ANNUAL REPORT

2001-2002

NATIONAL RESEARCH CENTRE FOR WEED SCIENCE
Jabalpur - 482 004 (MP)

Annual Report

वार्षिक प्रतिवेदन

2001-02

भाकृअनुप
ICAR

राष्ट्रीय खरपतवार विज्ञान अनुसंधान केन्द्र
(भारतीय कृषि अनुसंधान परिषद)
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(Indian Council of Agricultural Research)
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PREFACE

The year under report has been a historic one as the new Administrative-cum-Laboratory building was inaugurated on 09 April 2001 by the Hon'ble Union Minister for Agriculture Shri Nitish Kumar. The Centre faced certain constraints in the past such as lack of adequate laboratory space and other infrastructural facilities. With the coming up of the new building the Centre is poised for a new beginning. One of the major exercises done with the help of Research and Advisory Committee has been the prioritization of research projects. Keeping with the mandate of the Centre, priority has been given for basic, and strategic research. The emphasis has also been given for non-chemical methods of weed management involving cultural methods of weed control. New research areas include the evaluation of competitive crop cultivars, cover crops and zero tillage in weed management. Under AICRP-WC, reports of new infestation of *Phalaris minor* in Gujarat, *Orobanche* in Tomato in Karnataka and *Mimosa rubicaulis* in Assam have been made. It is a great pleasure for me to incorporate these new findings in the annual report of 2001-02.

I would like to thank Dr Panjab Singh, Secretary (DARE) and DG, ICAR; Dr J.S. Samra, DDG(NRM) and Dr Gurbachan Singh, ADG(Agro) for their interest, understanding and encouragement. The guidance and support received by Dr S. Sankaran, Chairman, RAC and other members of RAC and IMC is gratefully acknowledged.

I wish to express my sincere appreciations to the scientists of the Centre for their zeal and enthusiasm and I thank them for supplying the information for this report. I express my gratitude to the Editorial Committee comprising of Dr B.T.S. Moorthy, Dr K.K. Barman, and Dr M.S. Raghuwanshi for their painstaking efforts in compiling and editing the manuscript. Thanks are also due to Mr Sandeep Dhagat, Mr A.K. Bhowal and Mr. Manoj Gupta and other technical and administrative staff for their help in bringing out this publication.

(N.T. Yaduraju)
Director

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EXECUTIVE SUMMARY

The research activities of NRC for Weed Science during the year 2001-02 focused mainly on weed dynamics in cropping systems, integrated weed management in crops and cropping systems, effect of herbicides on soil biology, studies on crop-weed competition and allelopathy, biological and mechanical weed management and on-farm demonstration of proven weed management technologies. The salient findings are summarized as follows:

Weed dynamics in cropping systems

Inclusion of wheat in winter season in different cropping systems involving soybean, sorghum and maize in *kharif* season minimized the population of the weed *Echinochloa colona.* Lower density of *Commelina communis* was recorded in maize-based cropping system. During winter season, density of *Phalaris minor* and *Avena sterilis* ssp. *ludoviciana* showed an increase under sorghum-based cropping system.

Integrated weed management in crops and cropping systems

In soybean, a non-chemical method, soil solarization for a period of five weeks supplemented with pre-emergence application of herbicide metolachlor at 0.75 kg/ha or hand weeding proved effective in providing season-long weed control and higher seed yield.

Inclusion of cowpea as intercrop in between the normally spaced rows of maize significantly minimized the weed population and increased the grain yield of maize by 24.1 per cent (4.16 t/ha) over sole crop of maize (3.35 t/ha).

Vandana, a short duration upland rice cultivar of semi-tall plant type was found to be the best in terms of weed competitiveness. The variety because of its early seedling vigour and fast canopy closure was able to smother the weeds and yielded reasonably well with a single hand weeding. This variety may be recommended for sub-optimal management conditions.

In soybean, the herbicides metolachlor at 0.5 kg/ha, alachlor at 1.5 kg/ha and fluchloralin at 1.25 kg/ha effectively controlled the weeds and were comparable to hand weeding twice in terms of seed yield.

In transplanted rice, application of new herbicides pyrazosulfuron at 25 g/ha at 3 days after transplanting (DAT), fentrazamide at 4 DAT and cinosulfuron at 20 g/ha at 10 DAT proved more effective than the standard herbicide butachlor.

In direct-seeded rice, fenoxaprop at 60 g/ha, butanil (a ready mix formulation of butachlor and propanil) at 1.12+1.12 kg/ha, chlorimuron+metsulfuron methyl at 4.0 g/ha, pretilachlor at 0.75 kg/ha and pyrazosulfuron at 25 g/ha were promising in controlling weeds.

In wheat, application of a new herbicide carfentrazone-ethyl at 20-25 g/ha at 35 days after sowing (DAS) was found to decrease population and dry weight of weeds.

This herbicide can be a substitute of 2,4-D and metsulfuron methyl for the control of broad leaf weeds. This herbicide did not cause any phytotoxic effects on wheat crop.

Metsulfuron methyl with a surfactant at 4 g/ha and trisulfuron at 20 g/ha as post emergence application proved effective for the control of broad leaf weeds in wheat.

In soybean-wheat sequence, soybean sown after harvest of wheat crop under zero tillage condition yielded marginally higher than conventional tillage. Thus, zero tillage was better in terms of lower cost and higher yield of soybean.

Crop-weed competition studies

In wheat, the weed *Cichorium intybus* was most competitive (39.48 per cent loss of yield of wheat) due to its larger leaf area and biomass production. Wild oats was next in competitiveness causing a yield loss of 35.78 per cent.

In soybean during *kharif* season, *Echinochloa colona* was found to be more competitive (yield loss: 18-30 per cent) than *Euphorbia geniculata* (yield loss 13-19per cent).

Studies on allelopathy

Decomposed wheat straw extract was found to be highly toxic to germination, root and shoot growth of rice, but it has stimulatory effect on root and shoot growth of *Echinochloa colona*. *Phalaris minor* straw had also strong inhibitory effect on germination and root growth of rice and *E.colona*. Mixed decomposed straw extract of wheat and *P.minor* had strong inhibitory effect on germination of rice and *E. colona*.

Phenolic fraction of neem (*Azadirachta indica*) leaves and barks leachates at 15 ppm concentration caused irreversible damage to germination and growth of *E .colona* and proved to be highly toxic to the germination and growth of *Parthenium hysterophorus* and *Brassica napus*, but was found to be less toxic to rice.

Under standard test conditions, the allelo-chemical 0-anisic acid was lethal to aquatic weeds viz., floating species *Eichchornia crassipes*, *Salvinia molesta*, *Pistia stratiotes*, *Spirodela polyrhiza*, *Azolla nilotica* and *Lemna pausicostata* and submerged species *Hydrilla verticillata*, *Ceratophyllum demersum*. *Najas graminea* and *Chara* sp.at and above 5 mM. The treated plants were killed in about 5 days. Response of the aquatic weeds to m-anisic acid was almost similar. However, p-anisic acid though showed similar response, but had higher toxicity. Lethal dose for all the aquatic weeds was 2.5 mM. 0-Coumaric acid was lethal to aquatic weeds specially floating species at 5 mM and to submerged weeds at 1 mM.

Effect of herbicides on soil biology

In soybean, from the point of view of biological nitrogen fixation, metolachlor was a safer herbicide than fluchloralin and pendimethalin.

Biological weed control

The weed *Physalis minima* was attacked by a coccinellidae beetle *Henosepilachna vigintiopunctata* while *Lantana camara* was attacked by tinged bug (*Teleonemia scrupulosa*).

Mass rearing of the Mexican beetle *Zygogramma bicolorata*, a bio-agent for the control of the obnoxious weed *Parthenium hysterophorus* was done by making cages and mosquito nets. An awareness campaign to control *Parthenium* was successfully made involving various agencies and stakeholders in Jabalpur. Turtle beetle *Cassida* spp. was found to attack Alligator weed (*Alternanthera philoxiroides*), which is a becoming a serious problem weed in aquatic water bodies.

Transfer of technology

On-farm demonstrations on proven technologies were conducted on the crops viz., rice, soybean during kharif season. The herbicides pretilachlor and anilophos were found promising in controlling weeds in transplanted rice under farmers' field situations while in direct-seeded rice Almix was effective. The yield increase with improved practice over farmers' practice ranged from 8–56 per cent. In soybean, the new herbicides chlorimuron, chlorimuron plus fenoxaprop-p-ethyl and imazythpyr were promising with yield increases up to 250 per cent over farmers' practice.

AICRP- Weed Control

The little seed canary grass (*Phalaris minor*) infestation in wheat in central Gujarat have been received recently. The infestation is believed to have come through contaminated combine harvesters originating from infested areas of North West India. In hilly range and pasturelands of northern Himalayas, the species like *Ageratum conyzoides, A. houstonianum, L.* camera are shrinking the cultivable and grazing areas to a great extent. In northeastern states, a serious invasion of exotic weed *Mimosa rubicaulis* has been reported in the world famous Kaziranga National Park, Assam. The weed originally used as a cover crop to prevent soil erosion in tea garden has escaped into the forest areas. The weed, being very competitive has become successful in smothering local vegetation and creating food shortage to the herbivores inhabiting the forest. The weed is also alleged to be poisonous to animals. *Parthenium hysterophorus* is slowly invading the major crops of Gujarat and in banana plantation of Maharashtra. As much as 50 plant species were identified as host plant of *Cascuta sp.* in Assam. The herbicide resistance *P. minor* spreads very fast in the wheat growing areas of northern India produced by escaped plants. In the vegetable growing regions of Karnataka, the infestation of *Orobanchae* sp. is increasing in a alarming way more particularly in tomato.

The application of clodinofop 60 g/ha reduced the population of *P. minor* than the application of isoproturon 1.0 kg/ha in rice-wheat rotation. Use of preceding crops viz. Pea, oat, potato in uplands reduced the weed growth in succeeding direct seeded upland rice in north east region of the country. The application of pendimethalin 1.0 kg/ha to cumin crop (*rabi* season) should effect on succeeding pearlmillet (*kharif* season) grown in AER – 4 (Northern Plain and Central highlands, hot, semi-arid and eco-region).

