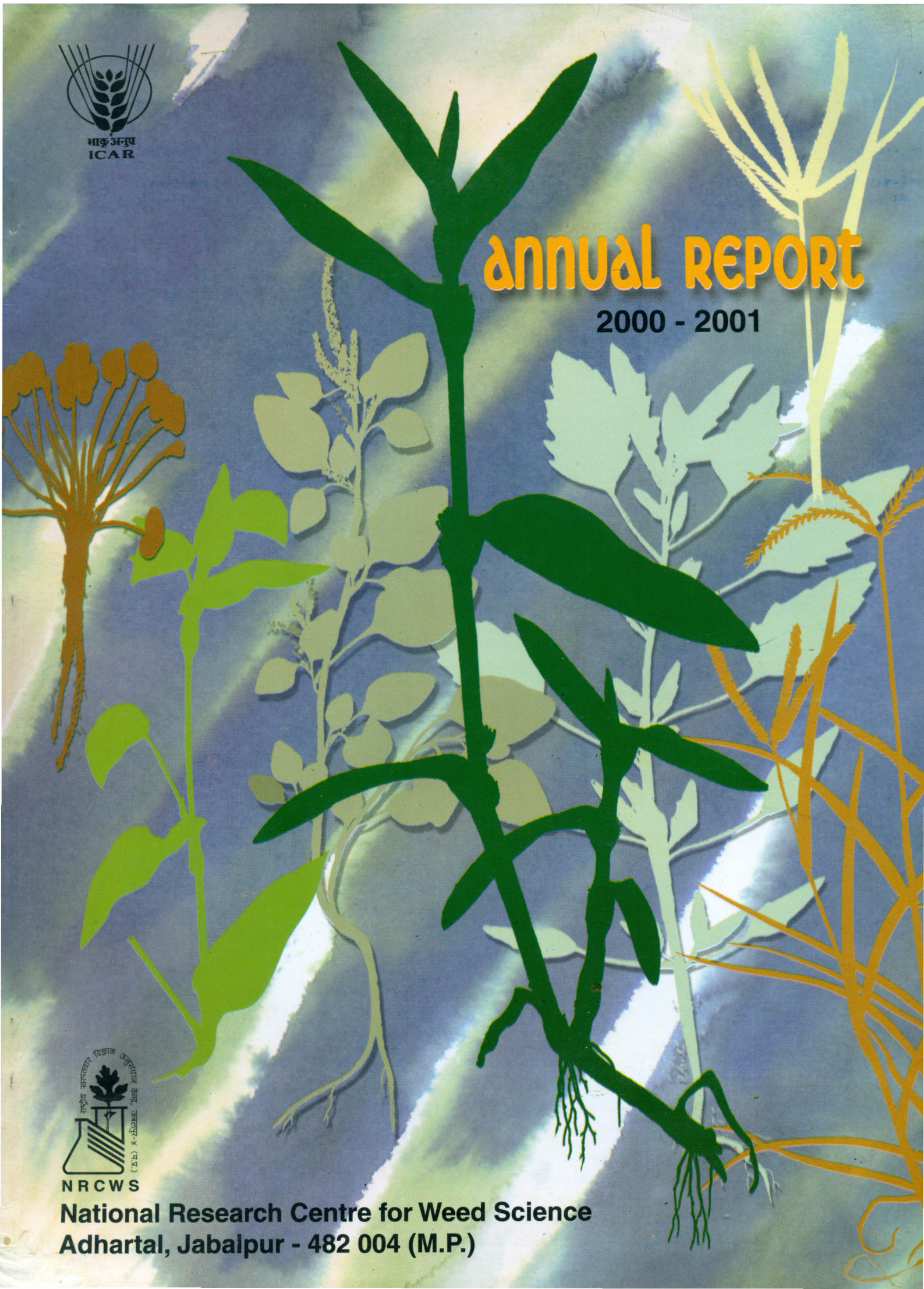
भाकृअनुप
ICAR
annual REPORT
2000 - 2001
NRCWS
National Research Centre for Weed Science
Adhartal, Jabalpur - 482 004 (M.P.)

Annual Report

वार्षिक प्रतिवेदन

2000-01

भाकृअनुप
ICAR

राष्ट्रीय खरपतवार विज्ञान अनुसंधान केन्द्र

(भारतीय कृषि अनुसंधान परिषद)

NATIONAL RESEARCH CENTRE FOR WEED SCIENCE

(Indian Council of Agricultural Research)

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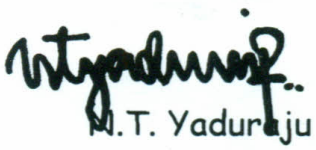
PREFACE

I am pleased to place before you the Annual Report for the year 2000-01. The year was a historic one as the new Administrative-Cum-Lab. Building was inaugurated on 9 April, 2001 by Hon'ble Agriculture Minister Shri Nitish Kumar. The Centre faced certain constraints in the past such as lack of adequate laboratory space and other infrastructural facilities. In the new building coming to service, the Centre is poised for a new beginning. As in the past, the Centre has done commendable job in identifying the weed problems and in suggesting management practices for controlling them. The long-term experiments being carried out at the Centre have given useful results. The understanding of the weed flora shifts as influenced by cropping systems will be useful in suggesting a suitable cropping system for managing a particular weed. Some weeds, which were less significant in the past, have suddenly become dominant with a particular weed management practice. Attempts are being made to understand biology and ecology so that an efficient and ecologically sustainable method of control can be developed. Research and management of specific weeds in different agro-climatic zones are being carried out at 22 centres under the All India Coordinated Research Project on Weed Control. As a separate Annual Report is brought out on the AICRP-WC results, only the salient findings are given in this report.

I would like to thank Dr R.S. Paroda, Secretary, DARE and DG, ICAR for his interest and encouragement; Dr J.S. Samra, DDG (NRM) and Dr B.R. Sharma, ADG (Agro) for their understanding, cooperation and support given to the Centre. The interest shown and guidance given by Dr S. Sankaran, Chairman, RAC and other members of RAC and IMC in shaping our research programme are gratefully acknowledged. I would like to thank Dr B.T.S. Moorthy; Dr K.K. Barman and Dr M.S. Raghuvanshi for compiling and editing this document. Thanks are also due to Mr Sandeep Dhagat, Mr A.K. Bhowal and other technical and administrative staff in bringing up this publication. I thank all the scientists of the Centre for their hard work and positive attitude. It is hoped; the Centre would receive feed back from stake holders including farmers, NGOs and industry to help us in prioritization of our research programmes and to meet all the requirements.



M.T. Yadur aju
Director, NRC- Weed Science,
Jabalpur

CONTENTS

EXECUTIVE SUMMARY

Research activities of NRCWS during 2000-01 focused mainly on weed dynamics in cropping systems, weed management in different crops, allelopathy, herbicide residues in soil, biological and mechanical weed control. The salient findings are as follows:

Weed dynamics in cropping system

A long-term experiment was conducted to examine whether any specific weed flora changes due to adoption of various cropping systems. Density of *kharif* weeds under maize, sorghum and soybean-based cropping systems decreased every year but showed a little increase in the fourth year of study. Lower density of *Commelina communis* was recorded with maize-based cropping system.

During winter season, higher population of *Phalaris minor* was recorded with maize and sorghum-based cropping systems whereas *Avena sterilis* ssp. *ludoviciana* was more under sorghum and soybean- based cropping systems. Higher population of *Cichorium intybus, Medicago* spp. and *Euphorbia geniculata* were recorded under soybean-based system. Lowest population and dry weight of weeds were recorded in maize-based cropping systems and where wheat was grown in rotation.

During rainy season, the density of *Echinochloa colona* increased more prominently in continuous growing of mustard and lentil or in rotation with wheat.

Continuous growing of mustard or its inclusion in rotation with wheat increased the problem of *Cichorium intybus*.

Weed management in crops

Studies were carried out to find out effective herbicides for controlling weeds in different crops. In potato, application of herbicide - metribuzin at 0.5 kg/ha as pre-emergence or early post-emergence spray proved very effective in controlling weeds and increasing the yield. Other pre-emergence herbicides like oxyfluorfen 0.2 kg/ha and atrazine 1.0 kg/ha were also effective.

In soybean, soil solarization for a period of 5 weeks integrated with herbicide application -metolachlor 0.75 kg/ha proved very effective in reducing weed density.

The broadleaf weed-*Euphorbia geniculata,* is becoming a serious problem of soybean-chickpea cropping system in Madhya Pradesh. Studies revealed that it can easily be controlled in soybean by pre-emergence application of metribuzin 0.50 kg or oxyfluorfen 0.20 kg/ha or post-emergence application (7-21 days after sowing) of a new herbicide-imezethapyr 100-150 g/ha or chlorimuron ethyl 12 g/ha or bentazone 1.0 kg/ha.

In rice, among the new herbicide formulations tested, acetachlor (75-100 g/ha) applied at 3 DAT, and pyrazosulfuron at 20-25 g/ha applied at early stage (3 days after transplanting) were found promising. Combination of clomazone with 2,4-D (200+270 g/ha) as pre-emergence spray also gave effective results.

In wheat, post-emergence application of isoproturon (1.0 kg/ha), sulfosulfuron (25 g/ha), clodinofop (60 g/ha) and fenoxaprop (100 g/ha), tralkoxydim (0.35 kg/ha at 30 DAS), metribuzin (0.30 kg/ha) were found promising for control of grasses.

Allelopathic studies

Residue of lantana leaf at 1-2 per cent (dry w/v) caused wilting/ chlorosis and desiccation of floating aquatic weeds *viz. Eichhornia crassipes, Salvinia molesta, Pistia stratiotes, Spirodela polyrhiza, Azolla pinnata* and *Lemna pausicostata* killing the treated plants in 5-10 days. In submerged species namely *Hydrilla verticillata, Ceratophyllum demersum, Najas graminea* and *Chara* sp, the residue caused chlorosis, loss of turgidity, fragmentation, death and decay of the treated plants in 4-10 days. The phytotoxic constituents involved are being isolated for further studies.

Rice crop responded favourably to the application of parthenium residue during *kharif* as it improved crop growth and yields without obvious toxicity to the crop. But it was phytotoxic to wheat because this residue could not be detoxified considerably in soil during *rabi* season.

Herbicide residues in soils

Sorghum root bioassay was performed to detect the atrazine and metribuzin residues in the soil where potato was raised. The rate of degradation of atrazine was found to be faster than that of metribuzin. The half-life of the former herbicide was 21.4 days while that of the latter one was 24 days.

Biological control of weeds

Two pathogens viz. *Trichoderma viride* and *Gliocladium virens* were tested in the laboratory conditions for their biological potential on different media against *Echinochloa colona* and *Phalaris minor*. Application of *Trichoderma viride* inhibited significantly the germination of *Echinochloa colona* and *Phalaris minor* by 55 and 80 per cent, respectively when grown on sorghum seeds.

Gliocladium virens inhibited significantly the germination of *P. minor* by 80 per cent when applied as soil treatment (grown on wheat grain) and by 94 per cent when applied as spray (grown on maize grains), while in case of *Echinochloa colona,* it completely inhibited the germination by 64 per cent when grown on sorghum seeds.

Soil application of *Trichoderma viride* (100 g/m^2 grown on neem cake) followed by treatment of wheat seeds with Ecofit 4 g/kg seed and spray of *Gliocladium virens* 8 g/lt water immediately after sowing significantly reduced the germination and vigour of *P. minor* with no adverse effect on wheat.

On *Lantana camara,* an exotic insect, tingid bug (*Teleonemia scrupulosa*) was found damaging the foliage during September-October but the attacked plants of *lantana* regained their lost vigour.

Turtle beetle *Aspidomorpha miliaris* was responsible for severe defoliation of the weed *Ipomoea fistulosa* in the month of September and October. Damage was compounded by another beetle of the same genus namely *Aspidomorpha sanctacercecis* (F.) simultaneously completing the life cycle on this weed. On another problem weed *Cassia tora,* lepidopterus insects -*Eurema hecabe* (Linn.), *Euproctis lunata* (Walk.), *Cosmophila erosa* (Hiibn.) and *Porthesia xanthorrhoea* Koll were found to attack foliage of the weed.

On the problem weed, *Parthenium hysterophorus*, an insect, *Nupshera lenita* was observed to damage the plants, which was more pronounced during September.

During a survey carried out in different ponds of Jabalpur, it was noted that the population of *Neochetina* spp. builds up from April to September and gradually declines upto February with corresponding feeding scars on water hyacinth (*Eichhornia crassipes*).

Mexican beetle (*Zygogramma bicolorata*) released near NRCWS farm, Jabalpur in 1997 was found to establish in the area about 5 km in all directions from the point of release and suppressed the growth of *Parthenium hysterophorus*.

Polyphagous insect hairy caterpillar *Dicracia obliqua* was found to damage alligator weed (*Alternanthera philoxiroides)* in low land area alongwith *Helicoverpa armigera* in the first week of October 2000. The parasitic weed *Cuscuta* sp could also damage the alligator weed to a significant level.

Mechanical weed management

A simple wick applicator has been developed and evaluated in mustard and soybean crops for application of translocated non-selective herbicide such as glyphosate. This has a tremendous utility for the control of perennial weeds, which are otherwise difficult to control selectively in the standing crop.

Transfer of technology

Improved weed management technologies were demonstrated in farmers' fields with a view to educate the farmers regarding the extent of yield improvement by these improved technologies over the traditional techniques. Release of thousands of beetles of *Zygogramma bicolorata* has been made in and around Jabalpur for the control of *Parthenium hysterophorus* involving farmers, residents, NGOs, Rotary Club etc. to create public awareness regarding the necessity of control of this noxious weed. Similarly the release of the insect *Neochetina eichhornae* has been made for the bio-control of water hyacinth.

Coordinated research

Location-specific research on the important weed problems and their management was carried out in 22 centres located in different states of the country and the important findings are as follows:

- *Phalaris minor* and most of the non-grassy weeds in wheat could be controlled effectively by the application of sulfosulfuron at 25 g/ha at 30 days after sowing (DAS) and after first irrigation.
- Application of isoproturon or oxadiazon or trifluralin each at 0.5 kg/ha or alachlor or metolachlor each at 0.75 kg/ha as pre-emergence spray was found very effective in controlling weeds in mustard.
- Spraying 10 per cent copper sulphate solution in brinjal and tomato crops controlled the parasitic weed *Orobanche* effectively.
- In direct seeded rice under puddled condition, a new post-emergence herbicide-butanil (butachlor + propanil) 1680 + 1680 g/ha applied at 10 DAS was found quite effective in controlling weeds.
- Continuous use of isoproturon in wheat increased the population of *Vicia sativa* and *Lolium temulentum,* while in rice-wheat cropping system, it encouraged the population of the weed-*Ranunculus arvensis, Alopecurus myosuroides* and *Phalaris minor* in wheat.
- Cowpea grown for fodder upto 35-40 days as intercrop with upland rice reduced the weed infestation because of its weed competition ability.
- Compost prepared from weeds like *Ageratum conyzoides* and *Legasia mollis* added more nitrogen than that prepared from weeds *Digitaria marginata* and *Dactyloctenium aegypticum* and could effectively be used as an organic source in finger millet.
- A new problematic weed *Mimosa rubicalis* over elephant grass was observed in Kaziranga National Park.

INTRODUCTION

General

In the year 1952, ICAR initiated a coordinated weed control scheme on wheat, rice and sugarcane in 11 States of the country to monitor the weed flora and also to find out the relative feasibility of economical weed control. Later, a number of crop research Institutes of ICAR and state agricultural universities were also involved in weed control research. Different SAUs also initiated the syllabus for weed management at under graduate and post-graduate levels to teach and train students and researchers on weeds and their managem ent.

It was in 1978 the weed research programme was strengthened through All India Coordinated Research Programme on Weed Control by the ICAR in collaboration with the United States Department of Agriculture (USDA). Initially, six centres were started at different SAUs for a period of six years. Later seven more centres in II phase and nine more centres in III phase were added during 1982-83 and 1985-86 respectively. The programme was continued with plan funds of ICAR. This project was instrumental in assisting the farming community through development of technologies for effective weed control in field crops. The research programme tackled critical problems of weed management for which facilities were earlier not available at different centres. In VII Plan, it was decided to establish a nodal centre for basic as well as applied research related to weed science in India. Accordingly, the National Research Centre for Weed Science (NRCWS) was approved during the middle of VII five year plan with a total outlay of Rs. 64 lakhs. Approval of Government of India for establishing NRCWS was conveyed vide DARE letter no. 13-13/85/AFC, dated 14 November, 1986. The Centre actually came into existence at Jabalpur (MP)on 22 April, 1989.

The Centre is located at 23.90^0 North Latitude, 79.58^0 East Longitude and at an altitude of 412 metres above the mean sea level. The average annual rainfall of the region is 1253 mm. The soil is medium black (Typic Haplustert) with moderately alkaline reaction. Rice-wheat cropping sequence is widely followed in this region.

