRCWS, Jabalpur from 26-27 April 2002. Around 70 scientists from different parts of the country participated in this workshop. Prof. R.C.Rajak, Head Deptt. of Bio-Sciences, RDVV, Jabalpur in his key-note address mentioned that allelo-



chemicals play a significant role in crop production but so far the results are based only on laboratory studies. Dr. S.V.R. Shetty, chairman of the session emphasized the need for practical use of allelopathic concepts in weed management. Dr. N.T.Yaduraju, Director emphasized on methodology and identification of allelo-chemicals. The resource persons Dr. Inderjit from Delhi University, Dr. A. S. Ahluwalia from Punjab University, Chandigarh, Dr. R.M. Kathiresan from Annamalai University, Dr. D.K. Pandey and Dr. D. Swain from NRCWS discussed thoroughly on various aspects of allelopathy and its potential role in integrated weed management.

Computer training

A short term computer training programme was organized by the ARIS Cell of the Centre during 2 - 7 September 2002 to appraise the administrative staff on the basics of

computer application including Windows, MS Office, Excel, Power point, E mail, Internet, Pay roll, NATP and FMS package. Dr. M.B.B.Prasadbabu, I/C ARIS Cell, Mr. Sandeep Dhagat, Tech. Officer, Mr. Pankaj Shukla, Tech. Asstt. and Mr. Sushil Rajput, SRF, took keen interest in training the staff and made them aware of the use of computer in day-to-day office work.

Special workshop on management of parthenium

A special workshop on management of parthenium was organized by the Centre on 10th September 2002 to make people aware of health hazards posed by parthenium and its management /utilization. Smt. Jayshree Banerjee, M.P., Jabalpur attended the function and released two publications on parthenium management. She also inaugurated the compost making facility-using parthenium at the Centre. Dr. V. M. Bhan, Ex. Director of the Centre chaired the workshop and stressed the need for an integrated approach involving manual, mechanical, chemical and biological to be adopted for managing this weed. In the technical session, deliberations on various aspects of *Parthenium* management and its utilization were made.

Winter School

A 21-day winter school on recent advances in weed management was organized during 21 October, 2002 to 10 November, 2002. 31 participants from 21 states of the country participated in this programme. Lectures on various aspects of weed management were delivered by the experienced resource persons from NRCWS and other organizations in the country. Dr. N.T. Yaduraju was the Course Director and Dr. B.T.S Moorthy, Principal Scientist coordinated the course programme.

A field day on management of parthenium

About 500 Mexican beetles, which are the bioagent of parthenium, were released during the year 2000 in Sonpur village of Jabalpur District. Currently vast area (more than 100 hectares) of waste and grazing land in and around Sonpur village are witnessing an excellent control of parthenium. A large population of both adults and larvae completely defoliated the plants along with its fruits and flowers. Taking advantage of this success, a field day was organized by the Centre on 5th October 2002 involving farmers, residents, school children, teachers and an NGO namely Bharat Forest Organization, Jabalpur to create awareness about the ill effects of parthenium and the need for its management.

A site heavily infested with *Parthenium*

The site after *Zygogramma's* attack

Kisan goshthi

NRCWS organized a kisan goshthi with the help of Government Arts College, Panager and Gram Panchayat under NSS programme at village Urdua on 20 November 2002. Around 250 farmers,

students and executive members of Panchayat samiti attended the function. Dr N.T.Yaduraju, Director of the Centre briefed the farmers about the importance of weed management practices. Scientists of the Centre explained the chemical and biological control of weeds in crops and non-cropped situations, use of mechanical tools and implements for weed control in field crops etc. Appropriate advice was given by the scientists on weed problems faced by the farmers.

Participation in 2nd international agronomy congress (IAC) exhibition

The NRCWS put up a stall in 2nd IAC Exhibition at IARI, New Delhi during 26-30 November 2002. In the exhibition various photographs and charts depicting the latest research achievement of the Centre were displayed. A large number of dignitaries including Minister of state for Agriculture, DG ICAR, DDG NRM, ADG (Agro), national and international delegates, progressive farmers, students and other entrepreneurs visited the stall and interacted with the scientists of the Centre.

Kisan Samman Diwas

On the birth centenary of late Shri Chaudhary Charan Singh Ji, former Prime Minister of India and a renowned farmer's leader, the Centre organized *Kisan samman diwas* on 23 December 2002 under the aegis of *National Krishak Samman Samaroh*. Around 300 farmers from Jabalpur division participated in this programme. Addressing the gathering, Director of the Centre Dr. N.T. Yaduraju

underlined the importance of weed management for sustainable crop production. While inaugurating the programme Shri Vishwa Nath Dubey, Mayor, Jabalpur asked the farmers to

include components of mixed farming such as poultry and fishery into their traditional mode of farming. Ten progressive farmers of the area were honoured with a certificate of merit and a shawl by the chief guest. A technical session was also conducted during the programme in which scientists of the Centre delivered lectures on various aspects of weed management in different crops and cropping systems, non-cropped areas and aquatic bodies. One wheel hoe and a packet of herbicide were also given to 20 lucky farmers as a token gift with an advice to use them in their field crops and give feed back to the Centre regarding their efficiency in managing weeds. A field visit was arranged to make the farmers aware of new weed management technologies being developed by the Center.