1.0 INTRODUCTION

General

Considering the severe problem of weeds in cropped fields and the need for solving the problem in India, a coordinated weed control scheme on wheat, rice and sugarcane was initiated as early as 1952 in 11 states of the country by the ICAR 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 SAUs were involved in weed control research. Different state agricultural universities also initiated the syllabus for weed management courses at under graduate and post-graduate level to teach and train students and researchers in weeds and their management. It was in 1978 the weed research programme in the country was strengthened by establishing All India Coordinated Research Programme on Weed Control (AICRP-WC) by the ICAR in collaboration with the United States Deptt. of Agriculture. 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 for a period of five years each. The programme was continued with the plan funds of ICAR. This project assisted farming community through develpment of improved weed management technologies. The research programme tackled key problems of weed and their management in different agro-climatic zones. In VII Plan, it was decided to establish a National Research Centre for conducting basic as well as applied research in 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 Govt. of India for establishing NRCWS was conveyed vide DARE letter no. 13-13/85/AFC,dtd. Nov. 14,1986. The Centre actually came into existence on 22.04.1989.

Fig.-1: Shri Nitish Kumar, Hon'ble Union Minister for Agriculture Inaugurating The New Laboratory- Cum - Administrative Building

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.

AICRP-Weed Control

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

Staff and finance

NRCWS has a sanctioned cadre strength of 27 scientists, 27 technical, 17 administrative and 25 supporting staff. The staff position as on 31.03.2002 was 17 scientific including one post of RMP, 24 technical, 10 administrative and 25 supporting (Table-1). The annual budget of the Centre for the year 2001-2002 is indicated in Table-2. The Centre also generates resources through the sale of farm produce and testing of new herbicide formulations provided by the industries.

Table - 1: Staff position on 31 March 2002

Categories	Sanctioned	Filled
Research Management Position	01	01
Scientific	26	16
Technical	27	24
Administrative	17	10
Supporting	25	25
Total	96	76

Table - 2: Budget and expenditure for the financial year of 2001-2002

(Rs. in lakhs)

Budget heads	2001-2002	
	Budget estimate	Expenditure
Plan		
Establishment charges	20.20	20.20
Travelling allowance	4.00	3.46
Other charges	59.90	59.90
Works	51.00	51.00
HRD	2.90	2.90
Total	**138.00**	**137.46**
Non-plan		
Establishment charges	81.00	81.00
Travelling allowance	1.00	0.99
Other charges incl. equipments	42.00	41.98
Works (repair & maintenance)	1.00	1.00
Total	**125.00**	**124.98**

Infrastructural facilities

The Centre has well equipped laboratories to carry out the research in the areas of bio-control of weeds using microorganisms and insects, herbicide residues, 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.

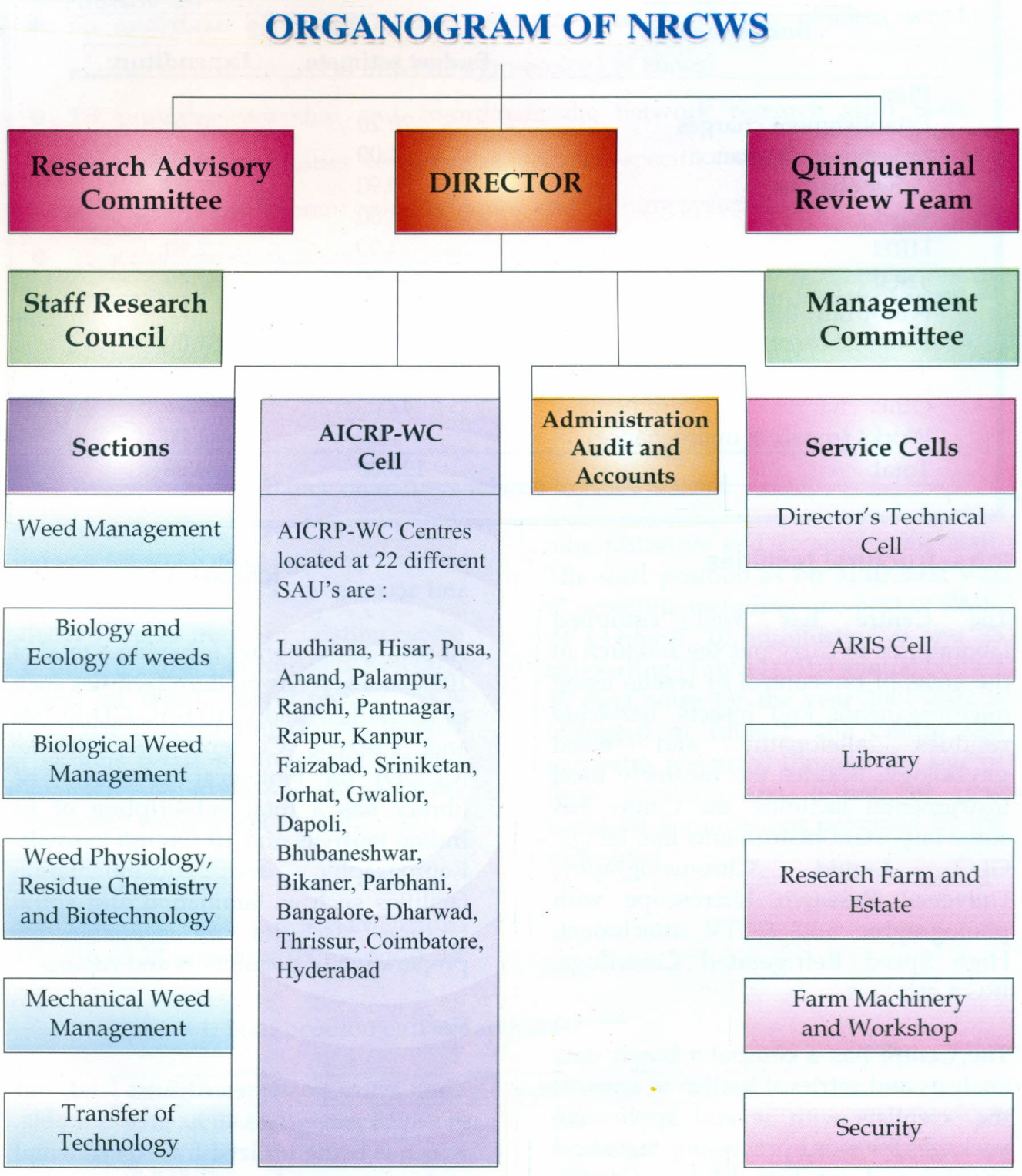
The Centre has a computer-based data analysis and retrieval system to support the scientists with several application packages for word processing, statistical analysis and graphics. Dial-up Internet accessing facility is also in operation. Most of the scientific staff has been provided with computer facilities for better presentation of their research results and other works. There is also a software package to facilitate for pay bill and account work.

At present the library is having a total of 1083 books. It has modern facilities such as CAB-PEST and CAB-SAC CD-ROMs and Current Contents on Diskette (CCOD) on biological sciences. The library 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

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.

Organizational set up



Works

Construction of road and gate in front of laboratory-cum-administrative building is on the verge of completion and the same is expected to be inaugurated soon. Immediately after the inauguration of road under construction, the approach to the main building will become very easy for employees and visitors.

Fig.-2: Construction of approach road and gate of the centre

2 RESEARCH ACHIEVEMENTS

Cropping system and weed management

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

A field experiment was conducted to study the changes in weed flora with soybean-wheat, soybean-chickpea, maize-wheat, maize-chickpea, sorghum-wheat and sorghum-chickpea cropping systems combined to four weed control measures *viz.*, weedy check, herbicide in rainy season followed by hand weeding (HW) in winter season.

During the rainy season, the weed population was reduced in all the cropping systems over a period of time. Population of *Echinochloa colona* was lower where wheat crop was taken in rotation. Low density of *Commelina communis* was recorded with maize-based cropping systems. Similarly lesser population of *Phyllanthus niruri* was observed under maize and sorghum-based systems. *Euphorbia geniculata* prevailed in soybean-based cropping system.

During winter season, density of *Phalaris minor* and *Avena sterilis* ssp. *ludoviciana* increased under sorghum-based cropping systems. Higher population of *Cichorium intybus, Avena sterilis* ssp. *ludovicia, Medicago* spp. and *Euphorbia geniculata* were recorded under soybean-based system. However, higher density of *Chenopodium album* and *Phalaris minor* was noted with maize-based systems.

During the rainy season, the lowest weed population and dry weight were recorded with maize-based cropping systems, while during winter season, lower weed population and dry matter production were recorded where wheat was grown in rotation. All the weed control treatments reduced the weed population and dry matter significantly over weedy check.

Effect of rice-based cropping systems on intensity and diversity of weed flora and their control

Density of *Echinochloa* showed an increase trend in rice-based cropping system but the increase was more pronounced either in continuous growing of mustard and lentil in the system or in rotation with wheat. The density of *Ammania baccifera* was also increased 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* spp., *Otellia* sp. 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 album.* Continuous growing of mustard or its inclusion in rotation with wheat increased the problem of *Cichorium intybus* over the period of time. Although cropping systems did not influence the total weed population but significantly recorded lower weed dry

matter where mustard crop was grown in rotation. All the weed control treatments gave significantly lower weed population and weed dry matter production. Herbicide during both the season recorded the lowest weed dry matter production (Table-3).

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				
Rice-wheat	10.57	8.32	7.13	3.98
Rice-mustard	11.21	8.15	7.13	4.85
Rice-lentil	10.49	9.21	7.14	4.21
Rice- mustard	10.86	7.57	7.12	4.38
Rice- lentil	11.84	9.59	6.99	4.25
Rice-wheat	11.56	10.10	7.31	5.39
LSD (P=0.05)	NS	1.51	NS	0.7
Weed control measure				
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

HW-Hand Weeding; H- Herbicide ; fb – followed by

Soil solarization – a technique of weed management in soybean

In soybean crop, soil solarization for a period of 5 weeks either with herbicide or hand weeding significantly reduced the weed population and its dry weight in comparison to herbicide treated plots, but it was at par with 2 hand weedings given at 20 and 40 DAS (Table-4). Lowest weed population and its dry matter were recorded with herbicide (metolachlor 0.75 kg/ha) applied in solarized plot for a period of 5 weeks. The maximum seed yield was recorded under solarization with metolachlor 0.75 kg/ha, which was significantly higher over either solarization or herbicide alone and weedy check (Fig.-3).