Mandate

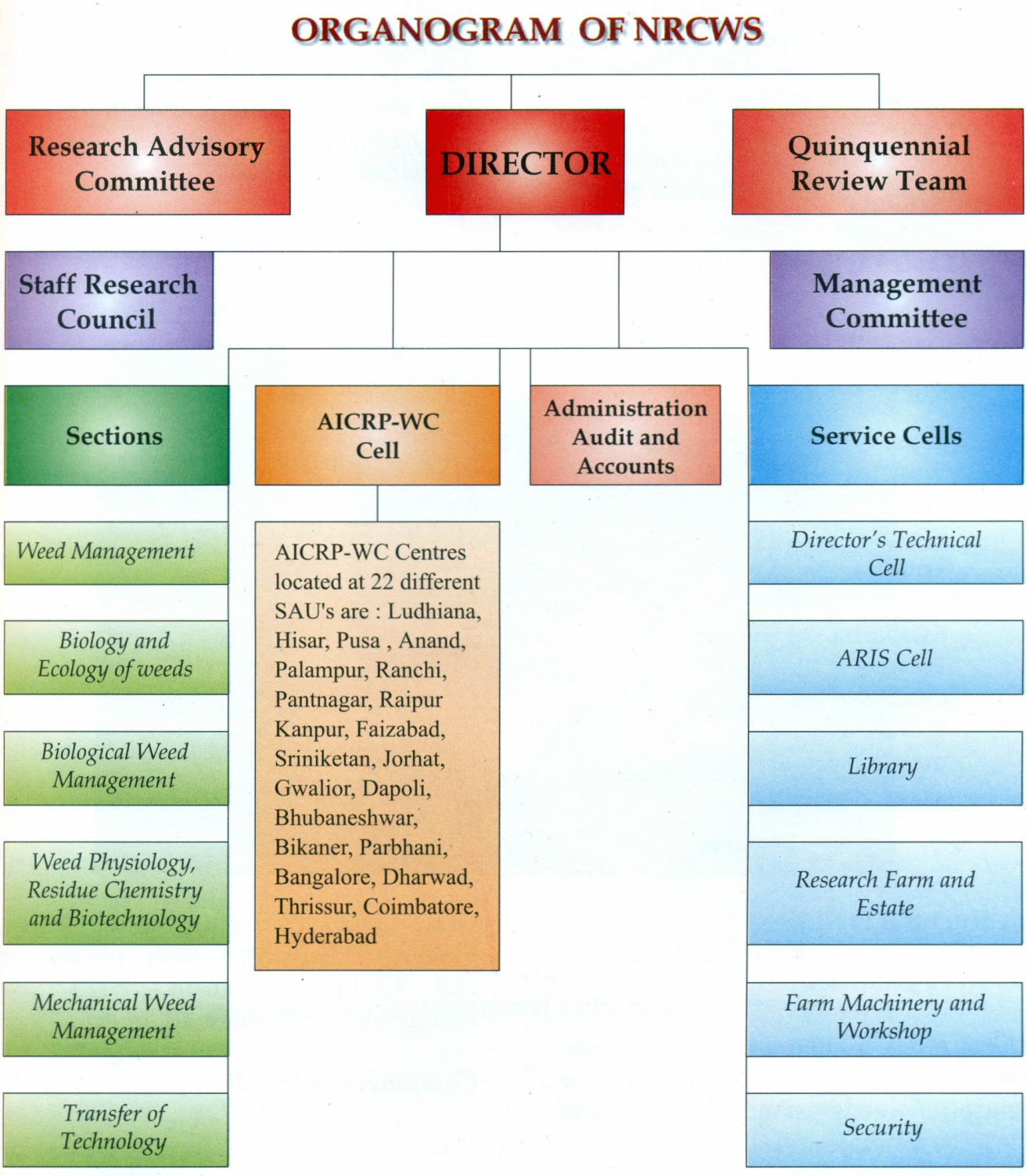
- To undertake basic and applied researches for developing efficient weed management strategies in different agro-ecological zones
- To provide leadership and co-ordinate the network research with State Agricultural Universities for generating location-specific technologies for weed management in different crops, cropping and farming systems
- To act as 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.

Objectives

- To undertake research work on biology, agro-ecology and physiology of weeds
- To study on aquatic and problem weeds and their control
- Screening and evaluation of new herbicide formulations for crops and cropping systems
- To develop technologies related to non-chemical methods of weed control including development and testing of weed control equipments
- To generate data on herbicide residues and their monitoring in soil, water and plant systems
- Survey and identification of bio-control agents and their development for management of weeds
- To develop integrated weed management modules for crops and cropping systems
- To conduct training programmes on weed science/management
- To undertake on-farm testing of newly developed weed management practices.

Organizational set up

The NRCWS is carrying out its activities effectively to fulfill its mandate. The organizational chart of NRCWS is as under:



AICRP-Weed Control

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

Staff and finance

The Centre has sanctioned cadre strength of 27 scientists, 27 technical, 17 administrative and 25 supporting staff. The staff position as on 31.03.2001 was 17 scientific inclusive of one post of RMP, 24 technical, 10 administrative and 25 supporting. The annual budget of the Centre for the year 2000-2001 is indicated in Table-1. The NRCWS generates resources from the sale of farm produce and testing of new herbicide formulations provided by the industries.

Table - 1: Budget and expenditure for the financial year of 2000-2001

(Rs. in lakhs)

Budget heads	2000-2001	
	Budget Estimates	Expenditure
	Plan	
Establishment charges	16.35	16.34
Travelling allowance	4.00	4.00
Other charges	57.00	56.95
Works	24.65	24.65
Total	**102.00**	**101.94**
	Non-plan	
Establishment charges	75.00	72.79
Travelling allowance	0.90	0.90
Other charges	35.10	34.71
Works (repair & maintenance)	4.00	4.00
Total	**115.00**	**112.40**

Infrastructural facilities

Laboratory facilities

The Centre has well equipped laboratories to carry out the research in the area of biocontrol of weeds using microorganisms and insects, residue studies, allelopathy and weed physiology. Besides the routinely used instrumental facilities, the Centre has some important instruments like HPLC, GLC, Liquid Chromatography, Universal Research Microscope with photographic and CCTV attachment, High Speed Refrigerated Centrifuge, IRGA etc.

Computer/ARIS cell

The Centre has computer-based data analysis and retrieval system to support the scientists with several application packages for word processing, statistical analysis and

graphics. Dial-up Internet accessing facility is also in operation. There is also a software package to facilitate for pay bill and account work

Library/Documentation

At present the library is having a total of 1036 books. It has modern facilities such as CABPEST and CABSAC CD-ROMs and Current Contents on Diskette (CCOD) on biological sciences. The library has a total subscription of 61 Indian journals and 10 foreign journals.

Reprographic and documentation facilities such as lamination and spiral binding machines are available for preparation of documents and reports.

Farm and glass house/ net house facilities

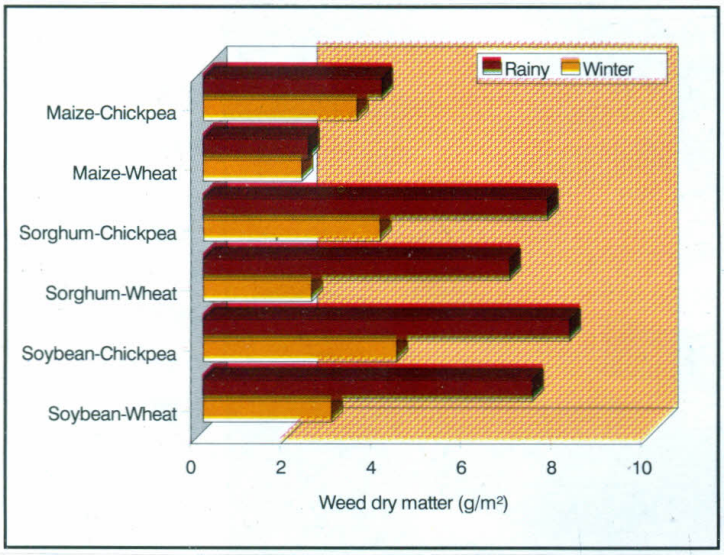
The Centre possesses 61.5 ha land, out of which more than 40 ha area is arable, which is being utilized for experimental and commercial crops/seed growing purposes. Poly house and net house facilities are recently added for carrying out pot culture experiments.

Newly commissioned Poly house

WEED MANAGEMENT THROUGH CROPPING SYSTEM

Weed dynamics under maize, sorghum and soybean-based cropping systems

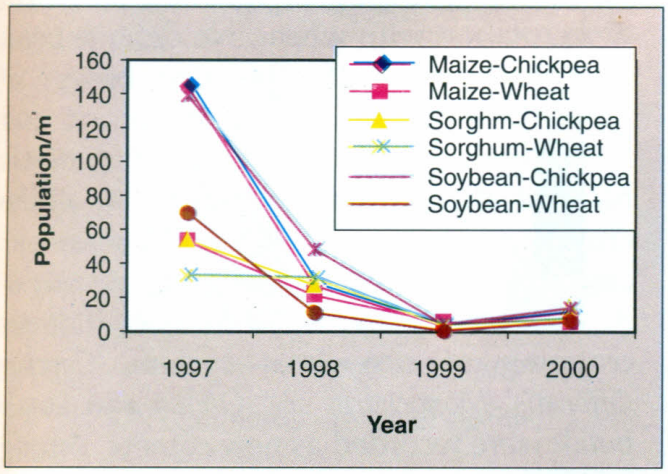
An experiment was carried out to observe the changes in weed flora under different cropping systems. The treatments consisted of six cropping systems viz., soybean-wheat, soybean-chickpea, maize-wheat, maize-chickpea, sorghum-wheat and sorghum-chickpea along with four weed control practices *viz.* weedy check, herbicide in rainy season *fb* hand weeding (HW) in winter season and vice-versa, and herbicide in both the seasons in a randomised block design with three replications. This study was carried out only on dominant weed flora.



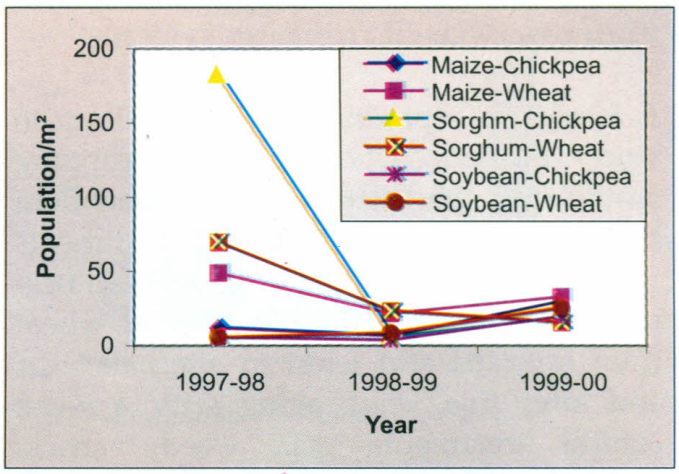
Effect of cropping systems on weed biomass production

The average of four years data showed that the density of weeds showed a decrease continuously under all the cropping systems. Substantial reduction in the density of *Echinochloa colona* and *Cyperus iria* was observed. Density of *kharif* weeds decreased every year but showed a little increase in the fourth year of study. It indicates that this is the only year when the cropping system needs to be changed. Lower density of *Commelina communis* was recorded with maize-based cropping system over others. Similarly lesser population of *Phyllanthus niruri* was observed under maize and sorghum based systems as compared to soybean-based systems. *Euphorbia geniculata* was still prevailing with soybean-based cropping system.

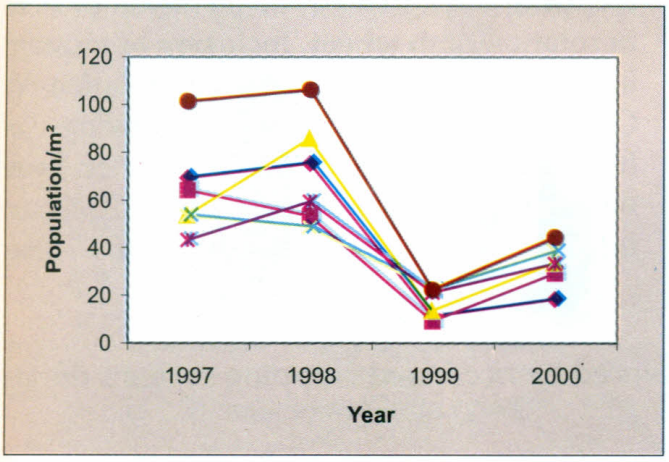
During winter season, irrespective of systems the population of *Phalaris minor, Avena sterilis* ssp. *ludoviciana* and *Euphorbia geniculata* showed an increase and that of *Cichorium intybus, Medicago hispida, Vicia sativa, Chenopodium album* and *Phyalis minima* were decreased over a period of time. Higher population of *P. minor* was recorded with maize and sorghum-based cropping systems whereas *Avena sterilis* was more under sorghum, and soybean- based cropping systems. The higher population of *Cichorium intybus, M. hispida* and *Euphorbia geniculata* were recorded under soybean-based system. However, higher density of *Chenopodium album* was noted with maize - based systems. Lowest weed population and dry weight of weeds were recorded in maize-based cropping systems and where wheat was grown in rotation.



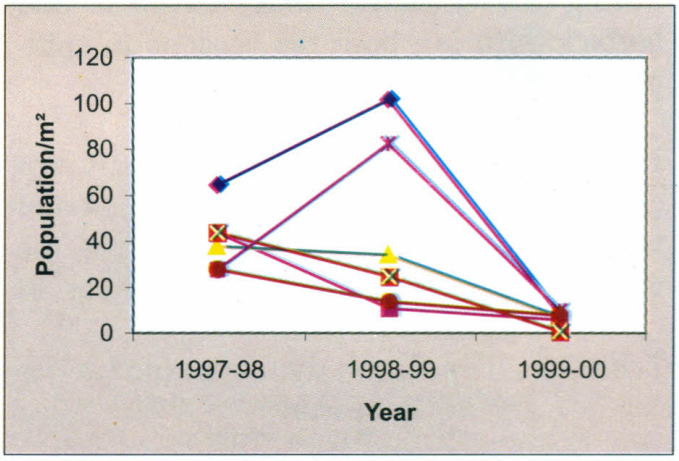
Echinochloa colona



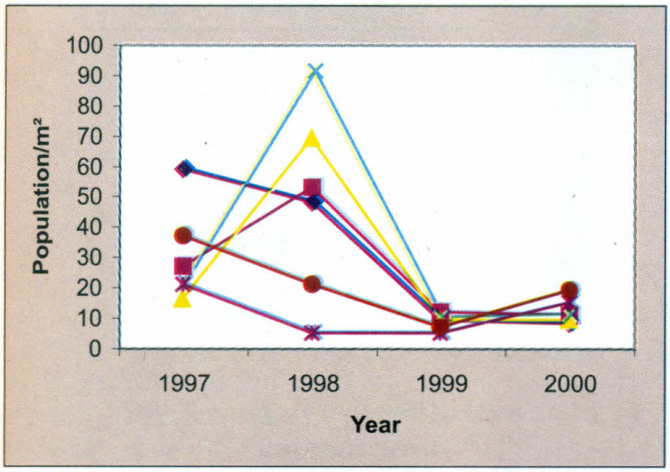
Chenopodium album



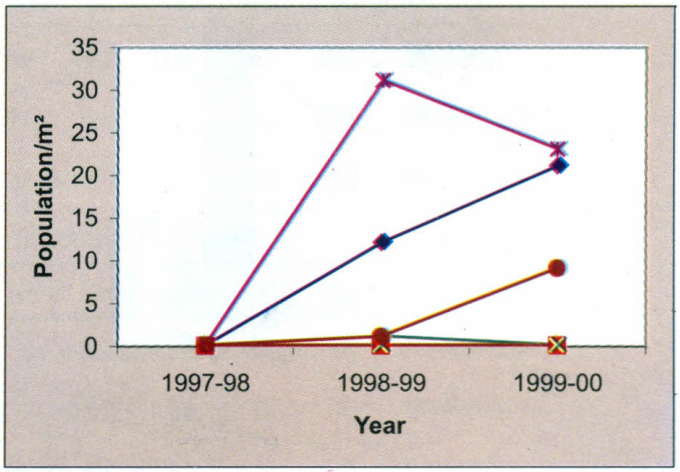
Commelina communis



Medicago hispida



Phyllanthus niruri



Euphorbia geniculata

Population dynamics of weeds under different cropping systems during rainy season

Population dynamics of weeds under different cropping systems during winter season

Intensity and diversity of weed flora under rice-based cropping systems

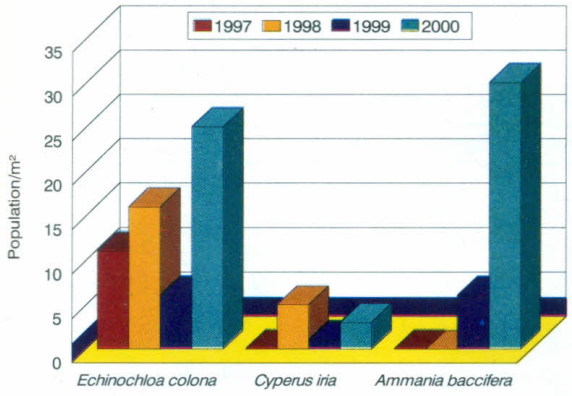
A long-term experiment was carried out to study the effect of rice-based cropping systems on the distribution of weed flora and its management by testing treatments viz. continuous cropping of rice-wheat, rice-mustard and rice-lentil, rotation of wheat from mustard and lentil in alternate year and after two years along with 4 weed control treatments *viz.*, weedy check, herbicide (H) as per crops during rainy season followed by hand weeding (HW) during winter season and vice-versa and herbicide during both the seasons in split-plot design with three replications..

During rainy season, the density of *Echinochloa colona* increased over a period of time in all the cropping systems but the increase was more pronounced either in continuous growing of mustard and lentil or in rotation with wheat. No definite trend was recorded with the distribution of *Echinochloa glabrescense, Cyperus iria* and *Commelina* spp. The density of *Ammania baccifera* also showed a increase in all the cropping systems except continuous cropping of rice-lentil. The lowest density of *A. baccifera* was recorded with continuous cropping of rice-wheat system. *Cyperus difformis, Monochoria* sp., *Otellia* and *Rotala indica* were recorded as new comers. During winter season, lowest population of *Phalaris minor* was recorded with continuous cropping of rice-wheat or inclusion of lentil in rotation with wheat. Inclusion of mustard in systems reduced the population of *Chenopodium*. Continuous growing of mustard or its inclusion in rotation with wheat increased the problem of *Cichorium intybus* over a period of time.