Dhan - dhanya master trainers training programme

The State Govt. of Madhya Pradesh organized a training programme "*Dhan-Dhanya*" at JNKVV, Jabalpur during 9-11 April 2002. Around 90 progressive farmers of the state were trained as master trainers by the NRCWS scientists on different aspects of weed management in field crops and non-cropped situations.

Lectures :

Dr. N.T. Yaduraju- (1) "Weed management in organic agriculture" in a training programme on "Organic agriculture-a paragon for sustainability" at JNKVV, Jabalpur on 4th April 2002 and (2) "Role of objectionable weeds in the management of seed production systems and effect of agronomic practices on seed quality-an overview" in a trainers training programme on seed production technologies of field crops for MPSSCA seed certification officers at JNKVV, Jabalpur on 19 December 2002

Dr. J.S. Mishra - Weed management in soybean and wheat" on 15th May 2002 during training programme of members of Zila Panchayat at farmer's training Centre, Jabalpur.

Dr. V.P. Singh- (1) Weed management in oilseed crops on 28th March 2003 at FTC, Adhartal, Jabalpur and (2) "Integrated weed management in *kharif* crops and weed control through herbicides in soybean and wheat" on 12th August and 10th September, 2002, respectively, in training programme of Rural Agricultural Extension Officers and Farmers at Farmer's Training Centre, Jabalpur.

Training to research scholars

he following M. Sc. students from different universities completed their research project work under the guidance of the scientist of the Centre during the reported period :

Name of the students & university	Period		Supervisors from the Centre
Ms. P. Lavanya, Nagarjuna University, Guntur	June 2002	August 2002	Dr. D.K. Pandey
Ms. Ms. Khammar Unnisa Begum, Nagarjuna University, Guntur	June 2002	August 2002	Dr. D. Swain
Ms. P. Chauhan, APS University, Rewa	November 2002	January 2003	Dr. D.K. Pandey
Ms. Ekta Srivastava, APS University, Rewa	November 2002	January 2003	Dr. K.K. Barman
Ms. Anita Srivastava, APS University,	November 2002	January 2003	Dr. D. Swain
Ms. Simran Deep Kaur, Model Science College, Jabalpur	February 2002	March 2003	Dr. Sushilkumar
Ms Raj Shree, Model Science College, Jabalpur	February 2002	March 2003	Dr. Sushilkumar
Mr. Jitendra Kumar, Model Science College, Jabalpur	February 2002	March 2003	Dr. Sushilkumar

Guest Lectures

Dr. S.N. Bagchi, Reader, Deptt. of Bio-Sciences, RDVV, Jabalpur -"Bentazon resistance in *Cyanobacterium synechococcus* on 9 August, 2002

Dr. Anupam Verma, National Professor, IARI, New Delhi - "Role of weeds in virus epidemiology" on 14th August 2002.

Dr. Sanjay Kushwaha, Assistant Professor (Weed Science), Allahabad Agricultural Institute, Allahabad - "Absorption, translocation and metabolism of isoxaflutole by yellow foxtail (*Setaria lutescens*) in maize" on 6th September 2002.

Dr. R.S. Verma, Principal Scientist (Agronomy), IISR, Lucknow - "Weed management in sugarcane based production System" on 12th September 2002.

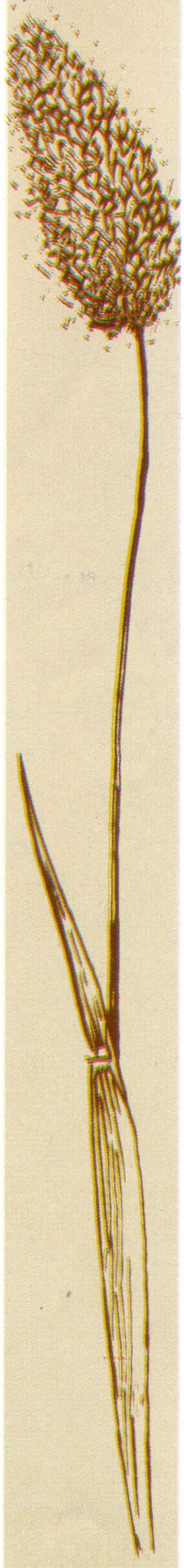
Radio/ TV talk

Dr. N.T. Yaduraju - "Weed management practices in rice" at All India Radio, Jabalpur on 26th June and weed management in wheat on November 16, 2002.