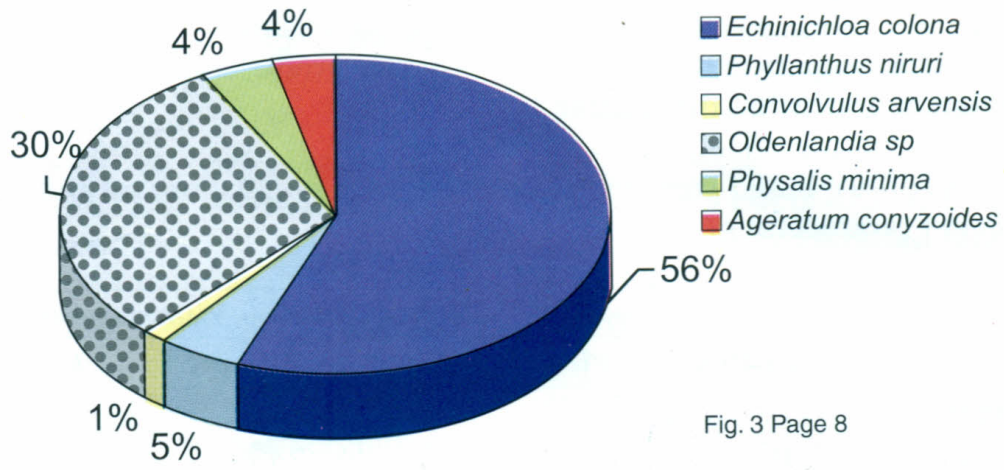


Fig. 3 Page 8

Fig.-3 : Relative distribution of weed flora in the experimental field

Table-4 : Impact of soil solarization and weed control measures on the weed growth and seed yield of soybean.

Treatments	Weed population (no./ m²)*	Weed dry weight (g/m²) *	Seed yield (kg/ha)
Soil solarization for 5 weeks	8.38	8.50	810
Metolachlor @ 75 kg/ha	13.59	8.64	731
Soil solarization+Metolachlor 0.75 kg/ha	5.04	3.21	1113
Soil solarization + hand weeding	5.96	3.91	940
Hand weedings (20 & 40 DAS)	10.64	4.50	949
Weedy check	24.82	16.89	413
LSD (P=0.05)	4.11	2.65	211

* Values subjected square root transformation

No-till drilling proved profitable in soybean under soybean-wheat sequence

No-till seed cum fertilizer drill (zero-till drill) was used for direct drilling of soybean after harvest of wheat by eliminating the tillage operations. Existing weeds were controlled by paraquat before sowing of soybean. The major weeds in the experimental field were *Phyllanthus niruri, Commelina communis, Echinochloa colona, Cyperus iria, Ageratum conizoides, Caesulia auxillaris* and *Oldenlandia* spp. No significant difference between zero-tilled (ZT) and conventional tilled (CT) conditions was observed in terms of weed population and its biomass. In general the soybean seed yield was poor due to continuous rains and delayed sowing. Seed yield was higher in ZT (421 kg/ha) than CT (375 kg/ha) but the difference was not significant. Metribuzin alone was not enough to control the weeds effectively, but when it was supplemented with one hand weeding (HW) at 30 days after sowing (DAS), the weeds were effectively controlled and seed yield improved significantly (Fig.-4). The results revealed that pulverized soil is not a

must for soybean grown after wheat. Zero tillage reduced 3-4 tillage operations as compared to conventional tillage and thus, it was found better than the conventional tillage in terms of lower cost and higher soybean yield (Table-5).

Table-5: Effect of tillage and weed control measures on weeds and seed yield of soybean

Tillage	Weed control measures			Mean
	Metribuzin 0.50 kg/ha + 1 HW at 30 DAS	Metribuzin 0.50 kg/ha alone	Weedy check	
Weed Population at 40 Days after sowing (per m²)*				
Conventional-tilled	6.27	11.57	11.78	9.87
Zero-tilled	5.87	9.87	10.43	8.70
Mean	6.06	10.69	11.11	
Weed dry matter at harvest (g/m²)				
Conventional-tilled	11.33	18.11	26.92	18.79
Zero-tilled	15.55	20.26	24.42	20.07
Mean	13.44	19.18	25.68	
Seed yield (kg/ha)				
Conventional-tilled	493	322	310	375
Zero-tilled	571	355	336	421
Mean	532	339	323	
LSD (P=0.05)	Weed Population	Weed dry matter*	Seed yield	
Tillage (T)	NS	NS	NS	
Weed Control (WC)	0.94	3.84	140	
T x WC	NS	NS	NS	

* Values subjected to square root transformation

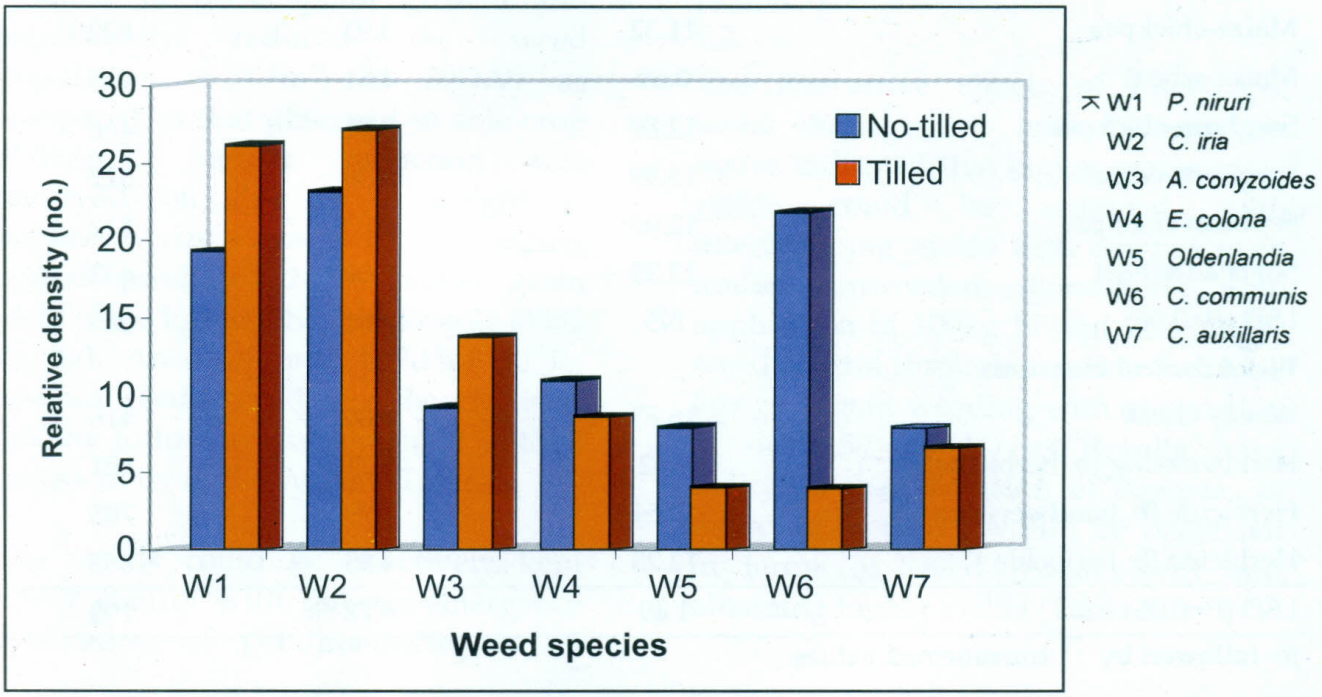


Fig.: 4 : Relative density of weed species under tilled and no-tilled conditions at 40 DAS

Weed dynamics under cropping systems

Distribution of weed flora under maize, sorghum and soybean-based cropping systems was studied in a long-term field experiment where the dominance of *Echinochloa colona, Commelina communis, Cyperus iria, Physalis minima* and *Oldenlandia* sp were significantly influenced under different cropping systems. The lowest population of *Echinochloa colona, Commelina communis, Cyperus iria,* and *Oldenlandia* spp were registered under maize-based cropping systems whereas; the lowest population of *Physalis minima* was noted under sorghum-based cropping systems. The highest population of *Physalis minima* and *Oldenlandia* sp. were recorded under maize and soybean based cropping systems, respectively as depicted in Fig.-5. The total population of weeds was not influenced significantly but the weed dry matter and soybean equivalent yield were significantly influenced by different cropping systems. The lowest weed dry matter and highest equivalent seed yield were recorded under maize-based cropping systems (Table-6). In general, the yield performance of crops was poor due to continuous heavy rains and delayed sowing.

Table-6 : Influence of cropping systems on weed growth and soybean equivalent grain yield

Treatments	Weed population (no./m^2) at 60 DAS *	Weed dry matter (g/m^2) at 60 DAS *	Soybean equivalent yield (kg/ha)
Cropping systems			
Maize-chickpea	11.32	3.93	892
Maize-wheat	9.69	4.51	935
Sorghum-chickpea	12.89	5.91	466
Sorghum-wheat	13.59	6.36	672
Soybean-chickpea	12.96	6.03	512
Soybean-wheat	13.35	5.99	433
LSD (P=0.05)	NS	1.81	283
Weed control measures			
Weedy check	16.83	8.89	416
Handweeding fb. herbicide	9.62	3.21	921
Herbicide fb. handweeding	10.51	4.79	705
Herbicide fb. herbicide	12.25	4.85	565
LSD (P=0.05)	1.49	0.78	195

fb- followed by ; * transformed values

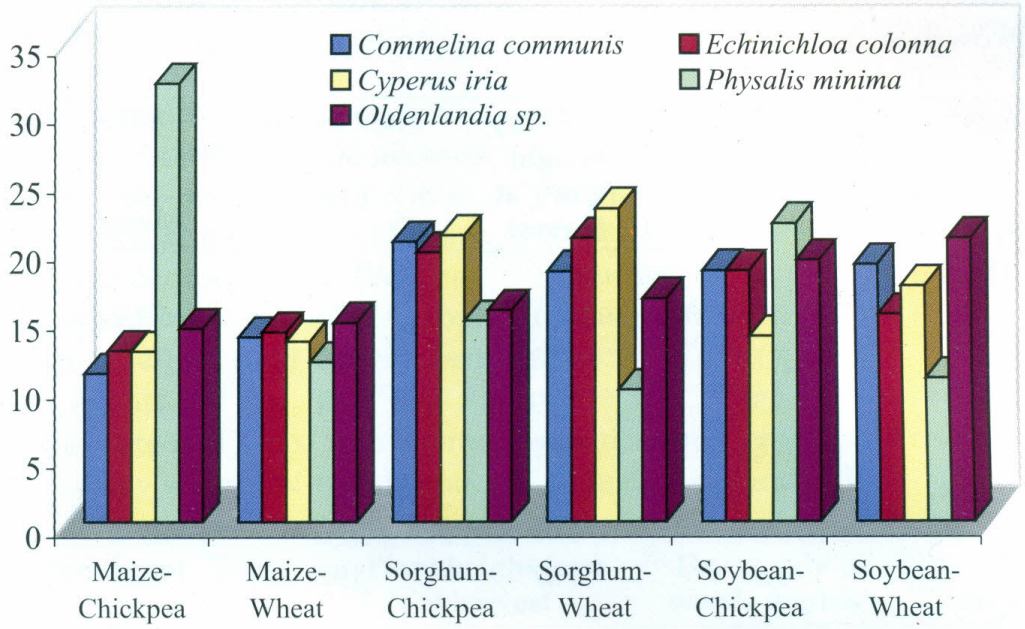


Fig.-5 : Effect of cropping systems on population of different weed species in rainy season