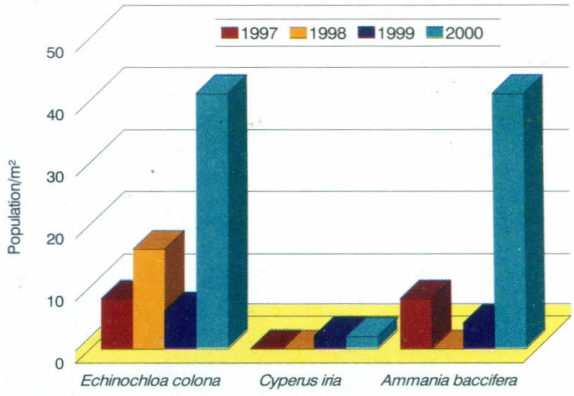
Table – 2 : Population dynamics (no/m^{-2}) as influenced by rice-based cropping systems during *winter* season

Year	*Phalaris minor*						*Chenopodium album*					
	S_1	S_2	S_3	S_4	S_5	S_6	S_1	S_2	S_3	S_4	S_5	S_6
1997-98	101	75	107	144	96	43	27	27	53	48	37	16
1998-99	105	213	138	62	191	76	36	34	36	22	21	30
1999-00	53	72	83	78	50	78	29	12	49	11	40	15
Year	*Medicago hispida*						*Cichorium intybus*					
	S_1	S_2	S_3	S_4	S_5	S_6	S_1	S_2	S_3	S_4	S_5	S_6
1997-98	75	48	32	32	0	64	64	11	0	16	0	21
1998-99	6	23	15	22	7	8	101	6	19	6	21	22
1999-00	5	9	13	17	29	11	7	22	32	15	50	19

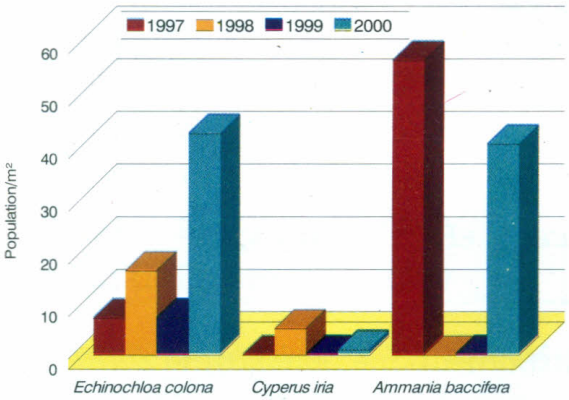
S_1 Rice-Wheat, S_2 Rice-Mustard, S_3 Rice-Lentil,
S_4 Rice- Mustard S_5 Rice- Lentil S_6 Rice-Wheat



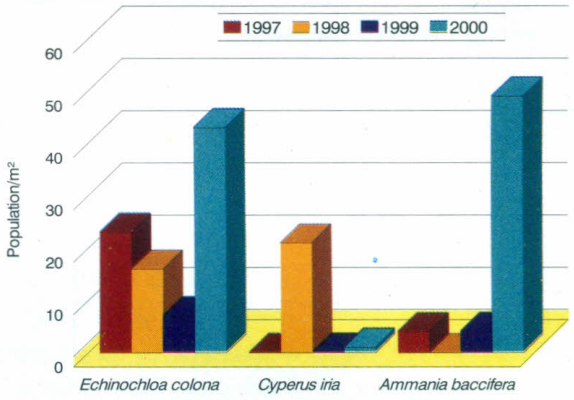
S1 - Continuous rice-wheat system



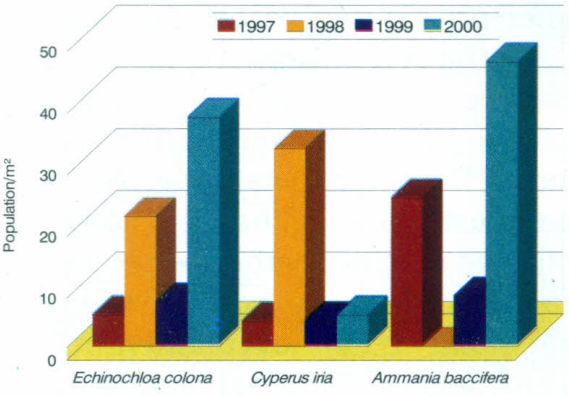
S2 - Continuous rice-mustard system



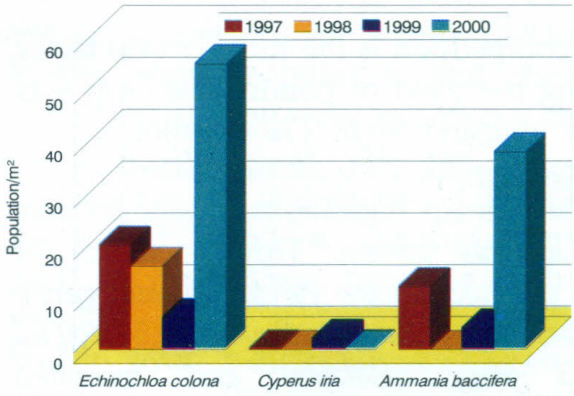
S3 - Continuous rice-lentil system



S4 - Rotation of wheat from mustard in alternate year



S5 - Rotation of wheat from lentil in alternate year



S6 - Rotation of wheat from mustard and lentil after two years

Weed dynamics as influenced by rice-based cropping system during rainy season

Table-3: Effect of rice based cropping systems on weed population/m^2 and weed dry matter production (g/m^2).

Treatments	Rainy season		Winter season	
	Population	Dry matter	Population	Dry matter
Cropping systems				
S_1	10.57	8.32	7.13	3.98
S_2	11.21	8.15	7.13	4.85
S_3	10.49	9.21	7.14	4.21
S_4	10.86	7.57	7.12	4.38
S_5	11.84	9.59	6.99	4.25
S_6	11.56	10.10	7.31	5.39
LSD (P=0.05)	NS	1.51	NS	0.7
Weed control measures				
Weedy	11.72	11.50	11.72	7.59
H fb HW	10.97	9.58	5.87	3.76
HW fb H	10.75	6.60	5.48	3.57
H fb H	10.90	7.62	5.46	3.12
LSD (P=0.05)	0.82	0.72	0.70	0.46

S_1 Rice-Wheat, S_2 Rice-Mustard, S_3 Rice-Lentil, S_4 Rice- Mustard S_5 Rice- Lentil, S_6 Rice-Wheat
Fb – followed by, H- Herbicide, HW – Hand Weeding

WEED MANAGEMENT IN VEGETABLE CROPS

Evaluation of herbicides in potato

Weed competition is the most critical factor affecting the yield of potato. The crop was mainly infested with *Chenopodium album, Medicago hispida, Vicia sativa, Phalaris minor, Avena sterilis* ssp. *ludoviciana, Rumex dentatus* and *Lathyrus aphaca.* Timely control of weeds boosted up the yield. Pre-emergence application of metribuzin at 0.5 kg/ha proved very effective and recorded significantly lower population and dry weight of weeds. Its application as an early post-emergence spray had no significant difference. In addition to this, oxyfluorfen 0.2 kg/ha and atrazine 1.0 kg/ha also gave effective control of all weeds except *Lathyrus aphaca.* Highest tuber yield (26.75 and 22.37 t/ha) of potato was recorded with metribuzin 0.5 kg/ha as pre-emergence followed by other herbicides *viz.* metribuzin 0.5 kg/ha as early post-emergence (23.47 and 18.71 t/ha), oxyfluorfen 0.2 kg/ha (19.87 and 17.76 t/ha) and atrazine 1.0 kg/ha (19.69 and 18.16 t/ha) (Table-4).

Table - 4: Bio-efficacy of pre- and post-emergence herbicides on weed growth in potato

Treatments	Weed population/m^2		Weed dry matter (g/m^2)		Tuber yield (t/ha)	
	98-99	99-00	98-99	99-00	98-99	99-00
Metribuzin 0.5 kg/ha PE	2.88	1.93	1.46	1.93	26.75	22.37
Metribuzin 0.5 kg/ha PO	4.18	5.29	1.73	5.11	23.47	18.71
Oxfluorfen 0.2 kg/ha PE	7.09	6.25	2.83	4.62	19.87	17.76
Glyphosate 0.5 % PO	9.11	9.13	3.65	7.85	16.94	13.71
Paraquat 1.0 kg/ha PO	9.39	9.45	5.25	9.09	15.43	11.27
2,4-D 0.5 kg/ha PO	8.24	8.03	3.40	7.61	18.32	14.65
Atrazine 1.0 kg/ha PE	3.38	4.83	2.02	5.30	19.69	18.16
Promytrin 0.75 kg/ha	6.09	7.09	3.08	6.08	18.93	16.18
Weedy check	10.61	11.09	11.29	16.34	13.87	10.35
LSD (P=0.05)	2.13	1.76	1.06	1.55	4.33	3.67

PE - Pre- emergence , PO- post - emergence (8 DAT) at 10-15 per cent emergence of potato

Impact of irrigation levels and metribuzin in Potato

Effect of levels of irrigation and metribuzin on intensity and dry matter production of weeds and tuber yield of potato was studied. The treatments include four levels of irrigation *viz.* rainfed, one irrigation at 30 days after planting (DAP) two irrigations at 30 and 45 DAP and three irrigations at 30, 45 and 60 DAP in the main plot and three levels of metribuzin ((0.30, 0.50 and 0.75 kg/ha) along with two hand weedings at 20 and 40 DAP and weedy check.

Experimental field was infested mainly with the weeds *viz. Chenopodium album, Medicago hispida, Rumex dentatus, Lathyrus aphaca* and *Cichorium intybus* as broadleaf weeds and *Phalaris minor* and *Avena sterilis* ssp. *ludoviciana* among grasses. Uncontrolled weeds throughout the growing season caused 41 per cent reduction in tuber yield of potato. Though all the levels of irrigation produced significantly higher population of weeds and their dry matter production over rainfed control but they were at par with each other in respect of weed population. Studies conducted for two years revealed that three irrigations being at par with two irrigations produced significantly higher weed dry matter and highest tuber yield. All the weed control treatments produced significantly lower population and dry matter of weeds over weedy check. The lowest weed population and their dry matter production were recorded with hand weeding twice at 20 and 40 DAP. Application of metribuzin at 0.50 kg/ha proved very effective. The maximum tuber yield of potato was recorded with hand weeding twice which was significantly higher over metribuzin 0.3 kg/ha and weedy check. The interaction effect between levels of irrigation and metribuzin were significant. It is evident from the study that the response of metribuzin increased with increasing levels of irrigation. The highest tuber yield of potato was recorded with metribuzin 0.5 kg/ha under three

irrigations given at 30, 45 and 60 DAP. Even metribuzin 0.3 kg/ha under three irrigations gave higher yield compared to metribuzin 0.75 kg/ha with one irrigation given at 30 DAP (Table-5).

Table-5: Effect of irrigation levels and weed control measures on weed growth at 60 DAS and tuber yield of potato

Treatments	Weed population/m^2		Weed dry matter (g/m^2)		Tuber yield (t/ha)	
	98-99	99-00	98-99	99-00	98-99	99-00
Irrigation levels						
Rainfed	4.12	5.26	2.56	5.01	10.83	13.87
Irrigation at 30 DAP	6.14	5.79	3.64	5.49	16.64	15.31
Irrigations at 30 & 45 DAP	6.34	5.53	3.92	6.11	19.0	17.89
Irrigations at 30, 45, & 60 DAP	5.98	5.26	4.15	6.62	20.47	20.63
LSD (P=0.05)	0.45	NS	0.28	0.67	1.43	2.28
Weed control practices						
Metribuzin 0.30 kg/ha PE	5.58	4.72	2.96	4.35	15.35	16.84
Metribuzin 0.50 kg/ha PE	4.12	3.85	2.26	3.67	18.72	18.06
Metribuzin 0.75 kg/ha PE	4.26	3.21	2.00	3.22	19.02	18.23
2 hand weedings (20&40DAP)	4.02	3.91	1.62	3.72	19.19	19.74
Weedy check	8.87	11.76	8.74	14.08	11.40	11.74
LSD (P=0.05)	0.50	0.80	0.38	0.74	1.81	0.96

Table-6: Interaction effect of irrigation levels and weed control measures on the tuber yield (t/ha) of potato (Mean of two years)

Irrigation levels	Weed control measures					Mean
	W_1	W_2	W_3	W_4	W_5	
Rainfed	12.02	12.85	13.16	14.90	8.83	12.35
Irrigation at 30 DAP	14.47	17.24	18.28	18.43	11.46	15.98
I irrigations 30 &45 DAP	17.99	20.36	20.56	20.75	12.57	18.45
Irrigations at 30, 45 & 6 0 DAP	19.91	23.13	22.50	23.79	13.44	20.41
Mean	16.10	18.40	18.63	19.47	11.58	

LSD (P=0.05)	A-Irrigation	B-Weed control	Two level of B at the same level of A	Two levels of A at the same level of B
	1.86	1.39	2.78	3.20

W_1-Metribuzin 0.3 kg/ha PE , W_2-Metribuzin 0.50 kg/ha PE, W_3- Metribuzin 0.75 kg/ha PE, W_4-2 hand weedings at 20 & 40 DAS, W_5- Weedy check

SOIL SOLARIZATION

Soil solarization in soybean

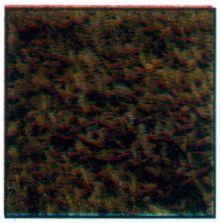
Presence of weeds in soybean caused 45 per cent seed yield loss. Reduction was observed under tilled condition. Soil solarization for a period of 5 weeks integrated with metolachlor 0.75 kg/ha and hand weeding significantly reduced the weed population and dry weight and was at par with hand weedings twice.

Application of metolachlor at 0.38 and 0.75 kg/ha alone was less effective in weed control until combined with soil solarization treatment (Table-7).

Table – 7 : Impact of soil solarization and weed control measures on the weed dry matter (60 DAS) and seed yield of soybean as influenced by tillage

Treatments	Weed dry matter (g/m^2)			Seed yield (kg/ha)		
	No tillage	Tillage	Mean	No tillage	Tillage	Mean
Soil solarization	8.01	3.80	5.91	960	1040	1000
Metolachlor 0.38 kg/ha PE	14.96	8.05	11.51	774	826	800
Metolachlor 0.75 kg/ha PE	9.32	5.46	7.39	943	1087	1015
Metolachlor 1.13 kg/ha PE	8.27	4.38	6.32	976	1104	1040
SS +Metolachlor 0.38 kg/ha	3.32	2.41	2.86	1053	1271	1162
SS +Metolachlor 0.75 kg/ha	2.08	1.39	1.73	1207	1316	1262
SS + 1 hand weeding- 20 DAS	2.67	3.44	3.05	1026	1055	1040
2 HW at 20 & 40 DAS	7.38	4.60	5.99	1026	1249	1138
Weedy check	16.57	9.04	12.81	676	716	696
Mean	8.06	4.73	-	960	1074	-
LSD (P=0.05) A-Tillage			2.40			143
B- Weed control			1.93			202
B at the same level of A			12.73			285
A at the same level of B			3.32			296

BIOLOGY AND CONTROL OF PROBLEM WEEDS IN SOYBEAN



Euphorbia geniculata Orteg. is an erect annual, monoecious broad leaf weed and belongs to family *Euphorbiaceae* (Spurge family). It is native to the Tropical Americas but is widespread in eastern Africa and Asia. The weed is characterized by its hollow stem, milky sap and leaves that are whitish beneath. The seeds have no dormancy and germinate throughout the year and thus, plants complete up to four generations a year but its infestation is more severe in rainy season. It can grow even after the young shoots are cut. Experimental results revealed that the seeds could germinate up to 14 cm depth but the maximum seedling emergence was recorded at 6 cm depth and 15 days after sowing.

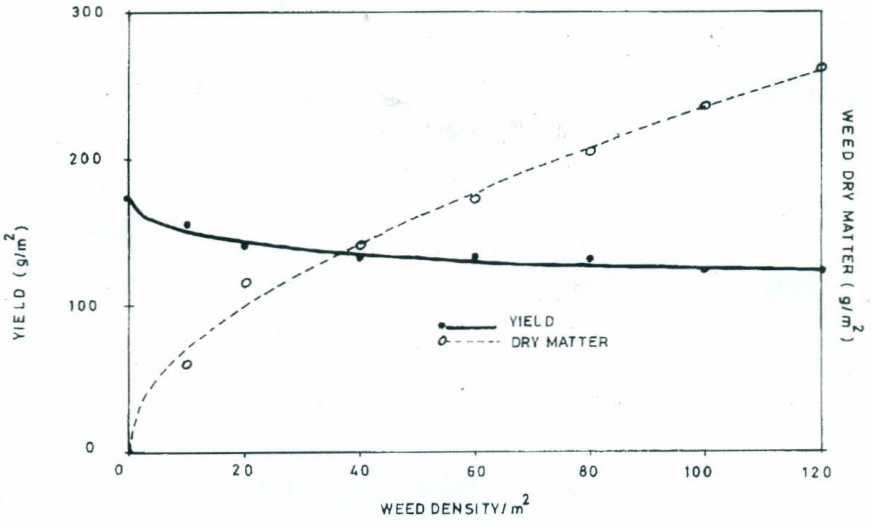
In Madhya Pradesh, this weed has emerged as a serious bottleneck in soybean production. The infestation of this weed is more pronounced in soybean-chickpea system as compared to soybean-wheat or soybean-mustard systems. Studies on the interference of *E. geniculata* in soybean revealed that increase in weed density from 10 to 30 /m^2 reduced the soybean yield by 12 to 30 per cent. The relationship of weed density with seed yield of crop and weed dry matter was best fitted with cubic root model ($Y=a+bx+ cx^{2/3} + dx^{1/3}$).The constant values for yield were a=174.05; b=0.41; c= -2.62; d= -7.44 and R^2 = 0.98. The same values for weed dry matter were, -0.53; 0.17; 5.97; 19.04 and 0.99, respectively.

The weed can easily be controlled in soybean by pre-emergence application of metribuzin 0.50 kg or oxyfluorfen 0.20 kg/ha or post-emergence application (7-21 DAS) of imezethapyr 100-150 g/ha or chlorimuron-ethyl 12 g/ha or bentazone 1.0 kg/ha (Table-8).