Dr. R.P.Dubey - Weed management in vegetable crops on November 10, 2002

Dr. P.K.Singh - Ways to control parthenium on November 21, 2002, increasing infestation of parthenium in south asian countries and role of NRCWS in its management" on Voice of America on November 4, 2002.

Dr. Anil Dixit - Chemical control of weeds in non-crop situations on March 26, 2003.



Drs. P.K. Singh, J.S. Mishra and A. Dixit-On-line interaction on *Hello Krishi Jagat* programme with the farmers August 2002.

Dr. V.P.Singh - Weed management in *kharif* crops on August 14, 2002.

Dr. M.S. Raghuvanshi - Weed management in urdbean and mungbean on August 20, 2002

Dr. A. Dixit - Weed management in soybean on August 22, 2002

Dr. P.K.Singh - Management of *kans*, nutsedge and *doob* grass on February 28, 2003.

Monthly Seminar of the Centre

Dr. Anil Dixit - Herbicide application techniques and role of herbicide mixtures and adjuvants in weed management- August 03, 2002 and September 7, 2002, respectively

Dr. D.K. Pandey - Soil seed bank-September 7, 2002.

Dr. (Mrs.) Shobha Sondhia-Isolation and identification of allelochemicals from *Xanthium strumarium(* 3rd World Congress on Allelopathy-challenges for the new millennium held at Tsukaba, Japan during August 26-30, 2002)-September 19, 2002.

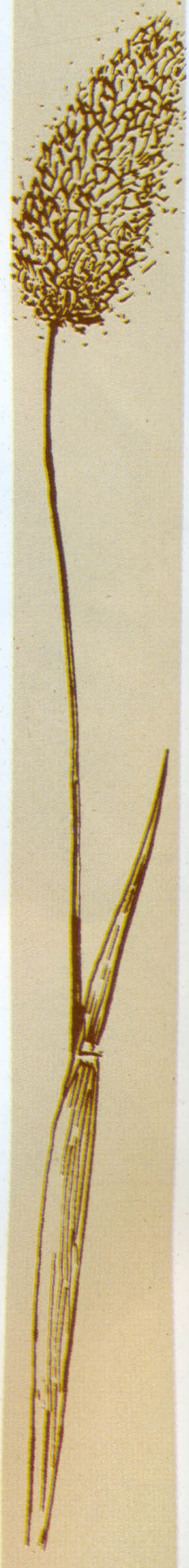
Ms. P. Chauhan, M.Sc., Student trainee, APS University, Rewa -Herbicidal property of neem parts on alligator weed -December 30, 2002

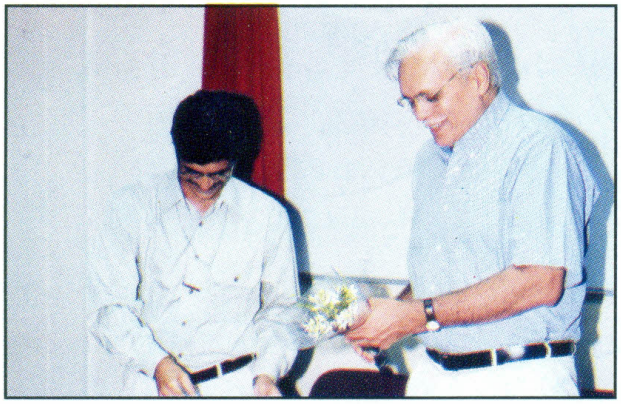
Ms. Ekta Shrivastava, M.Sc., Student trainee, APS University, Rewa -Efect of butachlor on soil bioinoculants-January 23, 2003 and March 03, 2003

Ms. Anita Shrivastava, M.Sc., Student trainee, APS University, Rewa - Biochemical evaluation of allelopathic potential of neem and sesame against some cereal crops and their problem weeds-March 03, 2003.