Intercropping

Role of intercrops on crop-weed competition and productivity of maize-based intercropping systems

The inclusion of cowpea as intercrop in between the rows (60cm.) of maize resulted in better plant growth and significantly reduced the weed population (6.31/m^2) at 60DAS as compared to that observed in sole crop (7.84/m^2). Similar reduction was observed on dry weed weight at harvest. Maize + cowpea intercropping system produced 24 % higher grain yield (4160 kg/ha) than maize sole (3352 kg/ha). An additional yield of 80 kg cowpea seeds could also be obtained leading to further improvement in total productivity of the system (Table-7).

The weeds could be effectively kept under control with the pre-emergence application of pendimethalin at 1.0 kg/ha followed by one hand weeding at 30 DAS and increased the grain yield by 49 % over unweeded control. Applying higher levels of nitrogen increased the crop growth, kept weeds at minimum and significantly improved the maize grain yield by 103% (100kgN/ha) over no nitrogen application (2210 kg/ha) (Table-7).

The interactive effects of intercrops, weed management and nitrogen on maize indicated that higher maize grain yields could be obtained with intercropping maize with cowpea even under unweeded condition with application of 100kg N and also under weed control through pendimethalin 1.0 kg+ one hand weeding with application of only 50 kg N/ha. Results have indicated that inclusion of cowpea, as intercrop in maize would be beneficial in terms of weed management and obtaining higher yields (Table-8).

Table - 7 : Effect of intercrops, weed management and nitrogen on weed growth, growth and yield of maize

Treatments	Weed (no/m²)* 60DAS	Weed dry weight (g/m²)* at harvest	Plant height of maize (cm)	Yield (kg/ha)	
				Maize	Intercrop
Intercropping system					
Maize sole	7.84	6.61	173	3352	-
Maize+Soybean	7.19	8.58	179	3148	57
Maize+Cowpea	6.31	5.29	198	4160	80
LSD(P=0.05)	0.63	0.79	23	420	-
Weed management					
Unweeded	9.69	9.09	176	2852	47
Pendimethalin 1.0kg/ha+1HW	4.54	4.57	192	4255	66
LSD(P=0.05)	0.30	0.65	14	433	-
Nitrogen levels (kg/ha)					
0	7.59	7.98	141	2210	68
50	6.92	5.96	197	3966	54
100	6.82	6.55	212	4484	48
LSD(P=0.05)	0.31	0.56	11	384	-

* Transformed values

Table – 8 : Interaction effect of intercrops, weed management practices and nitrogen on grain yield of maize (kg/ha)

Interactions	Unweeded check			Pendimethalin 1.0 kg/ha		
	0 N	50 kg N	100 kg N	0 N	50 kg N	100 kg N
Maize sole	1703	3426	2833	2241	4315	5592
Maize+Soybean	1500	3537	2852	1870	4500	4629
Maize+cowpea	1722	2648	5444	4222	5370	5555
LSD(P=0.05) =	456					

Maize sole Maize+Cowpea

Fig.-6 : Effect of intercropping on weeds

Crop cultivars and weed management

Upland rice is highly weed infestation prone and substantial yield losses occured due to weed competition. Growing of weed competitive cultivars is an important component in IWM for minimizing weed problems in this crop. Keeping this in view, field experiment was conducted during *kharif* 2001 season to screen the available pre-release and released varieties of upland rice for their weed competition abilities. In this study 8 upland rice varies *viz.*, Kalinga III, Heera, Vandana, JR 201, JR 75, JR-199, RR151-3 and RR51-1 were grown under unweeded, once hand weeded and weed free conditions.

Table - 9 a : Effect of weed management practices and crop cultivars on plant height, dry weight of weeds and grain yield of upland rice

Treatment	Plant height (cm) at harvest	Dry weight of weeds (kg/ha)*	Maturity duration (days)
Weed management			
Unweeded check	67.7	44.76 (2054)	
Hand weeding once (21 DAS)	71.2	32.56 (1082)	
Weed free check	68.4		
LSD(P=0.05)	NS	4.80	
Genotypes			
Kalinga III	83.3	40.20 (1702)	87
Heera	57.5	44.24 (2073)	82
Vandana	91.3	32.35 (1063)	93
JR201	81.5	36.24 (1336)	105
JR199	72.90	37.45 (1492)	93
JR75	60.7	42.34 (1867)	89
RR151-3	71.0	34.26 (1202)	100
RR51-1	54.7	42.25 (1808)	95
LSD(P=0.05)	6.98	4.91	

* Values subjected to square root transformation

Table - 9 b. Grain yield under different upland rice varieties and weed management

Treatments →	Unweeded	Hand weeding once	Weed free	Mean
Kalinga III	0.37	0.93	1.68	1.00
Heera	0.29	0.72	1.57	0.86
Vandana	0.47	1.66	2.13	1.42
JR201	0.03	0.22	1.16	0.47
JR199	0.28	0.94	1.93	1.05
JR75	0.12	0.31	1.08	0.50
RR151-3	0.47	1.60	2.14	1.40
RR51-1	0.03	0.11	0.85	0.33
Mean	0.26	0.81	1.57	
L.S.D.(0.05)	Weed management (W) 0.15	Varieties (V) 0.22	W at the same level of V 0.38	V at the same level of W 0.38

The results indicated that among the varieties tested, Vandana showed its superiority by suppressing weeds as evidenced by lower dry weight of weeds recorded in this variety (Table-9a&b). It has also recorded the highest grain yield (1.42 t/ha). The weed competitive ability is mainly due to its semi-tall plant height (91.25 cm) and early canopy development. Next best in terms of weed competitiveness and grain yield is RR151-3. The varieties like Heera, RR51-1 did not exhibit weed competitiveness because of their short stature. The maturity duration of different varieties varied from 82-105 days.

Evaluation of new herbicides in different crops

Bioefficacy of S-metolachlor and chlorimuron-ethyl in soybean

The herbicide S-metolachlor at low and 1250 g/ha controlled weeds effectively and comparable to hand weeding twice. The seed yields of the afore-said treatments were comparable. Weed control efficiency of different treatments varied from 24 to 44per cent as against 48 per cent in hand weeding. (Table-10). In another study, chlorimuron-ethyl at 9 g/ha (3-7 DAS) performed better when applied with surfactant than without surfactant treatment.

Table - 10 : Efficacy of S-metolochlor in soybean

Treatments	Rate of application (g/ha)	Weed count (No./m²)	Weed dry weight (g/m²)	Yield (kg/ha)
Untreated	-	10.11	46.00	340
S-metolachlor	500	8.88	32.17	568
S-metolachlor	750	8.18	28.00	580
S-metolachlor	1000	7.85	26.00	622
Fluchloralin	1250	8.31	26.00	612
Pendimethalin	1000	8.47	35.00	545
Alachlor	1500	7.99	28.00	578
HW 20 & 40 DAS	-	5.20	24.00	630
LSD (P=0.05)		0.31	2.10	136

Bio-efficacy of new herbicides in transplanted rice

Application of pyrazosulfuron at 25 g/ha, clomazone+2,4-D (175+270g/ha) at 3 DAT, fentrazamide at 210-240 g/ha applied at 4 DAT were superior to herbicide-butachlor. The cinosulfuron at 20 g/ha-applied at 10 DAT was also superior to butachlor.

Evaluation of post-emergence herbicides in direct-seeded rice

The herbicides *viz.* butanil (a ready mix formulation of butachlor and propanil) at 1.12+1.12 kg/ha and dithiopyr 120g/ha, fenoxaprop 60g/ha chlorinuron + metsulfuron 4g/ha ethoxysulfuron 15g/ha pretrilachlor 750g/ha, bentazone 1000 g/ha butachlor 1250 g/ha and pyrazosulfuron 25 g/ha as a post emergence and MON-46992 (butanil) at 1375, 2060, 2750 g/ha applied at 8-10 and 12-14 days after seeding were

evaluated for their efficacy in drilled rice. The results indicated that fenoxaprop, butanil chlorimuron+ metsulfuron, pretilachlor and pyrazosulfuron were promising for controlling weeds.

Bio-efficacy of carfentrazone-ethyl against broadleaf weeds in wheat

The major weed population of experimental plots comprised of *Phalaris minor, Chenopodium album* and *Medicago* sp. Other weed species of minor infestation were *Rumex dentata, Convolvulus arvensis* and *Vicia sativa.*

Application of carfentrazone-ethyl (40 WP) at 20-25 g/ha (35 DAS) was found to decrease weed population and weed biomass in comparison to weedy check. However, carfentrazone-ethyl in combination with 2,4-D application at 10+125g/ha was also effective in controlling broad-leaved weeds. The grain yield was the highest under weed free treatment followed by carfentrazone-ethyl at 25 g/ha alone and in combination with 2,4-D (Table-11). It may be attributed that carfentrazone-ethyl can be a substitute of 2,4-D and metsulfuron-methyl for the control of broadleaved weeds. There was no phytotoxic effect of carfentrazone-ethyl in wheat. It was also observed that carfentrazone-ethyl acts fast and was found to show its effect within 2-3 days after application.