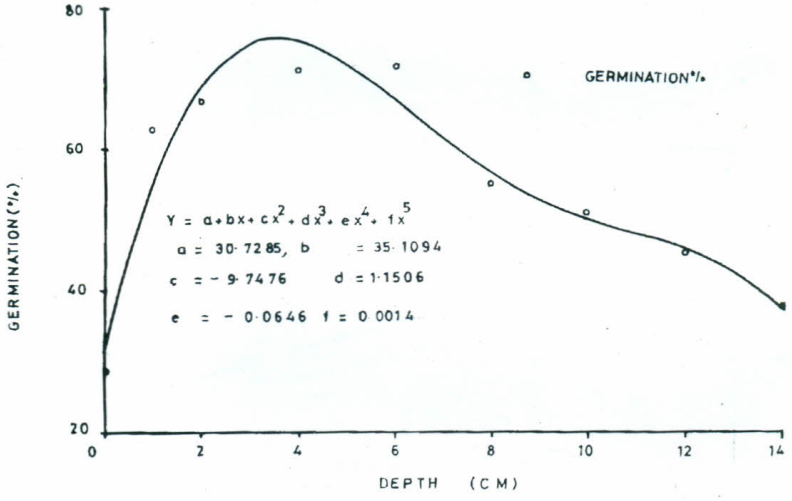
Table-8: Efficacy of herbicides against *Euphorbia geniculata* in soybean

Treatments	Weed population/m^{2*}		Weed dry matter (g/m^{2*})		Seed yield
	30 DAS	45 DAS	30 DAS	45 DAS	(t/ha)
Oxyfluorfen 0.2 kg/ha PE	7.53	7.55	4.41	8.93	1.40
Metribuzin 0.5 kg/ha PE	6.91	7.48	3.24	6.40	1.67
Bentazone 1.5 kg/ha PO	11.20	9.61	5.01	12.33	1.11
Chlorimuron 10 g/ha PO	9.44	6.30	3.94	7.24	1.49
Imezethapyr 70 g/ha PO	11.75	9.76	4.51	8.52	1.22
Weedy check	22.08	16.69	7.19	20.75	0.69
LSD (P=0.05)	3.12	3.12	1.33	3.15	0.25

PE- Pre-emergence; PO – Post emergence ; DAS – days after sowing
Values subjected to square root transformation √(x+0.5)



Effect of *Euphorbia geniculata* density on its dry matter accumulation (g/m²) and seed yield (g/m²) of soybean



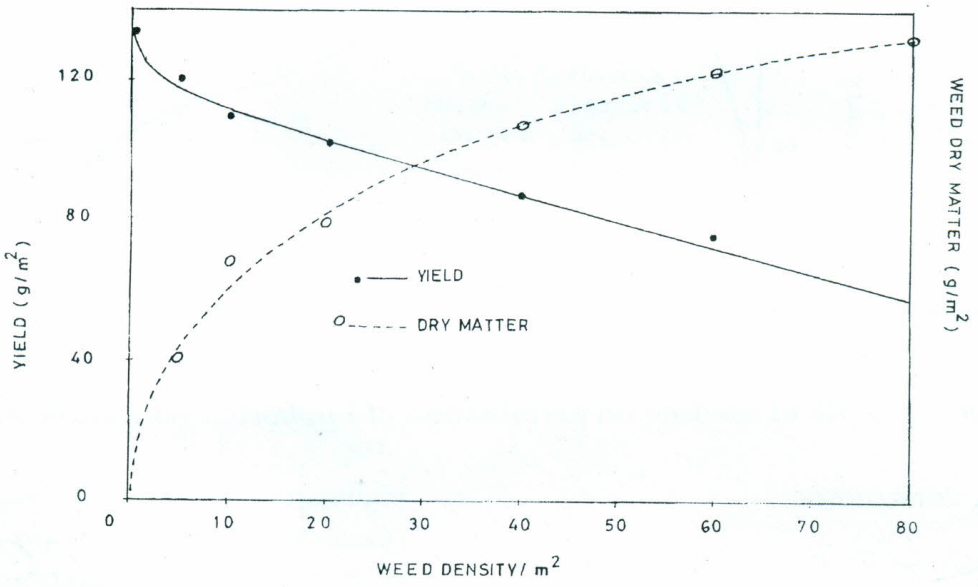
Effect of depth of seeding on germination of *Euphorbia geniculata* at 30 DAS

Commelina communis

Commelina communis is a serious weed of soybean. It is not easily controlled by many of the recommended herbicides for soybean. Studies on the interference of this weed in soybean revealed that increasing weed density increased the weed dry weight/m² but dry weight/plant decreased. Increase in weed density from 5 to 80 /m² reduced the soybean yield by 10.59-58.38 per cent (Table-9). The relationship of weed density with seed yield of soybean and weed dry matter was best fitted with cubic root model ($Y=a+bx+cx^{2/3}+dx^{1/3}$). The constant values for yield were a=134.42; b=-0.83; c= 1.87; d= -10.56 and R^2 = 0.99. The same values for weed dry matter were, -0.17; -1.60; 11.51; 10.79 and 0.99, respectively.

Table-9 : Effect of increasing densities of *Commelina communis* on weed dry matter, yield attributes and yield of soybean.

Density (no/m²)	Weed dry weight (g/m²)	Weed dry weight (g/plant)	Pods /plant	Seeds /pod	Seed wt (g/plant)	100-seed wt (g)	Seed yield (g/m²)
0	-	-	52.7	2.1	10.2	8.1	134
5	39.9	7.9	49.1	2.0	7.8	8.0	120
10	67.5	6.7	44.8	1.9	6.7	7.9	110
20	78.8	3.9	44.1	1.9	6.7	7.8	102
40	106.7	2.7	40.6	1.8	6.5	7.8	87
60	123.2	2.1	40.2	1.8	5.7	7.5	75
80	131.7	1.6	39.9	1.7	5.4	7.4	56
LSD (P=0.05)	34.1	-	8.3	0.2	1.4	1.0	23



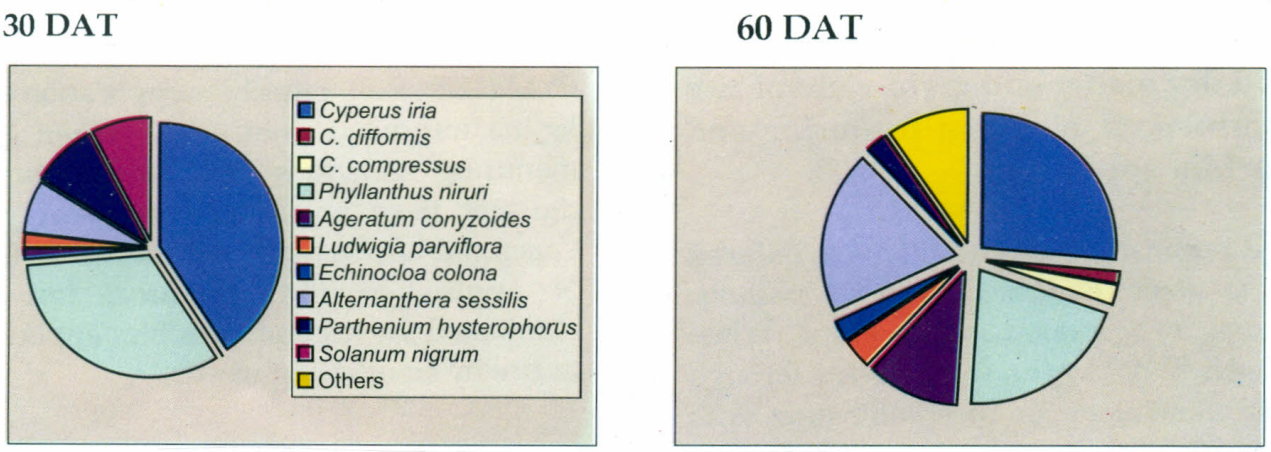
Effect of density of *Commelina communis* on dry matter and seed yield of soybean

Effect of water submergence and nitrogen levels on weed growth and yield of transplanted rice

Soil moisture and nitrogen are known to influence the growth of crops and weeds. Therefore, appropriate water and nitrogen management are important for controlling weeds in transplanted rice. Results of a pot culture experiment revealed that maintaining water submergence 2.5 cm throughout the growing season completely checked the weed emergence. Weeds were observed only in saturated conditions. Among different weed species *Cyperus iria* (41 and 26 per cent) and *Phyllanthus niruri* (33 and 21 per cent) were predominant at 30 and 60 DAP, respectively. Application of N (80 kg/ha and above) reduced the total weed population as compared to 40 kg and no nitrogen. Grain yield increased significantly due to water submergence as compared to saturation, however, the difference in yield between 5.0 (8.53 t/ha) and 7.5 cm (8.76 t/ha) water submergence was not significant. The maximum grain yield (8.91 t/ha) was recorded from 120 kg N/ha that was at par with 80 kg N/ha (8.31 t/ha) but significantly superior to rest of the N levels. Maintaining 5.0 cm water submergence and application of 120 kg N/ha produced the highest grain yield (9.50 t/ha) (Table-10).

Table-10: Interaction of nitrogen and depth of water submergence on grain yield of rice (t/ha)

N-levels (kg/ ha)	Depth of water submergence				Mean
	Saturation	2.5 cm	5.0 cm	7.5 cm	
0	5.58	7.17	7.50	7.81	7.01
40	6.10	7.65	8.34	7.35	7.70
80	7.01	8.31	8.85	9.08	8.31
120	7.65	9.08	9.50	9.43	8.91
Mean	6.59	8.05	8.53	8.76	-
LSD (P=0.05)			1.18		



Relative density of weeds under saturated condition at 30 and 60 DAT

Effect of herbicides on soil microflora in soybean- wheat cropping system

Effect of three herbicides alachlor, fluchloralin and pendimethalin on soil fungal population and root nodulation in soybean was studied. Least fungal population was recorded in plots treated with alachlor throughout the growth period, while control plots where no herbicide was applied maintained the highest. The fungal population was found to decrease significantly from the initial value to 15 DAS in all the herbicide treatments but the population has restituted by 30 DAS surpassing even the initial population. Fluchloralin and pendimethalin did not differ significantly on their effect on soil fungi. No significant differences were observed in the fungal population at harvest among the three herbicides used. Highest grain yield of 15.20 q/ha was recorded in alachlor while fluchloralin and pendimethalin did not differ significantly in yield. However, the grain yield in control was found to be the least.

Table-11: Effect of herbicides on soil fungal population (No.X10^4 / g of dry soil) in soybean

Treatments	Soil fungal population (No.X10^4 / g of dry soil)						Dry weight of root nodules (g/plant)		Grain yield (q/ha)
	Initial	15 DAS	30 DAS	60 DAS	90 DAS	At harvest	40 DAS	60 DAS	
Control	5.02	5.92	9.87	13.92	21.14	25.01	3.85	3.89	8.10
Alachlor	4.87	2.04	5.53	8.14	18.01	21.12	2.86	2.89	15.20
Fluchloralin	4.94	3.01	8.64	12.01	20.01	22.13	2.07	2.11	13.60
Pendimethalin	4.89	2.83	6.88	9.01	18.13	22.01	2.23	2.24	14.70
LSD (P=0.05)	NS	0.19	1.09	0.91	0.18	1.06	0.18	0.14	1.10

The data presented in Table-11 shows the effect of herbicides on root nodules in soybean. The nodule dry weight increased from 40 DAS to 60 DAS irrespective of the herbicide applied. Among the three herbicides applied, alachlor was found to maintain highest root nodule dry weight as compared to the remaining two herbicides i.e., fluchloralin and pendimethalin.

Weed dry matter and grain yield of rice as influenced by green manuring and butachlor application

Weed population significantly was reduced due to green manure (dhaincha- *Sesbania aculeata*) incorporated in rice crop. When nitrogen @ 120 kg/ha was applied through either urea alone or in combination with FYM (U60+F60), butachlor application at 1.5 kg/ha improved grain yield. When green manuring was done butachlor application did not have any effect on grain yield. Green manure not only substituted fertilizer N application through urea, but also eliminated the need of butachlor application in rice by smothering weeds.

EVALUATION OF NEW HERBICIDES IN DIFFERENT FIELD CROPS

Wheat

Important post-emergence herbicides identified for weed control in wheat as include isoproturon (1.0 kg/ha), sulfosulfuron (25 g/ha as PO), clodinofop (60 g/ha as PO) and fenoxaprop at (100 g/ha), tralkoxydim (0.35 kg/ha at 30 DAS) against grasses. However, metribuzin at 0.30 kg/ha was the best treatment with regard to control of grassy as well as broad lead weeds were concerned. The grain yield was highest under metribuzin application.

Combining isoproturon with dicamba (1250+250 g/ha) though reduced weeds and increased two quintals more yield as compared to dicamba 0.5 kg/ha but it was not significant. It may be interpreted that dicamba application alone at 0.5 kg/ha was significantly superior to weedy check with regard to yield and weed parameters. Using more quantity of dicamba could not give effective results. It also indicated that the dicamba might be used as a substitute for 2,4-D for control of broad-leaf weeds to a greater extent.

Rice

Acetachlor

Application of acetachlor (75-100 g/ha) at 3 days after transplanting (DAT) was found very effective in controlling weeds as well as increased the yield of transplanted rice, which was in the range of 5.50–5.70 t/ha. Increase in its rate upto 300 g/ha though decreased the weed population significantly but was found toxic to rice and resulted in comparable yield (5.6-5.77 t/ha) during both the stages (3 DAT and 6-8 DAT).

Clomazone + 2,4-D

Combination of clomazone with 2,4-D (200+270 g/ha) as pre-emergence proved very effective in minimizing weeds and yielded 5.63 t/ha, which was comparable to hand weeding twice (5.71 t/ha) in transplanted rice.

Pyrazosulfuron

Application of pyrazosulfuron at 20-25 g/ha at early stage (3 DAT) significantly reduced the weed population and weed biomass as compared to its application at later stages i.e. on 10-12 or 15-18 DAT and increased the yield of transplanted rice.

Soybean

Tepraloxydim

Integration of bentazone (1200 g/ha) either with tepraloxydim (75 g/ha) or its application followed by acifluorfen (850 fb 1200 g/ha) resulted in excellent control of weeds and recorded highest yield of soybean.

Bentazone with acifluorfen

Post-emergence application of bentazone at 1200 g/ha was found promising in soybean. Its combination with acifluorfen (720 + 160 g/ha) produced seed yield comparable with the double dose of acifluorfen (1440+320 g/ha). This combination as post-emergence at 60 DAS checked the weed growth significantly and the highest weed control efficiency was observed under the treatment at higher rate. Its application alone and in combination with acifluorfen has been found very effective against the weed flora *Commelina communis, Phyllanthus*

niruri,, Caesulia spp., *Convolvulus arvensis, Ageratum spp.* and *Alternanthera* spp..

Oryzalin

The new herbicide formulation oryzalin at 1.0-1.25 kg/ha proved promising for weed control in soybean and was comparable to the proven herbicide-fluchloralin.

Imezethapyr

Application of imezethapyr at 100 g/ha proved very effective in controlling weeds in soybean as compared to bentazone alone. The combination of this herbicide either with metolachlor or alachlor was observed to be as the best combination in reducing growth of weeds as compared to unweeded check in soybean (Table-12).

Table-12: Effect of herbicides and herbicide mixture on weed control and seed yield of soybean

Treatments	Dose (g/ha)	Weed count (No./m²)	Weed dry weight (g/m²)	Seed yield (t/ha)
Imezethapyr	100	5.65	14.5	1.07
Bentazone	1250	6.09	19.0	0.93
Alachlor+Imezethapyr	1000+50	5.10	11.0	1.10
Alachlor+Imezethapyr	1000+75	5.00	10.0	1.11
Imezethapyr	50	6.75	23.0	1.01
Imezethapyr	75	6.63	21.0	1.03
Imezethapyr+Metolachlor	50+1000	4.82	8.5	1.14
Untreated		9.29	66.0	0.54
LSD (P=0.05)		0.69	4.9	0.22

ALLELOPATHY

Herbicidal property of phytotoxins from Lantana

Lantana (*Lantana camara)* leaf residue was lethal to 10 aquatic weeds tested at 1-2 per cent (dry w/v). In floating species namely *Eichhornia crassipes, Salvinia molesta, Pistia* spp., *Spirodela polyrhiza, Azolla nilotica* and *Lemna pausicostata* the residue at lethal dose caused stretiotes wilting/ chlorosis, desiccation and death of treated plants in 5-10 days. In submerged species namely *Hydrilla verticillata, Ceratophyllum demersum, Najas graminea* and *Chara* sp. The residue caused chlorosis, loss of turgidity, fragmentation, death and decay of the treated plants in 4-10 days. In partially purified terpenoid fraction obtained from lantana leaf residues, using various physio-chemical techniques, six pentacyclic triterpenoids were detected. The constituents are being obtained in larger quantities for further investigations for elucidating herbicidal property.

Effect of Parthenium residue on transplanted rice

The parthenium residue (PR) improved crop growth and yields without obvious toxicity to the crop (Table-13). The PR upto 13.33 t/ha dry weight was not toxic to rice. The yield of rice in PR applied plots was comparable to the ones in which recommended dose of fertilizers was applied. The findings showed that, i) parthenium may not inhibit rice through allelochemic interaction, ii) PR could be used instead of recommended dose of fertilizers, and iii) use of PR in rice cultivation could serve as an eco-friendly incentive for management of the weed by participation of public, and iv) the field soil appears to have tremendous potential for detoxification of allelochemic load during *kharif* season.

Table-13: Effect of parthenium residue (PR) on rice

Treatment	Yield t/ha	
	Straw	Grain
Recommended dose of fertilizer - weedy	5.34	4.99
Recommended dose of fertilizer – hand weeded	5.27	5.92
PR at 3.33 t /ha	4.41	4.42
PR at 6.66 t /ha	4.62	4.76
PR at 9.99 t /ha	5.62	4.77
PR at 13.3 t /ha	4.82	5.63
Hand weeded	5.00	5.33
Weedy	3.90	4.24
LSD (P=0.05)	0.95	0.92

Effect of Parthenium residue on wheat

Parthenium residue (PR) was, however, toxic to wheat (*cv.* WH 147) during *rabi* 2001. The PR reduced crop growth as evidenced by yields at 2.0-3.3 t dry weight/ha. PR is probably not detoxified considerably in soil during *rabi* season and thus wheat plants were unable to use it for growth and yields. The study showed that, i) the PR was toxic to wheat at much lower levels as compared to rice, ii) the PR was not detoxified considerably under field conditions, iii) *Parthenium* may inhibit wheat through allelochemic interaction, and iv) relatively poor detoxification of toxic constituents in the PR was probably due to lower soil temperature and resultant low microbial levels and their activity during *rabi* season. These are being investigated further.