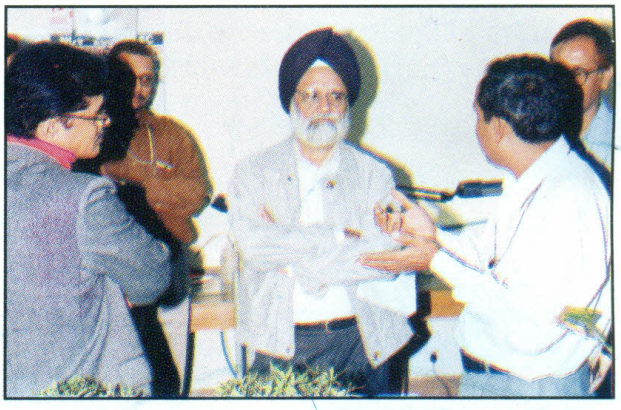
DISTINGUISHED VISITORS

Dr. Ratan Lal, Ohio State University, Columbus USA	01 April 2002
Dr Gary W. Mullins, Ohio State University, Columbus USA	01 April 2002
Dr. A.S.Tiwari, Vice Chancellor, JNKVV, Jabalpur	23 April 2002
Dr. S.V.R. Shetty, Sr. Consultant, IARSD, Bangalore,	23 April 2002
Dr. (Mrs.) Gita Kulsherstha, Professor, IARI, New Delhi	23 April 2002
Dr. V.M.Bhan, Ex-Director, NRSWS, Jabalpur	23 April, 24 June 02, 10 Sep 02, 24 Feb 03
Dr. C.L.Acharya, Director, IISS, Bhopal	24 April 2002
Dr. Gurbachan Singh, ADG (Agro.), ICAR, New Delhi	24 April & 24 June 02
Dr. M.S. Kairon, Ex-Director, CICR, Nagpur	24 June 2002
Dr. Anupam Verma, National Professor, IARI, New Delhi	14 Aug 2002
Dr. D.P.Singh, Vice Chancellor, JNKVV, Jabalpur	6 Sep 2002
Smt. Jayshree Banerjee, Member of Parliament, Jabalpur	10 Sep 2002
Dr. M. Velayutham, Ex. Director, NBSS&LUP, Nagpur	20 Sep 2002
Dr. J.S. Samra, DDG (NRM), ICAR, New Delhi	12 Nov 2002
Dr. J.S.P. Yadav, Former Chairman, ASRB	13 Nov 2002
Dr.N.N.Goswami, Former Dean & Joint Director, IARI, and VC, CSAUA&T, Kanpur	14 Nov 2002
Dr. G.S. Sekhon, Former Director, Potash Research Institute	15 Nov 2002
Dr. H.N. Verma, Director, WTC, Bhubaneshwar	8 Jan 2003
Dr. D.S. Yadav, Prof.& Head (Agronomy), NDUAT, Faizabad	7 Feb 2003
Dr. J.S. Kolar, Director Extension, PAU, Ludhiana	24 Feb 2003





Director welcomes
Dr. Anupam Verma, National
Professor for a guest lecture



Dr. J.S Samra DDG (NRM)
interacting with scientists

Dr. Ratan Lal & Dr. Gary W. Mullins
visit the NRCWS farm

Dr. Kolar visiting the research fields

सारांश

राष्ट्रीय खरपतवार विज्ञान अनुसंधान केन्द्र में वर्ष 2002-03 के दौरान अनुसंधान गतिविधियाँ मुख्यतः फसलों के प्रतियोगी किस्मों, अंतःवर्तीय फसलों का खरपतवारों पर प्रभाव, भूमि सूर्यीकरण, जैवकीय खरपतवार नियंत्रण, सस्यक्रमों का खरपतवारों पर प्रभाव, शाकनाशियों का परीक्षण आदि पर आधारित थी । इन गतिविधियों के परिणाम इस प्रकार से हैं ।

- सीधी बुवाई वाली धान की किस्में क्रमशः वंदना, कंलिगा-।।। एवं आर.आर.-151-3 में खरपतवारों से प्रतियोगिता करने की क्षमता ज्यादा दर्ज की गई । साथ-साथ खरपतवार प्रबंधन से अच्छी उपज भी प्राप्त की गई है । चने की जे.जी.-16 नामक किस्म में भी खरपतवार से प्रतियोगिता करने की क्षमता ज्यादा पाई गई है ।

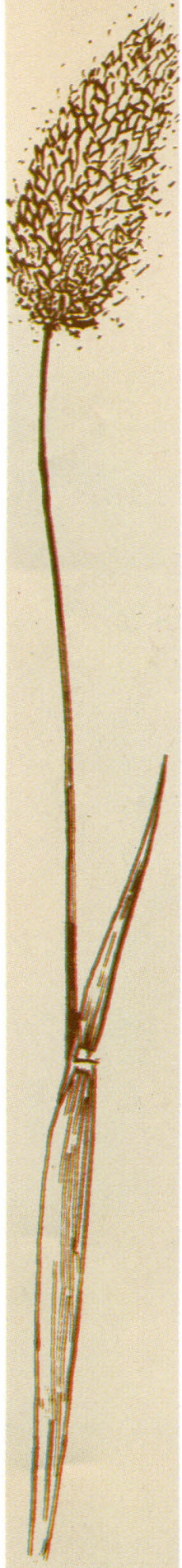
- सीधी बुवाई वाली धान में निहित मोथा (साइप्रस ईरिया) नामक खरपतवार से इसकी छोटी किस्मों जैसे- हीरा एवं अन्नाडा में लगभग बंदना (27-50 प्रतिशत) किस्म की उपेक्षा उपज में ज्यादा कभी (30-60 प्रतिशत) तक दर्ज की गई है ।