Table - 11 : Effect of carfentrazone-ethyl against broadleaf weeds in wheat

Treatments	Rate of application (g/ha)	Weed count * /m²	Weed dry weight (g/m²)	Yield (t/ha)
Weedy check		12.77	85.64	4.20
Weed free treatment		0.71	-	7.70
2,4-D sodium salt	500	10.71	32.53	5.13
Metsulfuron-methyl	4	9.34	19.54	6.57
Carfentrazone-ethyl	15	9.37	20.12	5.87
Carfentrazone-ethyl	20	9.22	18.51	6.80
Carfentrazone-ethyl	25	8.82	13.09	7.00
Carfentrazone-ethyl + 2,4-D sodium salt	10 + 125	9.12	15.37	7.00
LSD (0.05)		0.81	5.69	1.12

* Values subjected to square root transformation

Evaluation of metsulfuron and triasulfuron in wheat

Metsulfuron with surfactant at 4 g/ha and triasulfuron at 20 g/ha as a post-emergence proved effective for the control of broad-leaved weeds in wheat.

Herbicide evaluation for controlling Alligator weed

Preliminary testing of herbicides 2,4-D, glyphosate, atrazine, metribuzin, metsulfuron methyl, paraquat and imazathapyr was carried out to find out an effective one against alligator weed. Study revealed that metribuzine, atrazine, imazathapyr, paraquat were not effective. Preliminary testing of glyphosate, 2,4-D and metsulfuron-

methyl showed promising results hence were taken further for detailed study.

Evaluation of glyphosate, 2,4-D and metsulfuron-methyl against alligator weed

Glyphosate at 1.5, 2.0, 2.5, 3.0 kg/ha was effective against alligator weed one week after application. Yellowing of leaves and stems started after 4th day onward and drying of parts in air as well as below the water started after 7th day onward. Glyphosate at 2.5 and 3.0 kg/ha gave 100 per cent control after two week of treatment while at 1.5 and 2.0 kg/ha; it could control only 75 and 80 per cent, respectively. But re-growth appeared after three weeks of treatment in these doses. No re-growth was noticed under the doses of 2.5 and 3.0 kg/ha.

2,4-D ethyl ester was tested at 0.5,1.5,2.0 and 2.5 kg/ha. After 6-8 hours of spray, white spots started to appear on leaves and stems and the leaves also fell down flat on the surface of water. 3rd day onwards, plants started and dying and by 6th day 100 % alligator weed could be controlled at the dose of 2.0, 2.5 kg/ha. Under these doses, no re-growth appeared. By 9h day of spray, 2,4-D @ 0.5 and 1.5 kg/ha could control the weed by 90 and 95 per cent, respectively. But some re-growth appeared after 20 days of treatment in these doses. Metsulfuron- methyl started to show its little visual effect in the form of yellowing of leaves after 6th day onward. Plants start to drying from 10th day onward. By 18th day 100 % control was achieved at 8 g/ha, while at 3.5, 4 and 6 g/ha, it gave 70,75 and 85 % control, respectively. No re-growth appeared at 8 g/ha while at 3.5, 4 and 6 g/ha, some re-growth appeared.

Analysis of glyphosate, 2,4-D and metsulfuron methyl residues in water

Water samples of 300 ml were collected from each replication and mixed thoroughly. The water samples from treated alligator weed tubs were collected at 0,1,2,3,4,8,16,32 and 56 days of herbicide application. Residue of this treated water was estimated thorough petri dish aqueous assay.

Glyphosate applied at 1.5 kg/ha showed 0.205 ppm residue at 1 DASp (days after spray) which was disintegrated to 0.042 ppm after 32 DASp. But after 56 DAA, it was not detectable, whereas its application at 2.0 kg/ha showed 0.405 ppm residue at 1 DAS which was reduced to 0.013 ppm after 56 DASp. The application at 2.5 kg/ha showed 0.429-ppm residue at 1 DAA which was reduced to 0.019 ppm after 56 DAS. Whereas its application at 3.0 kg/ha showed 0.470 ppm residue at 1 DASp which was disintegrated to 0.77 ppm after 56 days. Water samples collected at 56 DASp showed 0.077 (3.0 kg/ha), 0.019 (2.5 kg/ha) and 0.013 (2.0 kg/ha) residue that was disintegrated to not detectable limit after 56 DASp at the rate of 1.5 kg/ha. 2,4-D applied at 0.5 kg/ha showed 0.046-ppm residue at 1 DAA (days after application), which disintegrated fast, and at 32 DAA it was not detectable. Whereas its application at 2.0 kg/ha showed 0.109 ppm residue at 1 DAA which was reduce to 0.009 ppm after 326 DAA and was not detectable after 56 DAA. Application at 2.5 kg/ha showed 0.131-ppm residue at 1 DAA, which was disintegrated to 0.013 ppm after 32 DAA. No residue was detectable after 56 DAA.

Metsulfuron methyl applied at 3.5 g/ha showed 0.016-ppm residue at 1 DAA

but after 16 DAA no residue was detectable. Its application at 4 g/ha showed 0.045-ppm residue at 1 DAA but no residue was detectable after 32 DAA, where as its application at 6 and 8 g/ha showed (0.134 and 0.1975 ppm residue at 1 DAS but after 56 DAS, no residue was detectable.

Effect of method of planting and herbicides on weed control in potato

Field experiments were conducted to find out the effect of methods of planting and time of metribuzin application on weed growth and yield of potato. The experiment was laid out in split-plot design with the combination of 4 methods of planting *viz.*, flat sowing, flat sowing followed by earthing at 40 DAP sowing in furrows + earthing and sowing on ridges in the main plots and three methods of weed control *viz.* metribuzin application as pre-emergence and early post-emergence along with weedy check in sub plots with 3 replications. The field was infested mainly with broad leaf weeds like *Chenopodium album* (21.21%), *Medicago hispida* (15.32%), *Lathyrus aphaca* (13.50%), *Vicia sativa* (8.85%), and *Cichorium intybus* (7.50%), grassy weeds like *Phalaris minor* (18.41%) and *Avena sterilis* ssp. *ludoviciana* (5.08%) and others (10.13%).

Fig.- 7 : Effect of methods of sowing and herbicides application in potato

Table - 12 : Effect of different treatments on total weed population/m², weed dry matter at harvest (g/m²) and tuber yield of potato (t/ha)

Treatment	Total weed * population (no./m²)		Total weed dry weight at harvest (g/m²)	Tuber yield (t/ha)
	40 DAS	Harvest		
Method of sowing				
Flat sowing	7.82	7.53	14.19	20.75
Flat sowing *fb* earthing at 40 DAP	6.05	3.81	8.95	21.27
Sowing in furrows+ earthing	8.18	7.34	15.18	19.09
Sowing in ridges	6.19	7.15	11.46	21.47
LSD (P=0.05)	NS	2.11	2.85	NS
Weed Control				
Metribuzin 0.5 kg/ha (Pre-em.)	4.92	5.93	7.28	24.51
Metribuzin 0.5 kg/ha (Post-em	7.62	6.19	12.29	19.86
Weedy check	8.63	7.25	17.76	17.55
LSD (P=0.05)	0.84	0.53	1.48	1.88

* Values subjected to square root transformation

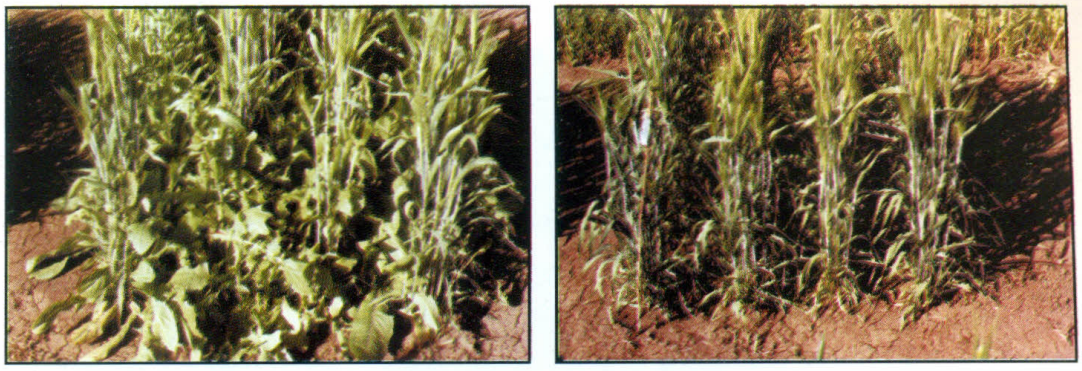


Fig.-8 : Competitive behaviour of winter season weeds in wheat

Effect of phosphorous and sulfur supply on competition between soybean and two weed species

A field experiment was conducted in microplots to study the effects of phosphorus (P) and sulphur (S) supply on interspecific competition between two weed species (*Euphorbia geniculata* and *Echinochloa sp*) and soybean. Each experiment had 12 treatments consisting of three species combinations (soybean monoculture, weed monoculture, soybean and weed mixture in equal proportions) and four levels of P and S supply (0 kg P_2O_5 ha^{-1} + 0 kg S ha^{-1}, 80 kg P_2O_5 ha^{-1}, 40 kg S ha^{-1}, and 80 kg P_2O_5 ha^{-1}+ 40 kg S ha^{-1}) in a randomized block design, with three replications.

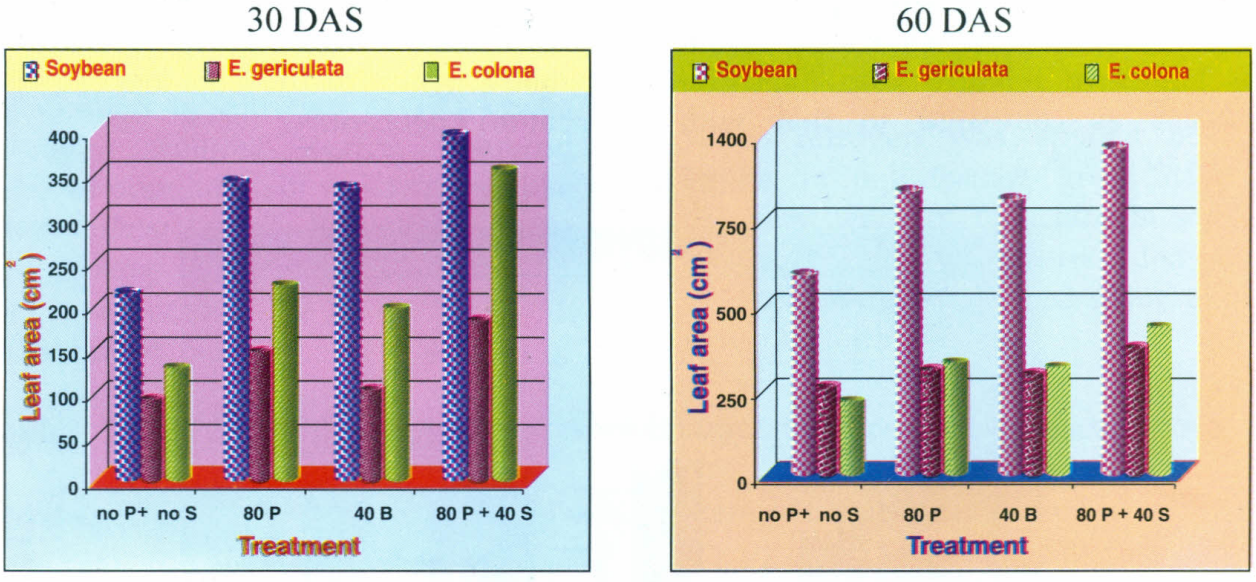


Fig.-9 a : Effect of P and S supply and competition on the leaf area of soybean, *E. colona* and *E. geniculata*

Presence of weeds throughout the growth period caused 28.4 % reduction in tuber yield. Different methods of planting did not influence the tuber yield of potato but flat sowing + earthing up at 40 DAP significantly reduced the weed biomass as compared to other methods. Metribuzin 0.50 kg/ha as pre- emergence spray produced the lowest weed biomass and highest tuber yield (24.51 t/ha) (Table-12).