Table-14: Effect of Parthenium residue (PR) on wheat

Treatment	Yield t/ha	
	Straw	Grain
Recommended dose of fertilizer - weedy	6.64	5.48
Recommended dose of fertilizer – hand weeded	6.27	5.74
PR at 0.5 t /ha	3.43	3.55
PR at 1.0 t /ha	4.24	3.81
PR at 2.0 t /ha	4.51	3.78
PR at 3.3 t /ha	4.01	3.47
Hand weeded	4.30	4.11
Weedy	3.96	3.36
LSD (P=0.05)	1.30	1.58

Phalaris minor Retz.

Wheat (cv. WH-147) and *Phalaris minor* were grown in pure and mixed culture with equal densities (100 plants/m^2) with a standard dose of fertilizer (N:P:K: :100:60:40). It was observed that the height of crop and weed in mixed culture were less than those in pure culture. The dry matter of crop in mixed culture was lower than that in pure culture. So also was the case with the weed. Its height was most severely affected. From the values of plant relative yield (PRY) and relative yield total (RYT), it was observed that the intra-specific interference of wheat is more severe than the inter-specific interference between crop and weed (PRY= 1.17) . In case of weed, the inter-specific interference was very severe (PRY= 0.19). Thus the growth of wheat was influenced in the presence of weed and weed growth was suppressed in the presence of wheat when grown in mixed culture.

Ischaemum rugosum Salisb.

Rice (cv. Kranti) seeds were treated with various concentration (0-10 per cent) of leachaetes of the weed in petridish and observations on germination and growth were made six days after planting. It was observed that 10 per cent concentartion of the leachaete significantly reduced the germination percentage of root and shoot growth of rice. The effect on root growth was most severe. With a similar bioassay test, it was also revealed that it is having a strong auto allelopathic effect and the germination, root and shoot growth were significantly reduced with 5 and 10 per cent of the leachaete.The weed also significantly reduced the germination percentage, root and shoot growth of *E. colona*, exhibiting the presence of strong allelopathic effect on it. It was observed that *E. colona* has also a considerable allelopathic effect on *I. rugosum* by significantly inhibiting the root and shoot growth of seedlings. However, germination percentage was not significantly affected.

Echinochloa colona (L.) Link.

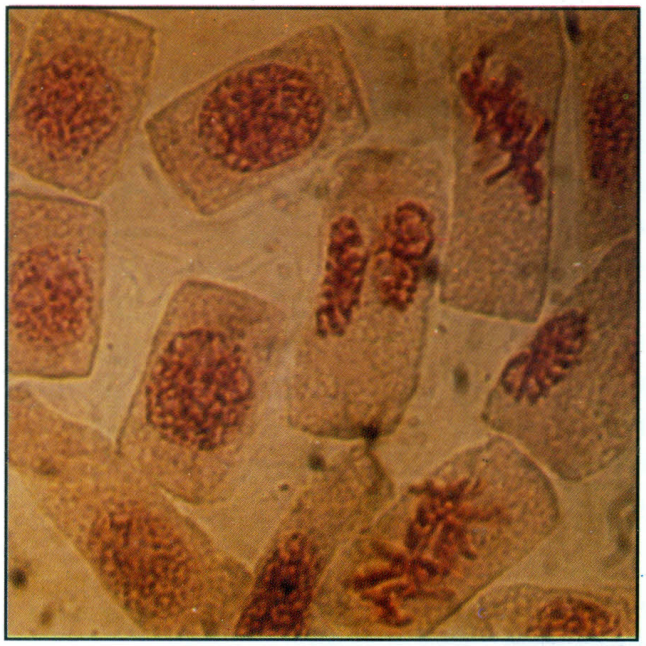
Rice and *Echinochloa colona* were grown in pure and mixed culture in equal densities (100 plants/m^2) in field condition. Different levels of nitrogen like 50,100,150 and 200 kg N/ha in addition to P_2O_5 : K_2O of 60 : 40 kg/ha were given as per the recommended practice. The observations on plant height and dry weight were recorded at 20,30 and 40 DAS. It was observed that the growth of rice at 20 DAS was not significantly different at different levels of nitrogen in pure as well as mixed culture. However, at 30 and 40 DAS, the growth was linear, the highest being at 200 kg/ha of N in pure and mixed culture but the growth of rice and *Echinochloa colona* in mixed culture were poorer as compared with their respective pure culture. The growth of weed was poorer than the crop at 20 DAS but the plants became taller at 30 and 40 DAS. The crop height and dry weight were more adversely affected in mixed culture than that of the weed from the relative yield total (RYT) values it was evident that, the adverse effect of the weed was more severe on rice at 30 and 40 DAS. Although the nutritional requirement of weed was more than that of rice as 30 and 40 DAS as evidenced by higher vegetative growth, there was no significant increase in dry matter production of crop with increasing N level suggesting, antagonistic effect of *E. colona* on rice.

Table-15: Plant relative yield (PRY) and relative yield total (RYT) values of rice and *Echinochloa colona (EC)* at different levels of nitrogen and growth

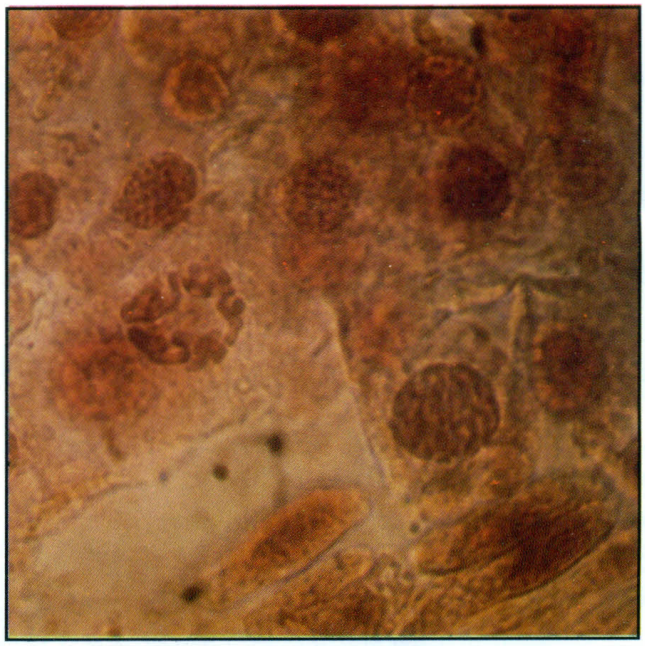
Nitrogen (kg/ha)	PRY of rice (DAS)			PRY of EC (DAS)			RYT of rice and EC (DAS)		
	20	30	40	20	30	40	20	30	40
50	0.91	0.83	0.84	1.04	0.87	0.76	0.98	0.85	0.80
100	0.81	0.94	0.89	0.91	0.82	0.73	0.86	0.88	0.81
150	0.96	0.93	0.92	1.04	0.95	0.94	1.00	0.94	0.93
200	0.96	0.94	0.89	0.97	0.84	0.94	0.97	0.89	0.92

Cytotoxic effect of *Echinochloa colona* leachaete on the cell and chromosome structure

Onion root tips *in situ* were treated with various concentrations (0-10 per cent) of *E. colona* leachaetes for 24 hours in coplin jars. The roots tips after fixation in 1: 3 acetoalchol for 24 h; were squashed in 1 per cent aceto-orcein following the standard cytological procedure and observed under the microscope. Visual observation showed that 5-100 per cent concentartion killed all the cells within 24 hrs and lower concentrations (1-4 per cent) killed the root tip within 72 hrs. Cells killed in higher concentration showed thickened and shortened chromosomes. The interphase and prophase chromatin appeared diffused and with reduced chromatin staining. There was a complete arrest of cell division. It appeared that higher concentrations acted like fixative quickly killing the cells. However, in lower concentration, the action was slower, and cells in various phases of division were noted with irregular arrangements and rotation of the divisional axes. As such the divisional plate was longitudinal rather than the normal transversional.



(a)



(b)

a) **Onion root tip cell treated with 1 per cent *E. colona* lechaete for 24 hrs, showing change in the divisional plane;**

b) **Effect of *E. colona* lechaete on onion root tip showing thickened chromosomes and diffused interphase nuclei. X- 1000.**

HERBICIDE RESIDUES IN CROP FIELDS

Sorghum root bioassay was performed to detect the atrazine and metribuzin residues in the soils of potato field. The rate of degradation of atrazine was found to be faster than that of metribuzin in the potato field. The half-life of the former herbicide was 21.4 days while that of the latter one was 24 days.

BIOLOGICAL CONTROL OF WEEDS

Biological control of weeds in rice and wheat

Two pathogens viz. *Trichoderma viride* and *Gliocladium virens* were tested in the laboratory conditions for their biological potential on different media against these weeds. Application of *Trichoderma viride* inhibited significantly the germination of *Echinochloa colona* and *Phalaris minor* by 55 and 80 per cent, respectively when grown on sorghum seeds.

Gliocladium virens inhibited significantly the germination of *P. minor* by 80 per cent when applied as soil treatment (grown on wheat grain) and by 94 per cent when applied as spray (grown on maize grains), while in case of *E. colona*, it completely inhibited the germination by 64 per cent when grown on sorghum seeds.

The above studies were also confirmed under field conditions. Application of *Trichoderma viride* as seed treatment + soil application (TV neem oil cake) + spray *Gliocladium virens* + mustard oil 10 per cent inhibited significantly the germination of *E. colona* with no adverse effect to rice.

Soil application of *Trichoderma viride* (100 g/m^2 grown on neemcake) followed by treatment of wheat seeds with treated seeds of wheat with Ecofit 4 g/kg seed and spray of *Gliocladium virens* 8 g/lt water immediately after sowing significantly reduced the germination and vigour of *P. minor* with no adverse effect on wheat.

Effect of *Gliocladium virens* and *Trichoderma viride* on *Parthenium hysterophorus*

Seed treatment with *Gliocladium virens and Trichoderma viride* fungus could reduce seed germination of *P. hysterophorus*. It also inhibited root/ shoot length. Addition of ammonium nitrate to the fungus enhanced the virulence of the fungus.

Survey of insect and non-insect fauna of weeds in Jabalpur and adjoining areas

In the survey, 42 insect species belonging to different orders were recorded from different weeds available in Jabalpur and adjoining areas. The turtle beetle on alligator weed was recorded first time from this area. The beetle is being further evaluated. Appreciable attack was noticed on *Physalis minima* vernacularly called '*Panchcuta*' by a coccinellidae beetle *Henosepilachna vigintioctopunctata* (F.). Mild infestation of *Bactra* sp. on *Cyperus rotundus* was observed. Four types of insects were recorded on *Lantana camara*, out of which tingidae bug (*Teleonemia scrupulosa*) damage was appreciable but overall impact of this exotic insect was not very severe. The attack was more during September-October

when the impact was visible in the form of brown leaves without chlorophyll inside.

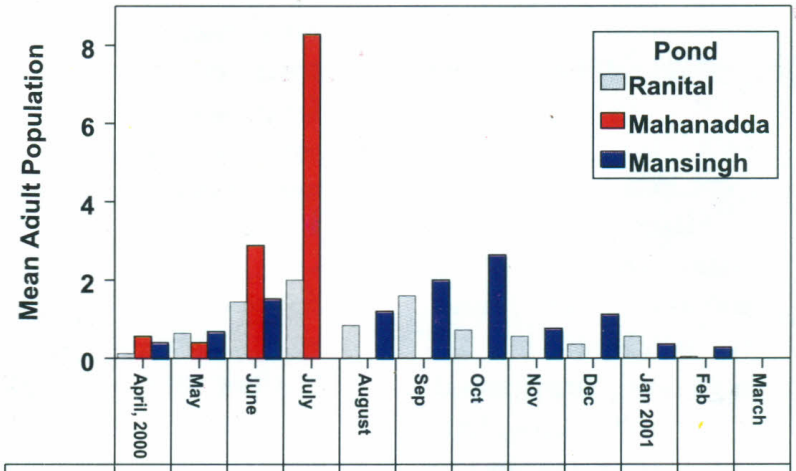
But by the end of October, attacked plants of lantana regained their lost vigour. On another waste land weed, *Calotropis procera* larvae of butterfly *Dannis plexipus* were recorded in the months of May and June. A blue coloured beetle identified as *Platycorynus* sp. was recorded during June to September on *C. procera*. The adult forms of this beetle were found to defoliate even big well-grown plants of *C. procera*. The attack was so severe that many plants were killed. An unidentified species of grey coloured weevil was also found to attack *C. procera*. Polyphagous species *Helicoverpa armigera* was recorded to feed on weed species *Chenopodium album, Cichorium intybus, Parthenium hysterophorus* and *Medicago hispida*. On the weed *Commeline* spp., larvae of butterfly *Ergolis ariadre* (Johanmex) were found to feed voraciously. At Jabalpur, turtle beetle *Aspidomorpha miliaris* was responsible for severe defoliation of the weed *Ipomoea fistulosa* in the months of September-October. On the weed *Cassia tora,* Lepidopterus insects - *Eurema hecabe* (Linn.), *Euproctis lunata*(Walk.), *Cosmophila erosa* (Hiibn.) and *Porthesia xanthorrhoea* Koll were found to attack on foliage. One unidentified Lepidoptera species was also found to attack on pods of *Cassia tora*.

Attack of shoot and root borer *Nupshera lenita* was also observed on *Parthenium hysterophorus*. The damage on the plants was more severe during September. At one place, hundred per cent damage was observed.

Population dynamics of *Neochetina* spp. on water hyacinth in different ponds

Monthly surveys were made in three ponds of Jabalpur on population of *Neochetina* spp. and corresponding damage to water hyacinth. The adult population varied month-to-month in all the three ponds. It was seen that population of adult in general washighest corresponding to the damage to leaves with few exceptions. It was also observed that even in a badly-infested pond wherein water hyacinth again established after the collapse due to action of *Neochetina* spp. , initially adults and larval population remained low and gradually increased corresponding to the damage. Mean adult population of *Neochetina* spp. varied from pond to pond and month to month. The highest population was recorded in Mahanadda pond in the month of July followed by Ranital and Man Singh' ponds. In Mahanadda pond, population build-up of the insect was so high that water hyacinth population completely collapsed and this weed remained unavailable even for sample purpose till March. In Ranital pond, population of *Neochetina* spp. remained erratic. Population gradually increased during May to June and than started to decline. However, adult population in Man Singh pond increased gradually from April to September and than gradually declined. The larval population remained in peak during April to June in Ranital and Mahanadda and May to August in Man Singh pond. In general, in all the ponds, population started to decline after August and continued till February.

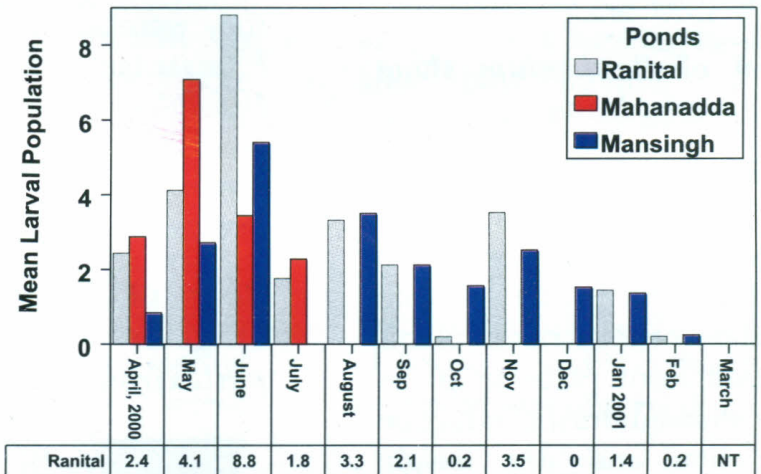
Adult beetles scrap the epidermis of leaf for food. The number of feeding marks varied month to month and pond to pond. In general, there was a gradual increase in number of feeding scars during April to July and decreased from November to March in all the ponds except in January in Ranital pond.