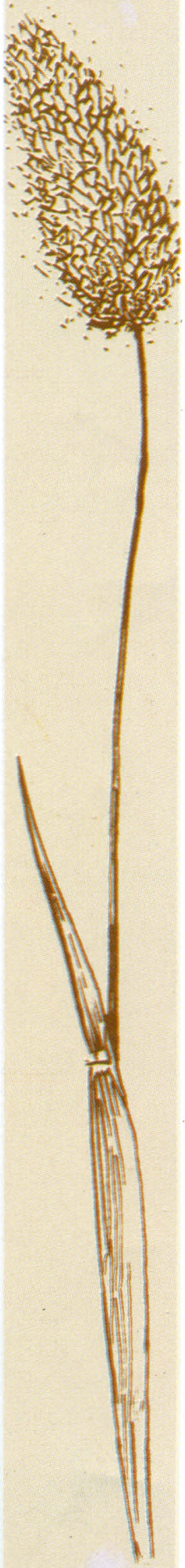
- मक्का फसल में इसकी दो पंक्तियों में लोबिया को अंतःवर्तीय फसल के रूप में ऊगाकर खरपतवारों की फसल के साथ प्रतियोगिता को काफी हद तक अर्थपूर्ण तरीके से कम किया जा सकता है ।

- सीधी बुवाई वाली धान, एकीकृत प्रबंधन के तहत ढेंचा या लोबिया को अंतःवर्तीय फसल के रूप में ऊगाकर अंकुरण पूर्व पेन्डीमिथालीन का छिड़काव कर 20 दिन पर निंदाई से खरपतवार प्रतियोगिता में अर्थपूर्ण कमी आती है ।

- सोयाबीन गेहूँ सस्य क्रम में, गर्मी के मौसम के दौरान पालीथीन की सहायता से पाँच सप्ताह तक भूमि सूर्यीकरण करने से सोयाबीन एवं गेहूँ के मुख्य खरपतवारों की वृद्धि को कम करने में अर्थपूर्ण सहायता मिलती है । इस सस्य क्रम में भूमि सूर्यीकरण को खरपतवारनाशी के उपर आधी दर पर उपयोग करने से या निंदाई करने से पूरे मौसम भर खरपतवार नियंत्रित रहते हैं तथा ज्यादा उत्पादन भी मिलता है

- आलू में, फसल के उगने के पूर्व या बाद में आंशिक रूप से सूखी हुई जल कुम्भी को फसलों की कतार में मेट्रीव्यूजीन नामक शाकनाशी को 0.25 किग्रा. प्रति है. के साथ प्रयोग करने पर खरपतवारों की वृद्धि को कम करने में सहायक पाया गया था खरपतवारीय की ऊपेक्षा उपज में अर्थपूर्ण इजाफा भी दर्ज किया गया है ।





- धान-गेहूँ सस्यक्रम को लगातार उत्पादन के रूप में अपनाने पर गेहूँ की फसल में सिचोरियम इन्टाइबस एवं मेडीकागो हिसपिडा नामक खरपतवारों को अर्थपूर्ण रूप से कम किया जा सकता है वही धान-मसूर के सस्यक्रम में फेलेरिस माइनर (चिरैया बाजरा) के प्रभाव को अर्थपूर्ण तरीके से कम किया जा सकता है।
- अन्य फसलों के सस्यक्रम जैसे- ज्वार-चना पद्धतियो, सिचोरियम इनटाइबस, मेडीकागो हिसपिडा एवं चिनोपोडियम अल्बम ज्यादा दर्ज किये गये । वही सोयाबीन पद्धति में यूफारेविया जनीकुलाटा एवं ज्वार पद्धति में जई नामक खरपतवार ज्यादा पाये गये ।
- गेहूँ की बिना जुताई फसल में चिरैया बाजरा खरपतवार की वृद्धि कम दर्ज की गई तथा जंगली जई नामक खरपतवार में वृद्धि अधिक दर्ज की गई ।
- मसूर एवं चने की फसल में प्याजी खरपतवार की 25-800/मीटर^2 सघनता से उपज में क्रमशः 4 से 47 तथा 5 से 19 तक की कमी दर्ज की गई । इस खरपतवार के प्रति गेहूँ एवं राई सहनशील पाये गये जबकि मटर इस के प्रति काफी संवेदनशील पायी गयी ।
- गेहूँ में मेडीकागो हिसपिडा नामक खरपतवार की 10-640/मी.^{2} सघनता से 3-39 प्रतिशत तक की उपज में कमी दर्ज की गई ।
- एक परजीवी खरपतवार कसक्यूटा का चना, मसूर एवं अलसी फसलों पर ज्यादा प्रभाव देखा गया जबकि राजमा, राई तथा गेहूँ फसलों में इससे ज्यादा प्रभावित नहीं हुई । मूंग एवं रामतिल फसलों में इसकी 1-10/ मी.^{2} सघनता से इनकी उपज में क्रमशः 28-88 तथा 39-88 तक कमी दर्ज की गई ।
- एलीगेटर खरपतवार (आल्तरनेनथेरा फिलाक्सोरायड) पर एक कीड़े टंरटल बीटल (केसिडा स्पी.) द्वारा साल भर क्षति दर्ज की गई ।
- गेहूँ में फ्लूफेनासेट एवं मेट्रीव्यूजीन नामक शाकनाशीयों के मिश्रण को सिंचाई के पहले उपयोग करने से प्रभावशील रूप से खरपतवारों की वृद्धि में कमी हुई तथा फसल उत्पादन बढ़ाने में सहायक सिद्ध हुये । इस ही फसल में एक अन्य शाकनाशी-कारफेन्टासूरान (25 ग्रा./है.) खरपतवारों की संख्या घटानें में प्रभावशील साबित हुआ ।
- सीधी बुवाई वाली धान में, व्यूटानिल (व्यूटाक्लोर + प्रोपेनिल) को अंकुरण पश्चात् क्लोरीमुरान + मेटसल्फ्यूरॉन के मिश्रण (4 ग्रा./है.) तथा पायरासुसल्फ्यूरान (25 ग्रा./है.) को अंकुरण पश्चात् उपयोग करने से खरपतवारों की सघनता को अर्थपूर्ण तरीके से कम करने में सहायक सिद्ध हुये।