Crop-weed competition studies

Competitive behaviour of winter season weeds in wheat

Competitive behaviour of different winter season weeds in wheat was studied under field conditions in micro plots (1 m^2). Results revealed that *Cichorium intybus* produced the maximum dry matter at harvest followed by *Avena sterilis* ssp. *ludoviciana*. The lowest weed dry matter was accumulated with *Asphodelus tenuifolius*. The highest grain yield of wheat was recorded under weed free condition. Among different weed species *Cichorium intybus* was the most competitive and significantly reduced the grain yield of wheat by 39.48 % as compared to weed free check (Table-13). This was followed by *Avena sterilis* ssp. *ludoviciana* (35.78 %). The higher competitive ability of these weeds is due to their more leaf area and higher biomass production. The least competition weed was *Asphodelus tenuifolius* (11.57%).

Table-13 : Effect of different weed species on weed bio-mass, yield attributes

Weed species	Leaf area/plant (cm^2)				Grain yield (t/ha)	Weed biomass* (g/m^2)	Reduction in seed yield due to weeds (%)
	60 DAS		90 DAS				
	Crop	Weed	Crop	Weed			
Asphodelus tenuifolius	311	27	272	19	5.60	8.18	11.57
Avena sterilis ssp. *Ludoviciana*	220	101	126	191	4.07	15.09	35.78
Chenopodium album	234	70	203	142	5.07	10.67	19.99
Cichorium intybus	212	103	122	228	3.83	28.45	39.48
Lathyrus aphaca	276	24	236	22	5.37	9.15	15.25
Medicago hispida	229	39	175	109	5.00	10.18	21.05
Melilotus alba	335	16	197	41	4.93	9.67	22.11
Phalaris minor	219	67	130	87	5.07	10.34	19.99
Vicia hirsuta	285	28	252	67	5.47	9.88	13.67
Vicia sativa	299	35	243	78	5.43	11.85	14.21
Weed free	349	-	375	-	6.33	0.71	--
LSD (P=0.05)	45	28	70	49	0.51	3.68	--

DAS =Days After Sowing,

* Values subject to square root transformation $\sqrt{(X+0.50)}$

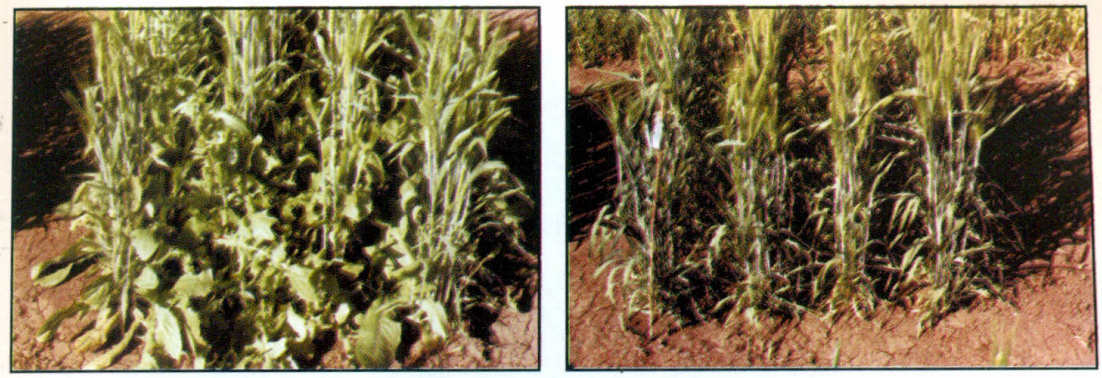


Fig.-8 : Competitive behaviour of winter season weeds in wheat

Effect of phosphorous and sulfur supply on competition between soybean and two weed species

A field experiment was conducted in microplots to study the effects of phosphorus (P) and sulphur (S) supply on interspecific competition between two weed species (*Euphorbia geniculata* and *Echinochloa sp*) and soybean. Each experiment had 12 treatments consisting of three species combinations (soybean monoculture, weed monoculture, soybean and weed mixture in equal proportions) and four levels of P and S supply (0 kg P_2O_5 ha^{-1} + 0 kg S ha^{-1}, 80 kg P_2O_5 ha^{-1}, 40 kg S ha^{-1}, and 80 kg P_2O_5 ha^{-1}+ 40 kg S ha^{-1}) in a randomized block design, with three replications.

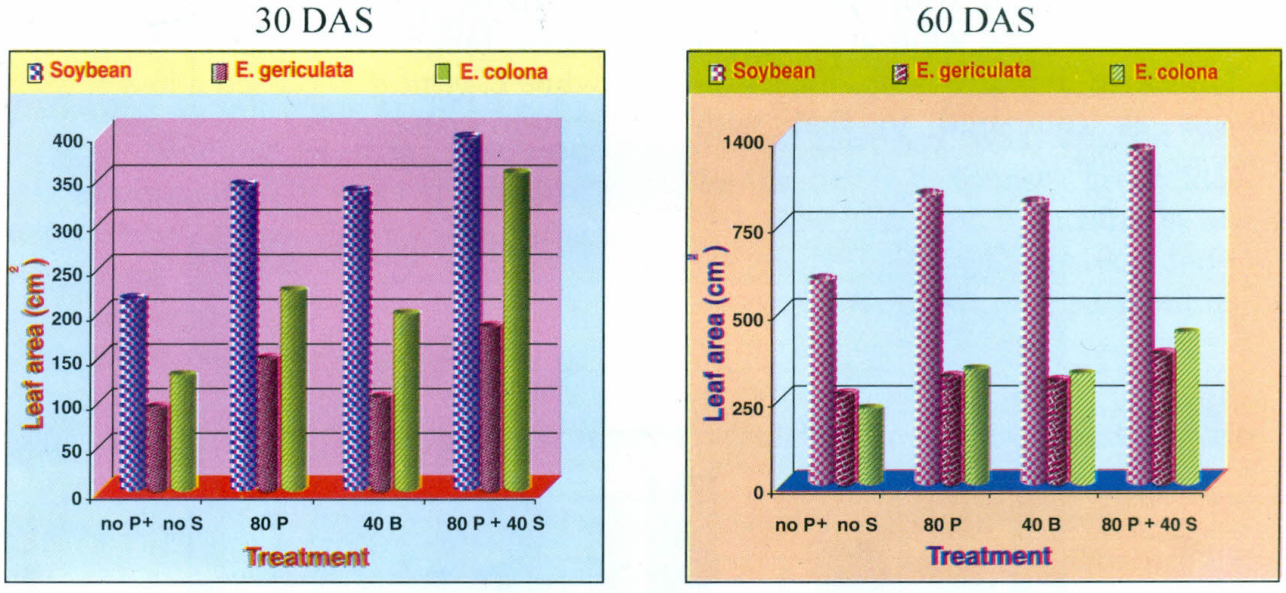


Fig.-9 a : Effect of P and S supply and competition on the leaf area of soybean, *E. colona* and *E. geniculata*

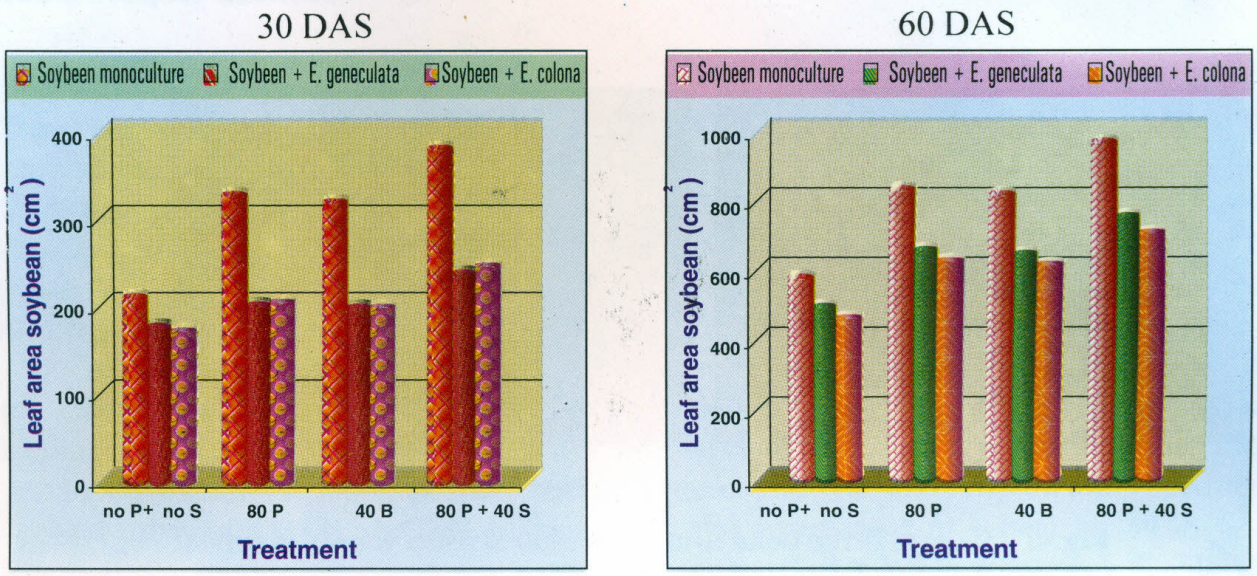


Fig. – 9 b : Effect of P and S and competition on the leaf area of soybean in monoculture and in mixture with *E. geniculata* and *E. colona*

The leaf area of soybean and weeds increased with the application of phosphorus and sulphur (Fig.-9b). Among the weeds, *E. colona* maintained higher leaf area at both the stages of crop growth. Soybean in monoculture maintained highest leaf area as compared to mixtures. Initially at 30 DAS, leaf area of soybean in mixture with either weed was more or less same while at 60 DAS it was higher in mixture with *Euphorbia geniculata* as compared to that with *Echinocloa colona*.