	April, 2000	May	June	July	August	Sep	Oct	Nov	Dec	Jan 2001	Feb	March
Ranital	0.1	0.6	1.4	2	0.8	1.6	0.7	0.6	0.4	0.6	0	NT
Mahanadda	0.6	0.4	2.9	8.3	NA	NA	NA	NA	NA	NA	NA	NT
Mansingh	0.4	0.7	1.5	NT	1.2	2	2.6	0.8	1.1	0.4	0.3	NT

Month

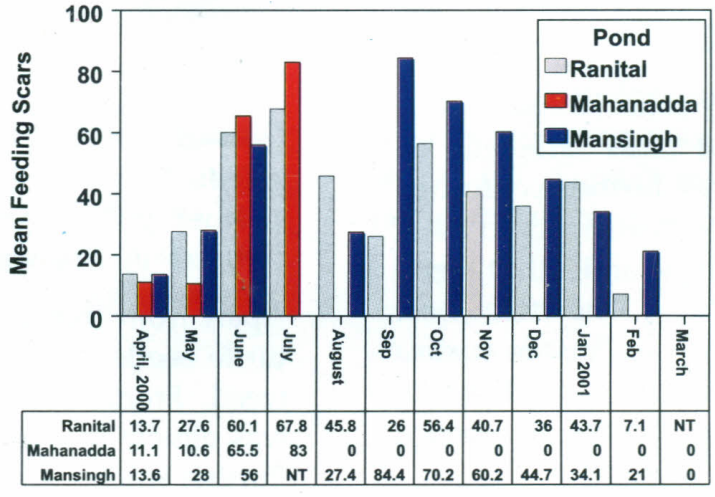
Mean adult population of *Neochetina* spp. in three ponds at Jabalpur



	April, 2000	May	June	July	August	Sep	Oct	Nov	Dec	Jan 2001	Feb	March
Ranital	2.4	4.1	8.8	1.8	3.3	2.1	0.2	3.5	0	1.4	0.2	NT
Mahanadda	2.9	7.1	3.4	2.3	NA	NA	NA	NA	NA	NA	NA	NT
Mansingh	0.8	2.7	5.4	NT	3.5	2.1	1.6	2.5	1.5	1.4	0.2	NT

Month

Mean larval population of *Neochetina* spp. in three ponds at Jabalpur



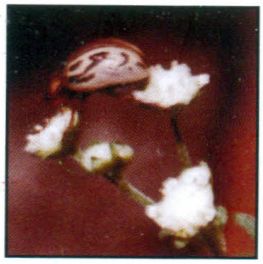
	April, 2000	May	June	July	August	Sep	Oct	Nov	Dec	Jan 2001	Feb	March
Ranital	13.7	27.6	60.1	67.8	45.8	26	56.4	40.7	36	43.7	7.1	NT
Mahanadda	11.1	10.6	65.5	83	0	0	0	0	0	0	0	0
Mansingh	13.6	28	56	NT	27.4	84.4	70.2	60.2	44.7	34.1	21	0

Month

Mean feeding scars of adult weevils *Neochetina* spp. in three ponds at Jabalpur

Establishment of Mexican beetle *Zygogramma bicolorata* in Jabalpur

Mexican beetle (*Zygogramma bicolorata*) was first released in Jabalpur near NRCWS farm on roadside in 1997 in a small area. By 1999, the beetle was found to establish in the area and suppressed the growth of *Parthenium hysterphorus*. This year population build-up started late in the end of August due to which overall impact was less. By now, this beetle has spread about 5 km in all the directions from the point of release.



Damage potential of *Parthenium* shoot and root borer *Nupserha lenita*

After the first monsoon, adults of shoot and root borer *Nupserha lenita* begin to emerge from the pupation. Adult population continued to increase till September and the rate of infestation of *Parthenium* plants by the borer varied from place to place. Preliminary study showed drastic reduction in flower production and dry weight production of the attacked plants.

DEVELOPMENTAL STUDIES OF INSECTS ON WEEDS

Development of the beetle *Henosepilachna vigintioctopunctata* (F.) was studied on *Physalis minima*. It was further confirmed that this insect could be developed on other hosts like tomato, brinjal and other weed locally called '*Datura*'. Therefore host specificity of the beetle on *Physalis minima* was ruled out and it was not considered an important insect for biological control programme against *P. minima*.

Life cycle study of an unidentified bug on *Croton bonpladianum* (a weed of wasteland area) was completed and the bug was also tried on other weed and crop plants but so far it has not completed its life cycle on any other plants. It shows that this bug may be host-specific to *C. bonpledanium*.

Life cycle studies of turtle beetle *Aspidomorpha miliaris* and *A. sanctacercecis* were completed on *Ipomoea fistulosa* weed. Further study revealed that *A. miliaris* can complete its life cycle on *Ipomoea fistulosa* and *I. batata* both but the development of another species of turtle beetle *A. sanctacercecis* was doubtful on *Ipomoea batata*. However, it was found that if newly hatched larvae were released on *I. batata*, they were able to complete the life- cycle on *I. batata* but if instars already developed on *I. fistulosa* were released on *I. batata* they were not able to feed. Unequivocally, *I. fistulosa* was preferable host for both the beetles.

Role of insects in suppression of alligator weed (*Alternanthera philoxiroides*)

Regular surveys were made to find out the insects damaging alligator weed in different ponds in Jabalpur as well as in the low land terrestrial area. Polyphagous insect-hairy caterpillar *Dicracia obliqua* was found to damage alligator weed in low land area along with another polyphagous insect *Helicoverpa armigera* in first week of October 2000.

Apart from this, an unidentified species of turtle beetle was found to feed on alligator weed. From October to March, this weed was almost free from any attack of insects. Further studies are underway.

Attack of *Cuscuta* on alligator weed

During the survey, in one of the ponds of Jabalpur, parasitic weed *Cuscuta* sp. was found to infest alligator weed. At one spot, the attack of *Cuscuta* sp. was so severe that the growth of alligator weed was very low in comparison to adjoining areas. After a month, the attacked spot along with parasitic weed sank down at that place. Parasitic weed was visible on alligator weed along side the borders of clear spot indicating its further spread on the adjoining area. This observation clearly reflected that parasitic weed *Cuscuta* may be used to suppress alligator weed at least up to some extent in ponds where after killing alligator weed it itself sinks down along with the damaged weed. This may be exploited at least in water bodies where there will be no fear of further spread of parasitic weed.

Herbicides against alligator weed

Herbicides such as 2,4-D, glyphosate, atrazine, metribuzin, metsulfuron methyl were tested against alligator weed. Glyphosate at 3.5 kg/ha gave 95 per cent control at 20 days after application (DAA) while the lower dose of 3.0 and 2.5 kg/ha killed only 80 and 75 per cent of this weed. No re-growth was registered in 3.0 and 3.5 kg/ha dose while at 2.5 kg/ha, re-growth appeared after 30 days of herbicide application. After spray up to three days, no effect was observed but after 4th day onwards, yellowing of leaf started and gradually leading to dryness.

2-4 D at 2.5 and 3.0 kg/ha gave 100 per cent control at 30 DAA while lower dose 1.5 and 2 kg/ha controlled 90 and 95 per cent growth of alligator weed. Some re-growth appeared in case of 1.5 and 2.0 kg/ha doses after 35 DAA. Another study revealed that metribuzin did not suppress alligator weed at 1,2,3 or 4 kg/ha. Re-growth appeared after two months of spray in all concentrations. Atrazine also did not show promising result when applied on alligator weed at all doses (2.0 to 3.5 kg/ha).

Preliminary testing done with metsulfuron-methyl gave 65,75,80 and 90 per cent control at 3.5, 4, 6 and 8 g/ha, respectively. No regrowth was observed.

PHYSIOLOGICAL STUDIES

Germination of *Parthenium* seeds under sub-optimal conditions with reference to common wheat

Experimental results (Table-16) confirmed that *Parthenium* seed germination was more sensitive than wheat (cv. Sujata) to temperature, pH, NaCl salinity and PEG osmoticum. This suggests that *Parthenium* is probably not as hardy a plant as it has been believed.

It was further confirmed that *Parthenium* seed germination was more sensitive than wheat (cv. Sujata) to trace elements and heavy metals such as Hg, Ni, Cr and Ar.

Table-16: Effect of temperature, pH, salinity and PEG osmoticum on germination of *Parthenium* and wheat

Treatment		Lethal dose for		Value inhibitory to germination (at P< 0.05)	
		Parthenium	Wheat	*Parthenium*	Wheat
Temperature (°C)	Low	10	5	20	15
	High	40	45	35	40
pH	Low	2	1	3	1
	High	13	>13	12	<12
Salinity (M, NaCl)		0.20	0.50	0.05	0.30
Ψw (MPa) of PEG osmoticum		-0.75	-1.00	-0.40	-0.75
Effect of heavy metals (mM)					
Mercuric chloride		1.0	>10.0	0.001	1.0
Nickel nitrate		1.0	>10.0	0.10	10.0
Potassium di-chromate		1.0	>10.0	0.10	10.0
Selanium trioxide		10.0	100.0	1.0	10.0
Arsenic dioxide		0.5	>1.0	0.1	1.0
Lead acetate		>10.0	>10.0	0.001	>10.0

Ageing of weed and crop seeds at ambient temperature

Representative seeds of crops like wheat, lentil, pea, linseed, clover (berseem) and mustard and weeds like *Parthenium hysterophorus, Echinochloa crus-galli,, Echinochloa glabrascence, Medicago denticulata* and *Phalaris minor* stored at ambient temperature during 1992 lost viability completely in 2-3 years, while seeds from the same lot preserved in a liquid preservative have been found viable (by May-June 2001). This proves to be very effective, cost effective and a simple technique for preservation of seeds for various purposes including for gene banks and for biodiversity conservation.

MECHANICAL WEED MANAGEMENT

Design improvements and prototype development of improved weeding tools and implements

Weeding tools of various designs have been developed for different crops and soil conditions. But for mass production, complete design details and prototypes of various designs of weeding tools are not available. This study was undertaken with the aim to draw complete design details and manufacturing design of selected designs of weeding tools. Prototypes of selected weeding tools and implements were developed after incorporating suitable design improvements. The brief details of design improvements, which are made in respect of different weeding tools in study, are as follows:

1. IARI Crescent hand hoe: The blade geometry of the weeder was modified keeping in view that the V - shape blades are more efficient in cutting of weeds and self cleaning of sharp edge. The detailed specifications of the weeder have been finalized to manufacture its prototypes.

2. Wheel hoe with large wheel (600 mm): The unit was developed based on the available review of drawing. The complete specifications of the weeder were drawn to fabricate its prototypes. The shape of handle was designed to suit the operator.

3. Wheel hoe with small wheel (300 mm): This weeder was fabricated based on its available drawing. But complete design detail of its frame and its attachment with blade was not shown in the drawing. The same was worked out and the complete design details of the unit was developed and prototype of the unit was fabricated.

4. IIT-WAM-82-2 Multi-weeder: This weeder was developed based on available review of literature. Its different attachments were made to make this weeder a versatile unit. The design details of handle of the weeder were developed.

5. NRCWS- Wick applicator for contact herbicides: This unit was improved upon and two prototypes were developed and fabricated for different row spacings of *kharif* and *rabi* crops. A moulded plastic container replaced the metallic chemical tank and flow control of liquid herbicide was added in the system.

The design of the above-mentioned weeding tools was refined and complete details of each implement were worked out sothat its prototype can be fabricated. In *rabi* 2000-2001, the improved weeders were evaluated under identical field conditions in mustard crop (Table-17).

The performance of three wheel hoes and multi-weeder was comparable based on weed contrôl efficiency attained, number of weeds removed per square metre but the performance of wheel hoe with big wheel was superior based on fresh weight basis and comparable performance was attained in case of rest of the three wheel hoe weeders.

The highest operation capacity in hrs/ha was attained in case of twin wheel hoe weeder of 15.46 hrs/ha (Table-17) followed by IIT design multi-weeder (20.08 hrs/ha), wheel hoe big wheel (21.65 hrs/ha) and wheel hoe small wheel (23.15 hrs/ha). Speed of operation of twin wheel hoe was also high i.e. 26.45 m/min followed by IIT design multi-weeder (23.85 m/min), small wheel hoe weeder (21.86 m/min), big wheel hoe weeder (21.45 m/min).

Table-17: Weed control efficiency (per cent) and operation capacity (hrs/ha) of different weeding tools and their impact on yield of mustard

Weeding tools	Weed control efficiency (%)	Operation capacity, (hrs/ha)	Speed of operation, (m/min.)	Seed yield (t/ha)
Wheel hoe (600 mm)	53.74	21.65	21.45	2.67
Wheel hoe (300 mm)	53.71	23.15	21.86	2.71
Multi weeder (IIT)	46.48	20.08	23.85	2.93
Crescent hoe (IARI)	39.79	29.33	33.49	2.44
Three tyne hand cultivator (grubber)	49.72	26.25	48.92	2.64
Crescent hoe (round blade)	45.38	32.57	37.77	2.46
Twin wheel hoe	54.46	15.46	26.45	2.76
No weed control measure	-	-	-	2.62

Engine-powered aquatic weed cutter/harvester for small water bodies

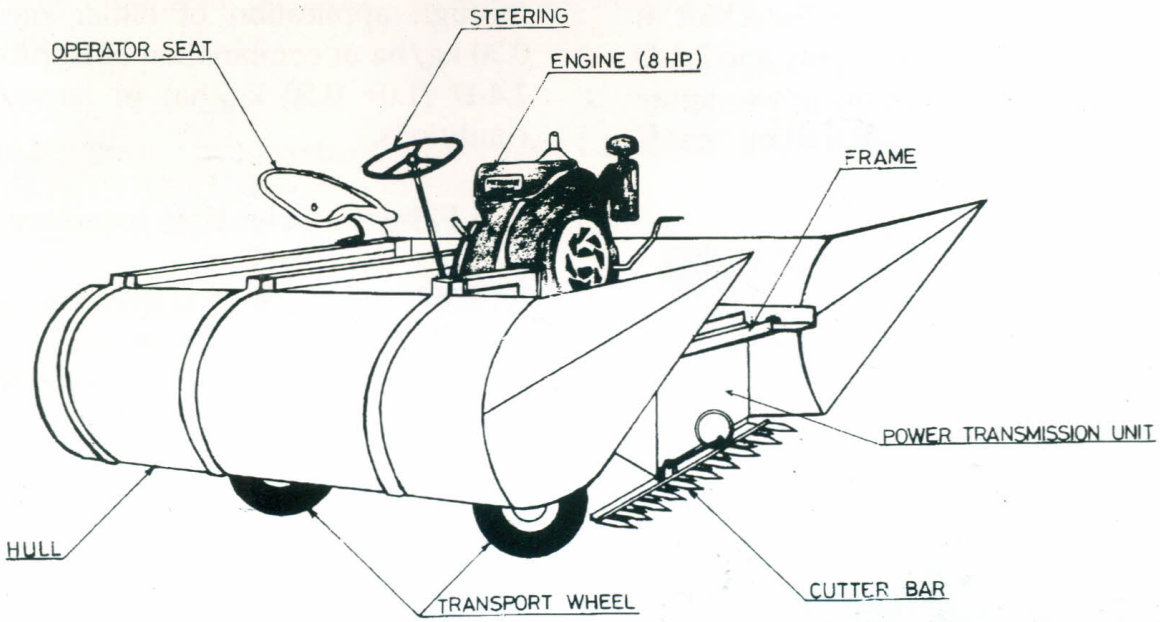
Based on the review of different designs of power aquatic weed cutters/harvesters, development of a small unit of power aquatic weed cutter/harvester was accomplished at NRCWS during this year for use in small and big water bodies, irrigation canals, ponds etc. An engine-operated power aquatic weeder on catamaran boat structure was designed and fabricated at the Centre's workshop. The power aquatic weeder developed 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, etc.

A 1.05 metre long cutter bar reciprocating type was used in the cutting unit. Power to the cutter bar was provided through a cam and a connecting rod arrangement. The four transport wheels are provided to carry the power aquatic weed harvester keeping in view the weight, shape and size of the machine. Power aquatic weed harvester/cutter can be toed behind the tractor vehicle. The total weight of the designed machine is 540 kg after its completion. Total weight of the machine with operator and extra load of weeds etc. should not be more than 600 kg.

The overall dimensions of the developed power aquatic weed cutter/harvester are: total length 285 cm, total width 235 cm, height 105 cm.

The two major considerations of design were that the centre of buoyancy of the power weed cutter was kept as close to ground as possible i.e. around 20 cm. Another consideration is to keep the centre of gravity of the power aquatic weed cutter at close to ground as possible i.e. about 42 cm from ground level.

The use of standard components and machine parts available in the market were used to give a finished and proper arrangement of vital components viz. Al. rudder plate, propeller fan mounting and power transmission system to propeller fan, engine mountings operator's sitting arrangement, cutter bar mounting and power transmission system, fabrication of hull and boat structure, main frame and adjustment for each vital components, power engaging and dis-engaging system for cutter bar and propeller fan.



Aquatic power weeder

Self-propelled power weeder

A need for power weeder was felt which can do the weeding operation fastly in equivalent working width of power driven seeder machine of tractor. Tractor mounted cultivators are also not suitable for weeding operation in standing crop. The work on design and development of a self-propelled power weeder for line-sown crops of 2.25 m width has been undertaken.

TRANSFER OF TECHNOLOGY

A. Demonstrations on proven weed management technologies

In *kharif*, 2000, demonstrations on proven weed management technologies in transplanted and drilled rice were laid out on eleven farmers' fields in eight villages. Infestation of *Echinochloa colona, Commelina communis* and *Cyperus* species locally known as *kani, sawa* and *motha*, respectively was observed. Application of butachlor at 1.5 kg/ha as pre-emergence spray and 2,4-D at 0.5 kg/ha as post-emergence spray proved very effective in controlling weeds in rice.

Visit of QRT to farmers fields

Seven field demonstrations were also conducted during *rabi*, 2000-01 in three villages of Jabalpur district to see the performance and profitability of proven herbicides *viz.* isoproturon at 1.0 kg/ha, 2,4-D at 0.75 kg/ha, isoproturon+2,4-D (1.0 +0.5 kg/ha) and metribuzin at 0.30 kg/ha on weed growth and yield of wheat. Fields were found infested mainly with *Phalaris minor, Medicago hispida, Chenopodiun album, Rumex dentatus, Lathyrus aphaca* and *Vicia sativa*. Results revealed that isoproturon failed to control *Phalaris minor* indicating the problem of resistance of this weed against isoproturon However, metribuzin controlled this weed effectively. Application of 2,4-D effectively controlled broadleaf weeds and mixture of 2,4-D with isoproturon gave broadspectrum weed control. All the herbicides used in demonstrations resulted in increase of 12 to 25 per cent in yield over farmer's practice. It may be concluded that broad-spectrum weed control in wheat crop, can be achieved through application of either metribuzin 0.30 kg/ha or combination of isoproturon + 2,4-D (1.0+ 0.50 kg/ha) in farmers' field conditions.

B. Farmers- scientists interface

NRCWS participated actively in the state and districts level *Kisan melas* to highlight the research activities on proven weed management technologies related to new herbicides tested prototypes of weed control tools and implements and biological weed control. Near about 20,000 farmers and other state agril. officials students, functionaries and entrepreneurs along with other dignitaries visited the Centre's stall and interacted with the scientists about the weed management technologies. Related folders and bulletins were also distributed to them. Scientists of the Centre have also actively participated in *kisan goshties* organized by JNKVV in different villages of Patan agar block and interacted with farmers.