- सोयाबीन की फसल में शाकनाशी मिश्रण जैसे क्लोरीमुरॉन + फिनाक्साप्राप को (6 +100 ग्रा./है.) की दर से उपयोग करने पर खरपतवार नियंत्रण में प्रभावी पाये गये तथा उपज बढ़ाने में भी सहायक सिद्ध हुये ।

- परीक्षण किये गये एलिलोफेमिकल्स में, क्वासेटिन उत्पलावी (सेलिवनिया मोलेस्ता एवं एजोला पिन्नाता) एवं निमग्न (नाजस, सिरेटोफाइलम, हाईड्रीला एवं चारा) जलीय खरपतवारों को 0.1 मिलीमाइक्रोन (30 पी.पी.एम.) पर उपयोग करने से नष्ट करने में सहायक रहा । जबकि एक अन्य रसायन क्वीनाल को 0.1 मिलीमाइक्रोन (11 पी.पी.एम.) पर उपयोग करने से निमग्न जलीय खरपतवार जैसे चारा को नष्ट करने में सहायक सिद्ध हुआ ।

- नीम की पत्ती के अवशेषों का एलीगेटर खरपतवार (आलटरनेनथेरा सिमिलिस) पर उपयोग करने से खरपतवार में जड़ों में शिथिलता आती है तथा तनों को सूखाने लगते है जिसके फलस्वरूप उपचारित पौधा पूर्ण रूपेण नष्ट हो जाता है।

- सीधी बोवाई वाली धान में एक प्रदर्शन के दौरान व्यूटाक्लोर (1.5 किग्रा./है.) को अंकुरण के पूर्व साथ-साथ फिनाक्साप्राप को 70 ग्रा./है. (25 दिन के बाद अंकुरण पश्चात्) उपयोग करने से खरपतवारों पर प्रभावी नियंत्रण पाया गया ।

- एक दूसरे प्रदर्शन में गेहूँ में आइसाप्रोटूरान + 2,4-डी (0.5 + 0.5 किग्रा./है.) मिश्रण का प्रयोग 30-35 दिन बाद करने से ज्यादा से ज्यादा खरपतवार नियंत्रण किये गये तथा उपज में अर्थपूर्ण वृद्धि दर्ज की गई । इसी फसल में एक अन्य शाकनाशी क्लोडिनोफाप (60 ग्रा./है.) के उपयोग करने से जंगली जई पर प्रभावशील नियंत्रण पाया गया ।

- चने एवं राई में पेन्डी मिथालीन या आइसोप्रोटूरोन (1किग्रा./है अंकुरण से पूर्व) एवं मटर में क्लोडिनोफाप (60ग्रा./है. अंकुरण पश्चात्) खरपतवार नियंत्रण में काफी प्रभावशील पाये गये । गैर-फसलीय क्षेत्रों में एक प्रदर्शन में मेट्रीव्यूजीन (0.3 प्रतिशत) नामक शाकनाशी को उपयोग करने से गाजरघास का प्रभावी नियंत्रण किया गया ।

- विपत्तीदायक खरपतवार जैसे गाजरघस के उन्मूलन हेतु केन्द्र द्वारा जनता को जागरूक करने हेतु भाषण , प्रदर्शन कार्यशाला आयेजित की गई । इसके अलावा गाजरघास को खाने वाले कीड़ों का भी वितरण गैर सरकारी संस्थाओं, अखिल भारतीय समन्वित अनुसंधान परियोजना-खरपतवार नियंत्रण के केन्द्रों को किया गया ।

अखिल भारतीय समन्वित अनुसंधान परियोजना-खरपतवार नियंत्रण

- पश्चिमी हिमालय और कम आर्द्र वाले क्षेत्र में, रापित धान की फसल में ब्यूटाक्लोर और ऐनीलोफास का लगातार प्रयोग करने से कुछ खरपतवारों में वृद्धि पायी गई जैसे - फीम्बरिस्टालिस मिलीयेसी सिसुलिया एक्सीलरीस और