Application P and S has resulted in increased seed yield of soybean as compared to control. An increase of 113 per cent over control with 80 kg P_2O_5 ha^{-1} + 40 kg S ha^{-1} was observed in the seed yield. Among the two weed species, *E. colona* caused more reduction in seed yield of soybean as compared to *E. geniculata*. The decrease in yield due to *E. colona* ranged from 18 to 30 per cent while *E. geniculata* caused a loss of 13 per cent to19 per cent.

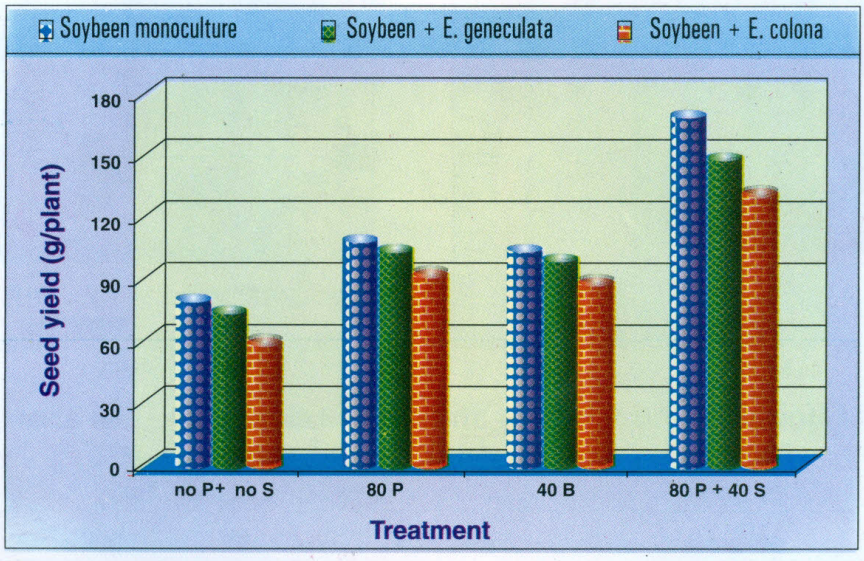


Fig. – 10 : Effect of P and S and competition on the seed yield (g/plant) of soybean

The relative seed yield of soybean (yield per plant in mixture/yield per plant in monoculture) was <1 in both the experiments, indicating that for this species the effects of inter-specific competition were greater than the effects of intraspecific competition as indicated in figure. A comparison of the relative yields of soybean shows that *E. Colona* was more competitive than *E. geniculata* as it has recorded lower relative yield of soybean.

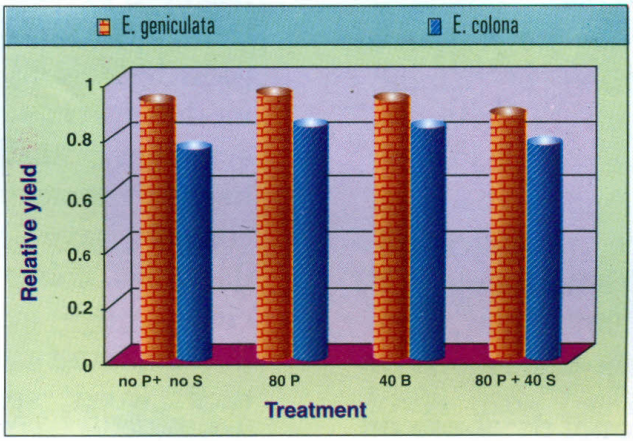


Fig.-11: Effect of P and S and competition on the relative seed yield of soybean (yield per plant in mixture / yield per plant in monoculture)

Effect of nitrogen sources on persistence of butachlor and weed population in transplanted rice

Application of nitrogen at 120 kg/ha through *dhaincha* (green manure) reduced population of weed species like *Alternanthera sessilis*, *Echinochloa colona* and *Cyperus iria* by 100, 50 and 65 per cent, respectively over control in transplanted rice. *Dhaincha* also proved better in reducing the weed dry matter of weeds to the tune of 65 per cent followed by farm yard manure over the control (Table-14).

When nitrogen was applied at 120 kg/ha through *dhiancha* green manure, the persistence of butachlor in soil as well as yield of rice was recorded more as compared to farmyard manure and urea (Table-15).

Table – 14 : Effect of nitrogen sources on weed population and their drymatter in rice

Weed species	Per cent change in weed population			
	Control	Urea	FYM	Dhaincha
Alternanthera sessilis	100	405	152	100
Echinochloa colona	100	133	100	50
Cyperus iria	100	70	39	65
Per cent reduction of weed drymatter over control	100	103	45	65

Table- 15 : Effect of nitrogen sources on yield of transplanted rice

Treatments	Yield (t/ha)
Sources	
Control	2.50
Urea	4.20
FYM	3.60
Dhaincha	4.40
LSD(P=0.05)	0.15
Weed Control	
No butachlor	3.50
Butachlor(1.5 kg/ha)	3.80
LSD(P=0.05)	0.71

Development of national database on weeds

The project on Development of National Database on Weeds was formulated to prepare weed maps of the country considering the crops and cropping systems, soils and rainfall pattern of different regions. The information on dominant weeds of varied agro-climatic zones of twelve states was compiled and maps of the agro-climatic zone of states *viz.* Assam, West Bengal, Bihar, Orissa, Jharkhand, Gujrat, Andhra Pradesh, Madhya Pradesh and Punjab have been prepared. The five dominant weed species of some important crops were identified and compiled alongwith their degree of infestation. The weeds were also classified on the basis of soil type and average rainfall pattern.

Information is being compiled on the basis All India weed survey collected from all the cooperating centres of AICRP-WC for preparation of weed map of the regions. Database of different weeds of agro-climatic regions has been prepared and the data entry of the state, agro-climatic zone, crops, growing seasons, eco-systems and weed modules *viz.* weed name, family, synonymy, distribution, morphology, habitat, character, disturbance type and control have been complied. This database containing information on crop-weed modules and coded nomenclature is to be carried out against each weed species including their distribution map of the weed. Major weeds of transplanted rice and invasive weeds of India have been indicated in the maps prepaed for the country.

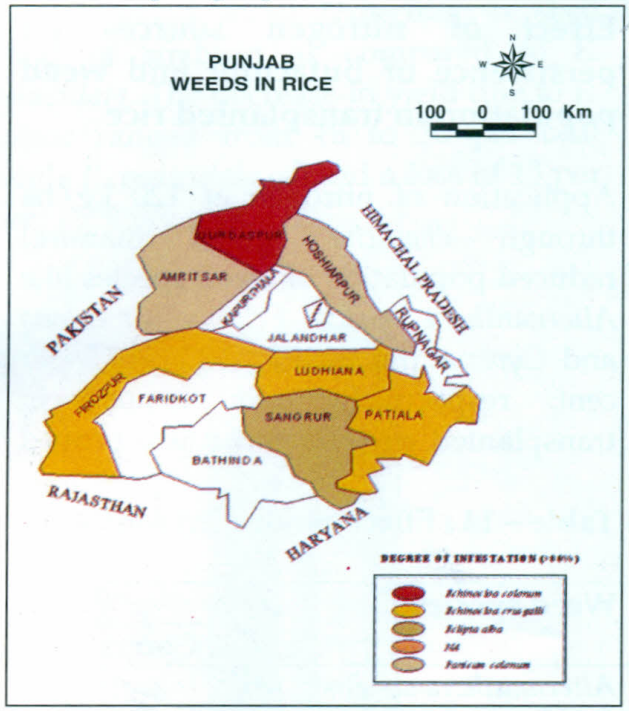


Fig. – 12 a : Weeds of Punjab in rice

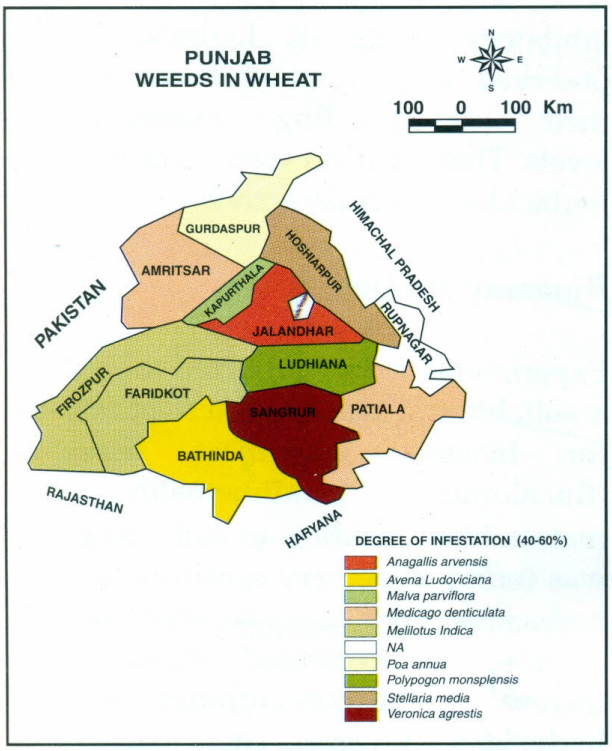


Fig.-12 b : Pattern of weed distribution in rice and status of invasive weed species in India

Herbicides and soil biology

Effect of herbicides on soil micro-flora, soil enzymes and *Rhizobium* – soybean symbiosis

Soybean (cv. JS-335) was sown in the pots containing 2 kg of black-cotton soil and the herbicides, *viz.*, fluchloralin, pendimethalin and metolachlor, were applied on the same day at 0, 50, 100, 200 and 500 per cent of recommended dose. The *Rhizobium*–soybean symbiosis was studied in terms of nodule count and nodule dry weight. Significant effect of all the herbicides was observed on nodulation in soybean. At 40 DAS, the nodule count in the treatment that received the application of 100 per cent of recommended dose of fluchloralin was significantly lower than that in control, indicating the adverse effect of this herbicide even at its recommended level of application. Metolachlor and pendimethalin, however, showed toxic effect on nodulation at 40 DAS only at 200 and 500% levels of recommended doses. In general, irrespective of the herbicide treatment the nodule count as recorded on 40 DAS has increased to that on 60 DAS. The adverse effect of fluchloralin on nodule count as was observed on 40 DAS has also disappeared on 60 DAS (Fig.-13). Similar to nodule count, significant effect of all the herbicides was also observed on the nodule dry weight especially at higher level of application. The nodule dry weight in the treatments that received the fluchloralin application at the rate of 100% or more than that of recommended dose was significantly lower than that in control on both 40 and 60 DAS. Application of pendimethalin at the recommended level has also adversely affected the nodule dry weight at 40 DAS but the toxic effect has disappeared by 60 DAS (Fig.-14). However, no toxic effect of metolachlor on nodule dry weight was noticed both at 40 and 60 DAS at the recommended level of application. It may be noted that the peak period of symbiotic nitrogen fixation in soybean is from 40 to 60 DAS. Hence, from the biological nitrogen fixation point of view, it seems that metolachlor is a safer herbicide than fluchloralin and pendimethalin.