EDUCATION AND TRAINING

Participation of scientists and other staff in trainings

Details of participation	Dates	Participating scientists
Recent advances in pulse production technology organized by TNAU, Coimbatore	September 13-October 31, 2000	Dr. V.P. Singh, Sr. Scientist
Techniques in plant genetic engineering organized by IARI, New Delhi	October 28-November. 11, 2000	Dr. D. Swain, Scientist
Integrated pest management organized by CCSHAU, Hisar	December 1-21, 2000	Dr. Sushilkumar, Scientist (SS)
National training on resource management under intensive cropping systems sponsored by JNKVV, Jabalpur	February 14 - March 15, 2001	Dr. R.P. Dubey, Sr. Scientist Dr. Anil Dixit, Scienist (SS)
Advances in crop physiology in relation to crop production organized by GBPUA&T, Pantnagar	November 27-December 17, 2000	Dr. J.S. Mishra, Scientist (SS)
Modelling growth and yield of crops organized by IARI, New Delhi	March 20, to April 09, 2001	Dr. M.B.B Prasad Babu, Scientist
Hindi translation organized by GCF, Jabalpur	April 4-7, 2000	Dr. M.S. Raghuvanshi, Tech. Off. Sh G.R. Dongre, Draftsman (T-4) Sh Manoj Gupta, Jr. Steno (Hindi)
Study leave for M.FA. (Master in Fine Arts) under Nagpur University, Nagpur	October 3, 2000-October. 2, 2002	Mr. V.K.S. Meshram, Artist

EXTERNALLY FUNDED PROJECTS

Title of the project	Principal investigator	Year of start	Year of completion	Total outlay (Rs.)	Funding agency
Biological control of *Echinochloa crusgalli* in rice and *Phalaris minor* in wheat crop	Dr. L.P. Kauraw, Pr. Scientist	Sepember, 2000	August, 2003	5,00,810/-	Cess Fund, ICAR
Developing strategies for the management of *Parthenium* weed in India using fungal pathogens	Dr. L.P. Kauraw, Pr. Scientist	July ,1997	March, 2001	1,39,949/-	CABI, UK
Phytotoxicity of allelochemicals to aquatic weeds	Dr. D.K. Pandey, Scientist (SS)	September, 2000	August, 2003	17,50,810/-	Cess Fund, ICAR
Role of insects in suppression of problematic allegator weed *Alternanthera philoxiroides* and testing of herbicides for integrated management	Dr. Sushilkumar, Scientist(SS)	September, 2000	August, 2003	7,50,810/-	Cess Fund, ICAR

AICRP- WEED CONTROL

The AICRP-WC started functioning since 1977-78 with 5 centres. Presently, it is operating with 22 centres located in different SAU's. The work done at these centres has been of immense value in the area of their jurisdiction. The major research results of the project are summarized as follows:

- Application of trifluralin 0.75 and 1.0 kg/ha as post-emergence spray before or after first irrigation alongwith a hand weeding provided good control of weeds and was also safe to wheat.
- In American cotton, glufosinate ammonium 0.75 and 0.90 kg/ha applied as directed spray at 6-8 weeks after sowing provided good control of weeds including perennials.
- Two sprays of paraquat (1.0 kg/ha) at two and three months after onset of monsoon economically and effectively controlled weeds in mango orchards.
- For effective weed management in groundnut (*rabi*) - rice (*kharif*) sequence, fluchloralin 1.5 kg/ha as pre plant incorporation for groundnut and oxadiazon 0.5 kg/ha as pre-emergence spary (2-3 DAT) proved superior in rice under labour scarcity condition.
- *Phalaris minor* and most of the non-grassy weeds in wheat could be controlled effectively by the application of sulfosulfuron at 25 g/ha applied at 30 days after sowing (DAS) and after first irrigation. Application before irrigation had adverse effect on wheat crop.
- *P. minor* appeared in the fields of Udhamsingh Nagar showed tolerance to isoproturon. Farmers were advised accordingly to change crop rotations and use alternate herbicides.
- Application of isoproturon or oxadiazon or trifluralin each at 0.5 kg/ha or alachlor or metolachlor each at 0.75 kg/ha as pre-emergence was found very effective in controlling weeds in mustard.
- Spraying 10 per cent copper sulphate solution in brinjal and tomato crops controlled effectively the parasitic weed *Orobanche*.
- Butachlor and pendimethalin did not persist beyond 25 and 65 days after herbicide application respectively in fingermillet-groundnut system in red sandy loam soil.
- In direct-seeded rice under puddled condition, butanil (butachlor + propanil) 1680 + 1680 g/ha and 2240 + 2240 g/ha applied at 10 DAS was found equally effective. Application of this herbicide at 10 DAS was more beneficial than its application at 15 DAS.
- Continuous use of isoproturon in wheat increased the population of *Vicia sativa* and *Lolium temulentum*, while in system like rice-wheat sequence, it encouraged the population of *Ranunculus arvensis*, *Alopecurus myosuroides* and *P. minor* in wheat.
- Efficacy of butachlor decreased with decrease in moisture level below field capacity in rice.
- Rice varieties Pankaj and Ranjit under transplanted conditions showed promise with better weed competitive ability.
- Cowpea grown for fodder upto 35-40 days as intercrop reduced weed infestation in upland rice.

- Closer planting (10 cm X 10 cm) of rice and pre-emergence application of butachlor (1.0 kg/ha) or anilofos (0.4 kg/ha) showed effective control of weeds in rice-rice sequence.
- Sequential application of isoproturon (0.75 kg/ha) and diclofop-methyl (0.5 kg/ha) produced maximum grain yield of wheat.
- In drilled fingermillet under rainfed condition, use of butachlor (1.0 kg/ha), isoproturon (0.562 kg/ha), anilofos (0.4 kg/ha) or 2,4-D Na salt (0.75 kg/ha) applied at 10 DAS gave grain yields comparable to hand weeding and saved Rs. 1200-1550/- towards weeding cost.
- Compost prepared from weeds like *Ageratum conyzoides* and *Legasia mollis* added more nitrogen than that from *Digitaria marginata* and *Dactyloctenium aegypticum* and could effectively be used in finger millet.
- A new problematic weed *Mimosa rubicalis* over elephant grass was observed in Kaziranga National Park.

Effect of pendimethalin for controlling weeds in onion

Infestation of *Mimosa rubicalis* in Kaziranga National Park

PUBLICATIONS

A. *Research Papers*

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Shukla, L., N.T. Yaduraju, T.K. Das and D.K. Singh. (2000). Effect of soil solarization on soil microflora. ***Ann. Plant Prot Sci.*** 8(2) : 218-222.

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weeds in moist tropical zones: banes and benefits", held on 2-4 November, 1999 at Kerala Forest Research Institute, Peechi, Thrissur, Kerela: 21

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Yaduraju, N.T and K.A. Gopinath (2000). Residual toxicity of herbicides and its management in crop production. ***Satsa Mukhapatra*** 4 : 31-40.

APPROVED RESEARCH PROJECTS DURING 2000-01

Project title	Name of the scientist and designation	Date of start	Date of completion
Biological weed management			
Microbial control of weeds using plant pathogens	Dr. L.P. Kauraw, Pr. Scientist	1997	2002
Survey of insect and non-insect fauna of weeds in Jabalpur	Dr. Sushilkumar, Scientist (SS)	1998	2002
Weed management			
Non-chemical approaches for weed management	Dr. V.P. Singh, Sr. Scientist	1998	2002
Weed management in vegetable crops	Dr. V.P. Singh, Sr. Scientist	1998	2001
Biology and ecology of problem weeds	Dr. J.S. Mishra, Scientist	1998	2002
Screening and development of new herbicides	Dr. Anil Dixit, Scientist (SS)		
Studies on herbicides-soil-microorganism interaction	Dr. MBB Prasad Babu, Scientist	1997	2000
Fate and phytotoxic efficacy of herbicides and its impact on nutrient cycle in soybean in relation to soil properties	Dr. K.K. Barman, Sr. Scientist	2000	2003
Weed physiology			
Physiological investigation on the effect of seed quality on crops and weed germination and stand establishment in relation to weed management	Dr. D. K. Pandey, Scientist (SS)	1999	2002
Herbicidal property of phytotoxins	Dr. D. K. Pandey, Scientist (SS)	1999	2002

Project	Name of The Scientist and designation	Date of Start	Date of Completion
Studies on the mechanism of herbicide tolerance /resistance of major crops and their problem weeds: physiological and genetic manipulation for greater crop protection and increasing herbicide efficiency	Dr. D. Swain, Scientist	1998	2003
Residue chemistry			
Studies on herbicide residue in soybean-wheat cropping system	Dr. S. Sondhia, Scientist	1998	2001
Studies on herbicide residue in maize-potato cropping system	Dr. S. Sondhia, Scientist	1998	2001
Mechanical weed management			
Design improvement and prototype development of different designs of improved weeding tools and implements	Er. H.S. Bisen, Pr. Scientist	1999	2003
Design , development and performance evaluation of self-propelled power weeder for line sowing crops, cutter for ponds	Er. H.S. Bisen, Pr. Scientist	1999	2003
Design, Development and performance evaluation of powered aquatic weed cutter for ponds.	Er. H.S. Bisen, Pr. Scientist	1999	2003
Transfer of technology			
Field demonstration of chemical and mechanical methods of weed control in cropped and non-cropped areas	Dr. P.K. Singh, Sr. Scientist	2000	2005

SRC, RAC, IMC AND QRT MEETINGS

Staff Research Council (SRC)

The Staff Research Council (SRC) of the Centre was constituted with the Director of the Centre as its chairman and all the scientists and technical officer of the Centre as the members and Dr. Sushilkumar as member secretary. The meeting was convened on 19-20 June 2000. In this meeting all the scientist presented their work done during 1999-2000 and proposed new experiments and projects to be undertaken. Chairman suggested to the scientists to use the guidelines of the perspective plan, ninth plan and RAC recommendations for their project proposals. It was also brought to their notice that multi-disciplinary approach should be followed while proposing new projects to achieve the desired goals.

Research Advisory Committee (RAC)

The meeting of Research Advisory Committee (RAC) was convened on 15 March 2001 under the chairmanship of Dr S. Sankaran, Ex-VC, TNAU. The members were Dr. O.P. Gupta, Ex-DRS and Dr. N.T. Yaduraju, Director a (Member Secretary). Dr. V. M. Bhan as Special Invitee also attended the meeting. Suggestions on formulation of research programme for the Centre were given by the members.

Institute Management Committee (IMC)

The meeting of the Institute management committee (IMC) was held on 28.02.2001 at NRCWS, Jabalpur under the chairmanship of Dr. N.T. Yaduraju, Director NRCWS, Jabalpur. The members were Dr. R.K. Malik, Professor Weed Science, CCSHAU, Hisar, Dr. K.L. Tiwari, Professor and Head, Deptt of Agronomy, JNKVV, Jabalpur, Dr. L.P. Kauraw, Sr. Scientist., Sh. S. Bilgrami, Sr. Finance and Accounts Officer, IGFRI, Jhansi, Sh. S.K. Parey, IJSC Secretary, Sh. A.K. Shrivastava, AFAO and Sh. Seshubabu, AAO. The committee discussed the agenda items on proposal for purchase of approved equipments and approved works to be taken up; proposal for purchase of need-based equipments under non-plan or other sources; purchase of infrastructural facilities for lecture hall, information hall and renovation of HIG quarters; condemnation and auction of vehicles; purchase of mini-tractor-cum-puddler; annual plan 2001-2002; progress of research work done and research programming; recruitment of administrative and technical posts; review of audit paras; proceeding of IJSC etc.

Quinquennial Review Team (QRT)

Quinquennial Review Team (QRT) in respect of NRC- Weed Science, Jabalpur was constituted vide council's letter no. 14-9/2000-IA-II dated 26.05.2000 with Dr. S. Sankaran Ex- Vice Chancellor (TNAU) as chairman and the members were Dr. O.P. Gupta, Dr. N.K. Jain, Dr. Gita Kulshrestha, Dr. R.C. Rajak and Dr. L.P. Kauraw. The QRT covered activities of NRCWS for the period of 1995-2000 (March). The Preliminary meeting of the QRT team was convened at the council with Dr. J.S. Samra, Deputy Director General (NRM) and Dr. P.C. Bhatia, Asstt Director General (Agro) on 14.09.2000 where DDG mentioned that earlier QRT recommendations should be kept in mind. There should be multi-disciplinary and farming system approach for weed management. Routine type of

experiments should be avoided. The NRCWS should take up national problems. The Centre should have project-based budgeting and the projects should have multi-disciplinary approach. Dr Sankaran suggested that NRCWS should take up national problem and there should be no duplication of work. He also stressed the need to have structural linkages with other national crop research institutes on rice, wheat, pulses, oilseeds, PDBC, CIAE and NRCs.

QRT members interacting with scientists

PARTICIPATION OF SCIENTISTS IN WORKSHOPS, CONFERENCES, MEETINGS AND SYMPOSIA

- **Dr(s) N.T. Yaduraju** and **A.K. Gogoi** attended conference on management of alien invasive species at M.S. Swaminathan Foundation, Chennai during 2-5 December, 2000.

- **Dr(s) L. P. Kauraw, P. K. Singh, D.K. Pandey, V.P. Singh, Sushilkumar, R.P Dubey, J.S. Mishra** and **M.S. Raghuwanshi**, participated symposium on biodiversity conservation-management and utilization for sustainable development at JNKVV, Jabalpur during 19-20 April, 2000.

- **Dr(s) P.K. Singh** and **V.P. Singh** participated in hindi rajbhasha workshop at NAARM, Rajendranagar, Hyderabad during 28-29 November, 2000.

- **Dr. D. K. Pandey** participated in international symposium on ageing - a challenge in the new millennium. Held at BHU, Varanasion during 10-12 November, 2000.

- **Dr(s) V.N. Saraswat, R.P. Dubey, Anil Dixit** and **Shobha Sondhia** attended the AICRP-WC workshop at HPKVV, Palampur (HP) during 13-15 May, 2000.

- **Dr. Sushilkumar** participated in workshop-cum-peer review on entomology and biological control held at Tropical Forest Research Institute, Jabalpur during 24- 25 September, 2000.

PERSONALIA

NRCWS, Jabalpur

Director
Dr. N.T. Yaduraju

Dr. V.N. Saraswat (Retired as Director on 31 July, 2000)
Dr. L.P. Kauraw (Incharge Director from 1 August to 4 September, 2000)

Scientists

Principal Scientists
Dr. B.T.S. Moorthy
Dr. L.P. Kauraw
Er. H.S. Bisen
Dr. A.K. Gogoi

Sr. Scientists
Dr. K. K. Barman
Dr. P. K. Singh
Dr. V.P. Singh
Dr. R. P. Dubey

Scientists - SS
Dr. D. K. Pandey
Dr. Sushilkumar
Dr. Anil Dixit
Dr. J.S. Mishra

Scientists
Dr. D. Swain
Dr. M.B.B. Prasad Babu
Dr. P.J. Khankhane
Mrs. Shobha Sondhia

Technical staff

Technical Officers
Dr. M.S. Raghuwanshi
Sh. Sandeep Dhagat

Technical Assistants
Sh O.N. Tiwari
Sh Pankaj Shukla

Photographers & Artists
Sh. Mukesh Bhatt
Sh. B. Mishra
Sh. V. K. S. Meshram

Field Assistants
Sh S.K. Parey
Sh J.N. Sen
Sh. K.K. Tiwari
Sh. S.K. Tiwari
Sh. S.K. Bose
Sh. G. Vishwakarma
Sh. Ajay Pal Singh
Sh. V.K. Raikwar
Sh. R.K. Meena
Sh. M.K. Meena

Farm Manager
Sh. R.S. Upadhyay

Draftsman
Sh G.R. Dongre

Drivers
Sh. Premlal
Sh. D.K. Sahu
Sh. Bhagunte Prasad

Library
Sh. R.N. Bharti

Mechanic
Sh M.P. Tiwari

Adminitratives and Finance staff

Asstt. Admn. Officer
Sh. Ch. Seshu Babu

Assistant
Sh. S.K. Sharma

Senior Clerks
Sh. J.P. Kori
Sh R. Hadge
Sh. T. Lakhera

Junoir Clerks
Sh. B.P. Uriya

Asstt. Fin. & Acc. Officer
Sh. A.K. Shrivastava

Stenographers (English)
Smt. Nidhi Sharma
Sh. A.K. Bhowal

Stenographer (Hindi)
Sh. M.K. Gupta

Supportinf Staff

Grade-III
Sh. Francis Xavier
Sh. Veer Singh
Sh. Raju Prasad
Sh. Jagoli Prasad
Sh. Jagat Singh

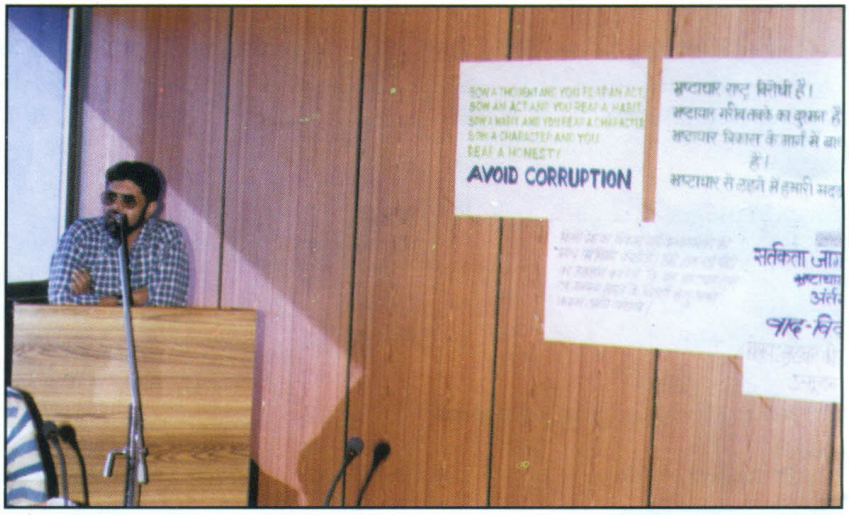
Grade-II
Sh. C.L. Yadav
Sh. S.L. Koshta
Sh. J.P. Dahiya
Sh. Madan Sharma
Sh. J. Vishwakarma
Sh. Anil Sharma
Sh. Ram Kumar
Sh. Naresh Singh