कोमोलिना बेंगोलेनसिस जबकि गेहूं में आइसोप्रोटूरान का उपयोग करने से मेडीकागो डेन्टीकुलाटा, लोरेंथस अफाका और मेलीलोटस इंडिका में कमी दर्ज की गई ।

- पश्चिमी घाट और कोस्टल प्लने में जो इकाइनाक्लोवा स्पी और मारसेलिया क्योडरोकोलिया से प्रबल रूप से गृसित है ।

- प्रेटीलाक्लोर और सेफनर 0.45 किग्रा./हे. का प्रयोग धान की सीधी बुआई में एवं 35 दिनों पश्चात् एक बार निंदाई करने में छोटा निंदा एवं सूखी सामाग्री पूर्वी धार टी.एन. अपलेण्ड और दक्षिण प्लेटुआ क्षेत्र में पायी गई ।

- कपास में ग्लाइफोसेनेट अमोनियम 0.75 किग्रा./हे. का सीधा प्रयोग करने से खरपतवारों का जैसे आदि का प्रभावशाली नियंत्रण होता है ।

- गेहूं में मेटसलफुरान एवं आइडोसल्फुरान (1.2 + 1.4 किग्रा./हे.) पोस्ट इमरजेन्स के रूप में प्रयोग करने पर फेलेरिस माइनर एवं घास रहित खरपतवारों का उत्तरी मैदानों और समशितोष्ण क्षेत्र मे प्रभावशाली नियंत्रण पाया गया । गेहूं की फसल में एक तरफ पहलीसिंचाई के पूर्व या पश्चात् ट्राइफलोरेलिन (0.75 और 1 कि./हे.)का छिड़काव या दूसरी और निंदाई आइसोप्रोटूरान के प्रयोग के बनाई फेलेरीस माइनर के लिये बहुत प्रभावशाली सिद्ध हुई है । विपत्तीदायक खरपतवारों जैसे आक्सिलिस लेटीफोलिया के प्रभावशाली नियंत्रण हेतु किसानों के खेतों में ग्लाइफोसेट (1 किग्रा./हे.) एवं एट्राजिन (1 किग्रा./हे.) उत्प्रेरक सहित छिड़काव करने या रेत के साथ प्रयोग करने से (150 किग्रा./हे.) रेत का मिश्रण कर फसल में दो या तीन पत्तियों की अवस्था में छिड़कने से ऐजीरेटम होस्टेनियम का प्रभावशाली नियंत्रण पाया गया ।

- सूरजमुखी की बोनी के पहले ग्लाइफोसेट (2 किग्रा./हे.) एजी.एफ (0.51/हे.) उत्प्रेरक के साथ प्रयोग करने से खरपतवारों का प्रभावशाली नियंत्रण पाया गया ।

- उत्तरी मैदानी क्षेत्र में आलू की फसल में क्लोमोजोन एवं पेन्डामेथलीन (125 + 500 ग्राम/हे) का प्रयोग खरपतवारों के प्रभावशाल नियंत्रण एवं उत्पादन में उचित वृद्धि कारक पाया गया ।

PERSONALIA

Director
Dr. N.T. Yaduraju

Scientific

Dr. B.T.S. Murthy	Pr. Scientist (Agro)
Er. H.S. Bisen	Sr. Scientist (Ag. Engg)
Dr. A.K. Gogoi	Pr. Scientist (Agro)
Dr. D.K. Pandey	Sr. Scientist (Pl. Physiol)
Dr. K.K. Barman	Sr. Scientist (Soil Sci.)
Dr. P.K. Singh	Sr. Scientist(Agril. Extn.)
Dr. V.P. Singh	Sr. Scientist (Agro.)
Dr. Sushilkumar	Sr. Scientist (Entomo.)
Dr. R.P. Dubey	Sr. Scientist (Agro.)
Dr. Anil Dixit	Sr. Scientist (Agro.)
Dr. D. Swain	Sr. Scientist (Eco. Bot)
Dr. J.S. Mishra	Sr. Scientist (Agro)
Dr. M.B.B.P. Babu	Scientist (SS) (Soil Sci.)
Dr. P.J. Khankhane	Scientist (SS) (Soil Sci.)
Mrs. Shobha Sondhi	Scientist (Residue Chem)
Dr. VSGR Naidu	Scientist (Eco-Bot)

Administration, finance and accounts

Sh. Balwant Rai	Asstt. Admn. Officer
Sh. A.K. Shrivastava	Asstt Fin & Acc Officer
Smt Nidhi Sharma	Sr. Steno
Sh. J.P. Kori	Sr. Clerk
Sh R. Hadge	Sr. Clerk
Sh. T. Lakhera	Sr. Clerk
Sh. B.P. Uriya	Jr. Clerk
Sh. Francis Xavier	Jr. Clerk
Sh. A.K. Bhowal	Jr. Steno
Sh. M.K. Gupta	Jr. Steno

Technical

Dr. M.S. Raghuwanshi	T-6 (Technical Officer)
Sh. R.S. Upadhyay	T-6 (Farm Manager)
Sh Mukesh Bhatt	T-5 (Artist-cum-Photographer)
Sh. S. Dhagat	T-5 (Technical Officer)
Sh B. Mishra	T-5 (photographer)
Sh V.K.S. Meshram	T-4 (Artist)
Sh G.R. Dongre	T-4 (Draftsman)
Sh O.N. Tiwari	T-4 (Tech. Asstt)
Sh M.P. Tiwari	T-II-3 (Mechanic)
Sh Pankaj Shukla	T-II-3 (Tech. Asstt)
Sh. R.N. Bharti	T-II-3 (Librarian)
Sh S.K. Parey	T-II-3 (Tech. Asstt)
Sh J.N. Sen	T-II-3 (Tech. Asstt)
Sh. K.K. Tiwari	T-II (Field Asstt)
Sh. S. K. Tiwari	T-II (Field Asstt)
Sh. S.K. Bose	T-II (Field Asstt)
Sh. G. Vishwakarma	T-II (Field Asstt)
Sh. Ajay Pal Singh	T-II (Field Asstt)
Sh. V. K. Raikwar	T-I (Field Asstt)
Sh. R.K. Meena	T-I (Field Asstt)
Sh. M.K. Meena	T-I (Field Asstt)
Sh. Premlal	T-II (Driver)
Sh. D.K. Sahu	T-II (Driver)
Sh. B. Prasad	T-II (Driver)
Sh. Sebasten	T-I (Driver)

Supporting

Sh. Veer Singh	Messenger (SSG-II)	Sh. C.L. Yadav	Farm Mazdoor (SSG-II)
Sh. A.K. Tiwari	Messenger (SSG-I)	Sh. Anil Sharma	Farm Mazdoor (SSG-I)
Sh. Shiv K. Patel	Messenger (SSG-I)	Sh. Ram Kumar	Farm Mazdoor (SSG-I)
Sh. Pyare Lal	Messenger (SSG-I)	Sh. Naresh Singh	Farm Mazdoor (SSG-I)
Sh. Sukha Singh	Messenger (SSG-I)	Sh. Gajjulal	Farm Mazdoor (SSG-I)
Sh. S.L. Koshta	Lab. Attendant (SSG-I)	Sh. S.C. Rajak	Farm Mazdoor (SSG-I)
Sh. J.P. Dahiya	Lab. Attendant (SSG-I)	Sh. Rajesh	Security Gaurd (SSG-I)
Sh. Madan Sharma	Lab. Attendant (SSG-I)	Sh. Gangaram	Security Gaurd (SSG-I)
Sh. J. Vishwakarma	Lab. Attendant (SSG-I)	Sh. Santosh Kumar	Security Gaurd (SSG-I)
Sh. Raju Prasad	Farm Mazdoor (SSG-II)	Sh. Santlal	Security Gaurd (SSG-I)
Sh. Jagoli Prasad	Farm Mazdoor (SSG-II)	Sh. Mahendra Patel	Security Gaurd (SSG-I)
Sh. Jagat Singh	Farm Mazdoor (SSG-II)		

Annexure - I

Meteorological data during 2002-03

Months	Temperature (°C)		Relative humidity (%)		Vapour pressure (mm)		Wind velocity (km/hr)	Sunshine (hrs)	Rainfall (mm)	Rainy days	Evaporation (mm)
	Maxi.	Mini.	I	II	I	II					
April, 02	39.0	21.3	45	12	10.1	6.8	2.9	8.6	1.5	-	-
May	42.7	27.7	40	18	13.1	7.6	6.9	7.8	29.8	2	-
June	37.5	26.7	65	40	18.8	16.8	7.0	5.4	88.1	6	7.7
July	33.9	26.1	72	50	19.2	18.8	8.2	4.7	96.6	5	6.9
August	29.4	23.9	92	78	21.5	22.2	5.3	2.0	747.6	20	3.0
September	30.5	22.6	88	65	19.9	19.7	2.6	6.0	239.3	11	3.7
October	32.2	18.7	86	39	16.0	13.3	1.9	8.3	21.1	2	3.6
November	29.3	12.8	88	34	10.8	9.8	1.6	7.9	1.0	-	2.9
December	27.8	11.2	90	37	9.6	9.7	1.5	7.8	2.3	-	2.3
January, 03	24.0	7.4	92	36	7.6	7.7	1.8	7.5	1.3	-	2.1
February	27.0	12.7	91	44	11.0	11.1	3.3	7.9	39.6	4	2.9
March	33.1	15.0	71	23	10.5	8.4	2.9	8.4	1.8	-	4.3
Total									**1270**		