Grade-I
Sh. Sebasten
Sh. A.K. Tiwari
Shiv K. Patel
Sh. Pyare Lal
Sh. Sukha Singh
Sh. Gajjulal
Sh. S.C. Rajak

Security
Sh. Rajesh
Sh. Gangaram
Sh. Santosh Kumar
Sh. Santlal
Sh. M. Patel

MISCELLANEOUS ACTIVITIES

Hindi Diwas celebrated at the Centre



Dr. N.T. Yaduraju, Director, NRCWS addressing staff on

Aquatic power weeder for small water bodies being exhibited at *Kisan Mela*

विशिष्ट सारांश

वर्ष 2000–2001 में केन्द्र की अनुसंधानीय गतिविधियां मुख्यतः बहु फसलीय पद्धतियों में खरपतवारों की प्रधानता, विभिन्न फसलों में खरपतवार प्रबंधन, भूमि में शाकनाशी रसायनों के अवशेष तथा जैवकीय एवं यांत्रिकीय विधियों द्वारा खरपतवार प्रबंधन में योगदान आदि पर आधारित था। इस वर्ष के मुख्य परिणाम इस प्रकार हैं।

फसलीय पद्धति में खरपतवारों की प्रवृत्ति

विभिन्न फसलीय पद्धतियों में प्रमुख खरपतवारों की गतिविधा से सम्बन्धित जानकारी हेतु एक लम्बी अवधि का परीक्षण किया गया। जिसके तहत यह ज्ञान हुआ कि खरीफ मौसम में मक्का, ज्वार एवं सोयाबीन फसलों पर आधारित पद्धतियों में खरपतवारों का घनत्व पहले तीन वर्ष में घटा परन्तु चौथे वर्ष यह घनत्व थोड़ा बढ़ा। *कामेलिना कम्यूनिस* नामक खरपतवार का घनत्व ज्वार एवं सोयाबीन आधारित फसल चक्र की अपेक्षा मक्के पर आधारित फसलीय चक्र में कम आंका गया।

रबी मौसम के दौरान, *फेलेरिस माइनर* (मंडूसी) का घनत्व ज्वार एवं मक्का में एवं *एविना स्टरलिस* (जंगवी जई) मक्के एवं सोयाबीन पर आधारित चक्रों में अधिक पाया गया। जबकि *यूफो–रबिया जेनिकुलाता* एवं *सिचोरियम इनटाइबस* की सघनता सोयाबीन पर आधारित फसल चक्र में अधिक पाया गया। कुल खरपतवार की संख्या एवं इसका शुष्क वजन प्रति ईकाई क्षेत्रफल की दर से कमी, मक्का आधारित फसल चक्र में हुई।

लगातार धान–सरसों या मसूर के फसलीय चक्र को अपनाने से वर्षा के मौसम में सवा (*ईकोईक्लोवा कोलोना*) नामक खरपतवार की अर्थ पूर्ण वृद्धि दर्ज की गई। जबकि रबी के मौसम में फसल चक्र जिसमें सरसों के चक्र में गेंहू से *सिचोरियम इनटाइबस* की संख्या ज्यादा दर्ज की गई।

फसलों में खरपतवार प्रबंधन

वर्ष के दौरान खरपतवार की समस्या को ध्यान में रखते हुए विभिन्न फसलों में खरपतवार प्रबंधन पर परीक्षण किये गये।

आलू की फसल में मेट्रीब्यूजीन नामक रसायन (0.5 कि.ग्रा./हे.) को अंकुरण के पूर्व या जल्द अंकुरण पश्चात छिड़कने से खरपतवारों पर प्रभावशील रूप से नियंत्रण पाया गया, साथ ही साथ आलू की फसल की ज्यादा पैदावार भी दर्ज की गई। इसके अलावा ऑक्सी फ्यूओरफेर (0.24 कि.ग्रा./हे.) तथा एट्राजिन (1.0 कि.ग्रा./हे.) भी खरपतवार नियंत्रण में प्रभावी पाये गये।

सोयाबीन में पांच सप्ताह तक भूमि का सूर्यीकरण करने के साथ–साथ मेटोलाक्लोर नाम शाकनाशी को 0.75 कि.ग्रा./हे. की दर से छिड़कने से खरपतवारों की संख्या में अर्थपूर्ण कमी दर्ज की गई।

मध्यप्रदेश में सोयाबीन, चने के फसलीय चक्र में *यूफोरविया जेनिकुलाटा* (दूधी) नामक खरपतवार की समस्या आ रही है। इस चक्र में इस खरपतवार की प्रवृत्ति एवं उसके नियंत्रण पर परीक्षण किये गये। जिससे यह ज्ञात हुआ कि इसकी समस्या से सोयाबीन की उपज में 12–30 प्रतिशत तक की कमी आती है। इसके नियंत्रण हेतु अंकुरण पूर्व शाकनाशियों जैसे–मेट्रीब्यूजिन (0.50 कि.ग्रा./हे.) या ऑक्सी फ्लोरफेन

(0.20 कि.ग्रा./हे.) या अंकुरण पश्चात शाकनाशी जैसे इमाइजेथापायर (10–150 ग्रा./हे.) या क्लोरीम्यूरानइथाईल (12 ग्रा./हे.) या बेन्टाजोन (1.0 कि.ग्रा./हे.) का छिड़काव प्रभावी सिद्ध हुये।

धान की फसल में खरपतवार नियंत्रण हेतु नये शाकनाशियों पर विभिन्न परीक्षण किये गये जिससे ऐसिटाक्लोर (75–100 ग्रा./हे.) एवं पायरोसलफयूरान (20–25 ग्रा./हे.) को रोपाई के तीसरे दिन छिड़कने पर प्रभावी नियंत्रण दर्ज किया गया है।

इसी फसल के एक अन्य परीक्षण में, क्लोमाजोन नाम (200 ग्र./हे.) शाकनाशी को 2, 4–डी (270 ग्रा./हे.) शाकनाशी के साथ अंकुरण पूर्व छिड़कने से अच्छे परिणाम दर्ज किये गये है।

गेंहू की फसल में प्रभावी खरपतवार नियंत्रण हेतु विभिन्न शाकनाशियों का प्रयोग कया गया जिसके तहत आइसोप्रोट्यूरान (1.0 कि.ग्रा/हे.) सल्फोसल्फयूरान (25 ग्रा./हे.) क्लोडिनोफॉप (60 ग्रा./हे.), फिनाक्साप्राप (100 कि.ग्रा./हे.) एवं ट्रलका–क्सीडिम (35 कि.ग्रा./हे.) का 30 दिन के पश्चात छिड़काव करने से खरपतवारों पर प्रभावी नियंत्रण पाया गया।

ऐलीलोपैथिक अध्ययन

लेन्टाना की पत्तियों के अवशेष को 1–2 प्रतिशत (शुष्क पदार्थ) की दर से उपचार करने से तैरने वाले जलीय खरपतवार सूखने लगते हैं ये खरपतवार जैसे जलकुंभी, सेल्वीनिया, पिस्टिया, स्पायरोडेला, एजोला एवं लेम्ना हैं। वहीं इसके उपयोग से पानी के अन्दर वाले खरपतवारों जैसे हाईट्रिला सिरेटो फाइलम, नाजस 4–10 दिन में सड़ जाते हैं। इस पौधे की पत्ती के अवशेष में व्याप्त विषाक्त मौलिक अंशो को पृथक करने का अनुसंधान जारी है।

धान की फसल में गाजर घास के शुष्क पदार्थ को उपयोग करने से फसल की बढ़वार एवं उपज में अर्थपूर्ण बढ़त दर्ज की गई एवं इसके उपयोग से धान पर कोई विपरीत प्रभाव दर्ज नहीं किया गया, परन्तु गेंहू की फसल में इसका उपयोग करने से प्रतिकूल असर देखा गया।

भूमि में शाकनाशी अवशेष पर अध्ययन

आलू के अनुसंधानीय क्षेत्र की भूमि में एट्राजिन एवं मेट्रीब्यूजिन शाकनाशियों के अवशेषों का पता लगाने हेतु एक परीक्षण किया गया। जिससे यह ज्ञात हुआ कि एट्राजिनशाकनाशी का पतन भूमि मेंमेट्रीब्यूजिन की अपेक्षा जल्द होता है। एट्राजिन एवं मेट्रीव्यूजिन शाकनाशी भूमि में क्रमशः कम से कम 21 से 24 दिन तक रहते है।

जैवकीय खरपतवार नियंत्रण

खरीफ एवं रबी मौसम के मुख्य खरपतवारों जैसे सवां (*ईकाईनोक्लोवा कोलोना*) एवं चिरैया बाजरा (*फेलेरिस माइनर*) पर उनके जैविक नियंत्रण हेतु दो फफूंद प्रजाति (*ग्लाइक्लेडियम बायरेंस* एवं *ट्राइकोडरमा विरिडी*) का परीक्षण किया गया। *ट्रायकोडरमा* को ज्वार के दानों पर उगाकर उपयोग करने से सवां एवं चिरैया बाजरा नाम खरपतवार का नियंत्रण क्रमशः 55 एवं 80 प्रतिशत तक दर्ज किया गया।

ग्लायक्लेडियम वायरेंस नाम फफूंद को गेंहू के दानों पर उगाकर भूमि उपचार एवं मक्के के दाने पर उगाकर छिड़काव करने से चिरैया बाजरा पर क्रमशः 80 एवं 94 प्रतिशत अर्थपूर्ण नियंत्रण देखा गया। वहीं सवां के खरपतवार को नियंत्रण करने के लिए इसे ज्वार के दानों पर उगाकर उपयोग करने से 64 प्रतिशत तक का नियंत्रण दर्ज किया गया।

ट्राइकोडरमा विरिडी नामक फफूंद को 100 ग्रा./वर्ग मीटर की दर से (नीम के केक पर उगाकर) भूमि उपचार करना तथा गेंहू के दानों को ईकोफिट से 4 ग्रा./कि.ग्रा. बीज की मात्रा से उपचारित कर बोआई करने के पश्चात *गाईक्लेडियम* फफूंद का 8 ग्रा./लीटर पानी में घोल बनाकर

का अंकुरण पूर्ण छिड़काव करने से चिरैया बाजरा (*फेलेरिस माइनर*) के अंकुरण एवं उसकी वृद्धि में अर्थपूर्ण कमी आती है। इस विधि के उपयोग से गेंहू की वृद्धि पर फफूंद का सकारात्मक प्रभाव दर्ज किय गया।

सितंबर माह में किये गये सर्वेक्षण के दौरान यह देखा गया कि लेन्टाना कैमरा नामक खरपतवार पर एक कीड़ा, टिनजिडवग (टेलेन्मीया स्कूपलोसा) इसके पत्तों को क्षति पहुंचा रहा है। परन्तु बाद में यह भी दर्ज कया गया कि यह झाड़ी फिर से वृद्धि करने लगती है।

एक कष्टकारक खरपतवार, गाजर घास (पार्थेनियम हिस्टेरोफोरस) पर एक अन्य कीड़ा इसी दौरान नपसेरा लेनिटा क्षति करता दर्ज किया गया।

तालाबों में सर्वेक्षण के दौरान यह अंकित किया गया कि जलकुंभी पर पाये गये नियोकेटीना प्रजाति के बीटल अप्रैल से सितंबर तक अपनी संख्या बढ़ाते हैं वहीं जलकुंभी की पत्तियों पर क्षतिग्रस्त धब्बे उसी अनुपात में दर्ज किये गये।

एक बाहरी कीड़ा मेक्सीकन बीटल (जाइगोग्रामा बाईकोलोराटा) 1997 वर्ष में केन्द्र के पास गाजर घास को नष्ट करने हेतु उन पर छोड़े गये थे। उनके विस्तार पर एक अध्ययन से यह पता चला कि यह कीड़ा 5 किलो मीटर के घेराव में स्थापित हो चुका है।

अक्टूबर माह में सर्वेक्षण के दौरान, एक कीड़ा डायकेसिया आव्लीक्वा को एक अन्य कीड़े हेलीकोवेरपा आमीजेरा के साथ आल्टरनेनथेरा फिलीक्सीरायड खरपतवार की पत्तियों पर क्षति करते दर्ज किया गया। इस खरपतवार के नियंत्रण पर कसकुटा (अमरबेल) का भी सकारात्मक प्रभाव देखा गया।

यांत्रिक खरपतवार प्रबंधन

केन्द्र में ग्लायफोसेट जैसे शाकनाशी को सरसों एवं सोयाबीन फसल की कतारों में उगने वाले खरपतवारों के नियंत्रण हेतु एक यंत्र विक एप्लीकेटर विकसित किया गया है। यह यंत्र लम्बी अवधि वाले खरपतवारों, जिन्हें नष्ट करना काफी मुश्किल होता है, को नियंत्रण हेतु काफी उपयोगी सिद्ध हुआ।

तकनीकी हस्तातंरण

तकनीकी हस्तांरण कार्यक्रम के तहत केन्द्र में विकसित खरपतवार प्रबंधन/नियंत्रण पर आधारित तकनीकियों का क्षेत्र प्रदर्शन, किसानों को शिक्षित एवं जागरूक करने के उद्देश्य से तथा साथ ही इनके प्रयोग से होने वाले लाभ को प्रदर्शित करने के लिए उनके खेतों में किया गया जिनमें मुख्यतः रबी एवं खरीफ फसलों के उगने वाले प्रमुख खरपतवारों का कम लागत पर शाकनाशियों के प्रयोग द्वारा नियंत्रण

प्रमुख था। इसी कार्यक्रम के तहत केन्द्र के फसलीय एवं गैर फसलीय क्षेत्रों में गाजर घास के प्रकोप को ध्यान में रखते हुए किसानों, सरकारी एवं गैर सरकारी संस्थाओं एवं रोटरी क्लब के साथ मिलकर विभिन्न गाजर घास प्रभावित क्षेत्रों में जैवकीय विधि द्वारा इसके नियंत्रण पर प्रशिक्षण एवं प्रदर्शन कार्यक्रम चलाया गया तथा गाजर घास को नष्ट करने वाले कीड़े मेक्सीकन बीटल (जाइगोग्रामा बाइकोलोराटा) को हजारों की तादात में छोड़ा गया एवं स्थानीय लोगों में वितरित किया गया। इसके अलावा एक प्रमुख जलीय खरपतवार जलकुंभी के नियंत्रण हेतु निपोकेटिना आईकोरनी कीड़े भी छोड़े गये।

समन्वित अनुसंधान

अखिल भारतीय समन्वित खरपतवार नियंत्रण अनुसंधान कार्यक्रम के अंतर्गत फसलों एवं गैर फसलीय क्षेत्रों में स्थान विशेष के आधार हेतु अनुसंधानीय कार्यक्रम को 22 समन्वित केन्द्रो में किया गया। इसकी विवेचना निम्नलिखित है।

गेंहू की फसल में, सल्फोसल्फयूरॉन शाकनाशी को 25 ग्रा./हे. की दर से बुवाई के 30 दिन पश्चात छिड़कन से चिरैया बाजरा एवं अन्य गैर घासीय खरपतवारों पर प्रभावी नियंत्रण दर्ज किया गया।

सरसों में, आइसोप्रोटूरान या आक्साडायजान (0.5 कि.ग्रा./हे.) एवं ऐलाक्लोर या मेटोलाक्लोर (0.75 कि.ग्रा./हे. अंकुरण पूर्व) नामक शाकनाशी खरपतवार नियंत्रण में उपयोगी सिद्ध हुये। टमाटर एवं भटे की फसल में कॉपर सल्फेट के घोल का उपयोग (10 प्रतिशत) खरपतवार नियंत्रण हेतु विशेष रूप से ओरोवेन्की के नियंत्रण में काफी प्रभावी सिद्ध हुये।

सीधी बोनी धान में, आइसोप्रोट्रान नामक शाकनाशी का लगातार उपयोग करने से विसियासटाइवा एवं लोलियम टेमूलेन्टम नामक खरपतवारों की संख्या में बढ़ोत्तरी होती है वहीं धान–गेंहू के फसलीय चक्र लेने से गेंहू में रेननकुलस आरवेंसिस, एलोपिक्यूरस मायोजुरायट्स एवं फेलेरिस माइनर के घनत्व में वृद्धि की गई।

ऊँची भूमि की धान में काऊपी (चारा) को अंतः फसल के रूप में शुरू के 35–40 दिन तक लेने से खरपतवारों की बढ़वार में अर्थपूर्ण कमी आती है।

एजीरेटम कॉनीज्वायडिस एवं लिगेसिया मोलिस नामक खरपतवारों से तैयार की गई खाद से ज्यादा नाइट्रोजन मिलती है व इसे फिंगर मिलेट में कार्बनिक स्त्रोत के रूप में प्रभावी रूप से उपयोग किया जा सकता है।

कांजीरंगा राष्ट्रीय उद्यान में मायमोसा रूबीकेलिस द्वारा ऐलीफेंट घास पर विस्थापना दर्ज किया गया।

Annexure-I

Meteorological data during 2000-01

Months	Temperature Maxi. (°C)	Mini.	Relative humidity Morn. (%)	Even.	Wind velocity (km/hr)	Rainfall (mm)	Sunshine (hrs/day)
April, 2000	39.5	20.4	46	14	2.9	-	8.7
May	38.0	26.4	51	28	4.8	43.7	8.7
June	34.0	25.7	76	56	4.6	296.6	5.2
July	30.3	24.3	91	75	4.4	478.4	2.8
August	30.6	24.6	90	73	4.1	175.9	4.6
September	30.5	23.1	90	66	5.7	108.6	5.2
October	32.9	18.5	84	39	NR	-	8.8
November	30.3	13.0	85	30	NR	-	8.7
December	26.3	7.0	89	25	NR	-	8.5
January, 2001	23.6	8.4	89	40	NR	18.3	7.2
February	28.7	10.7	77	27	NR	3.6	9.0
March	32.6	16.6	73	25	NR	6.4	7.7
Total						1131.5	