There was no significant effect of fluchloralin and pendimethalin on total bacterial population in soil at 40 DAS even up to the 5 times of their recommended level of application. Similar results were also recorded at 60 DAS. Metolachlor also did not show any toxic effect on total bacterial population when applied at recommended level. However, it has significantly reduced the bacterial population both at 40 and

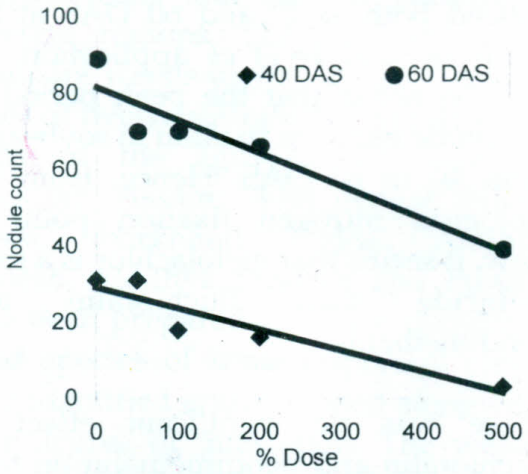
60 DAS when applied at two times or more of its recommended level.

Unlike bacterial population, fungal population was found to be sensitive to herbicide application. At 40 DAS all the herbicides have significantly affected the fungal population even when they were applied at the recommended level. The toxic effect of pendimethalin on fungal population however disappeared at 60 DAS even at the application level of 500% of its recommended dose. The toxic effect of fluchloralin and metolachlor on fungal population was also recorded at 60 DAS even at their respective recommended doses. Significant effect of all the herbicides on dehydrogenase activity in soil was recorded at 40 DAS. Data showed that the microbial activity was inhibited even at the recommended level of herbicide application. However, at 60 DAS no inhibitory effect of herbicides was observed when applied at the rate of their corresponding recommended levels. There was no significant effect of herbicides on urease activity.

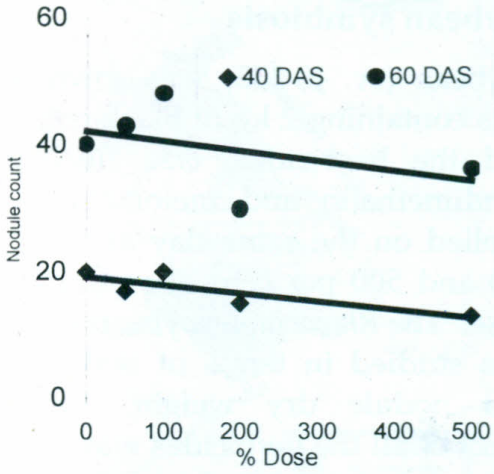
Bioassay studies

Experiments were conducted to find out a suitable test plant and test parameter for bioassay of these herbicide (fluchloralin, pendimethalin and metolachlor) residues in soil. Sorghum was found to be very sensitive to these herbicides. Both root and shoot lengths of sorghum decreased sharply with increase in the concentration of these herbicides. However, shoot length was found to be a better test parameter compared to root length and total dry matter production.

(a) Fluchloralin



(b) Metolachlor



Echinochloa colona leachates were also found to be toxic to the germination of its own seeds (auto-allelopathy). Leachates of higher concentrations (5 and 10 per cent) significantly reduced the root and shoot growth, proving thereby the presence of considerable auto toxicity. Similarly, rice leachates showed strong irreversible auto-allelopathic effect by completely inhibiting germination at higher concentrations of the leachates and also significantly reducing the shoot growth.

The effect of rice leachates on *Echinochloa colona* however was found to be relatively less toxic on its germination, root and shoot growth. These effects were reversible in nature and could be reduced on washing with distilled water.

b. Screening of allelopathic potential of mature straw of wheat and *P. minor* against rice and *Echinochloa colona* (Decomposing and decomposed leachates)

In rice- wheat cropping system the death and decay of the stubbles of wheat and *Phalaris* (residue) follows the sowing and germination of the rice and *Echinochloa colona* and vice-versa. Therefore the allelochemicals released during the decaying of residue or those formed by the soil microbial interaction of decomposed residue of wheat and *Phalaris* affects the germination and growth of rice and *Echinochloa colona*. In the present investigation this allelopathic effect was studied in two situations of decomposing and decomposed residue in petridish and pot cultures.

c. Effect of decomposing leachates of wheat and *P. minor* straw on rice and *Echinochloa colona*

Decomposing aqueous straw leachates and decomposed leachates of various concentrations (0-10 per cent). Decomposing leachates were obtained by soaking the straw powder in distilled water overnight followed by filtration and centrifugation .For obtaining decomposed leachates the straw powder was soaked in distilled water for about 10 days at room temperature and then cleared as in case of decomposing leachates. The decomposing leachates of wheat did not have any effect on the germination of rice and shama but their root growth were significantly reduced with 5and10% leachates. The shoot of rice was also significantly reduced but that of *Echinochloa colona* remained unaffected. The decomposing leachates of *Phalaris minor* has no allelopathic effect on germination of rice but significantly reduced the germination of *Echinochloa colona* at 5 and 10 per cent. It stimulated the root and shoot growth of rice but had inhibitory effect on root growth of shama. The mixed decomposing leachates of wheat and *P.minor* significantly reduced the germination of rice and *Echinochloa colona*. The root growth of rice and shoot growth of *E. colona* were stimulated at all concentrations. It was inferred that the decomposing leachates of wheat and *P. minor* had no adverse effect on germination of rice. However their mixed leachates had inhibitory effect on germination of both rice and sha *Echinochloa colona* ma. The shoot growth of rice and *E. colona* were adversely affected by decomposing leachates of both wheat and *P.minor* but their mixed extract stimulated it. The root growth of rice was adversely affected by wheat

(c) Pendimethalin

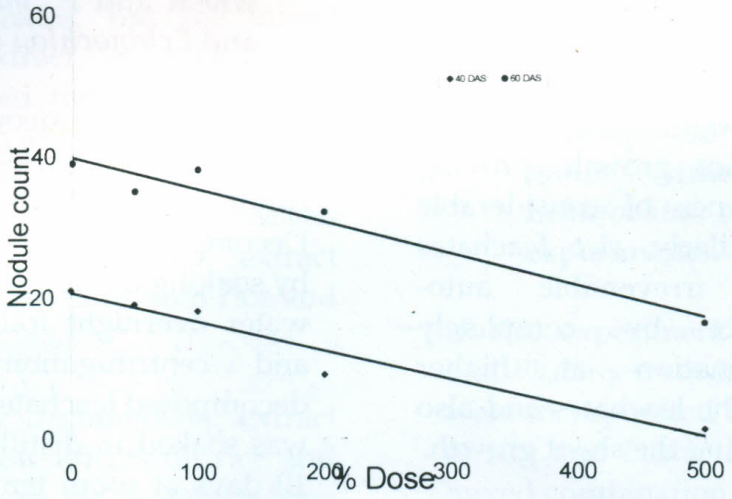


Fig. - 13: Effect of herbicides on nodule counts in soybean at different growth stages.

(a) 40 DAS **(b) 60 DAS**

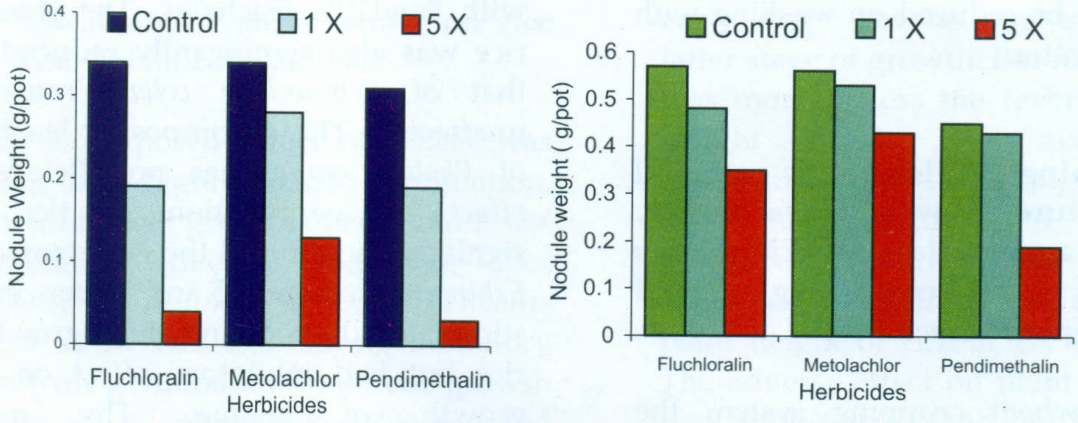


Fig.-14: Effect of herbicides on dry weight of nodule in soybean at different growth stages.

Weed Physiology

Evaluation and management of allelopathic influences of crops and weeds in rice wheat cropping system

a. Screening of mutual allelopathic potential of rice and *Echinochloa colona* (plant dry powder)

Effects of various concentrations (0-10 per cent) of *Echinochloa colona* leachates (dry powder obtained from 60 days old plant) on the germination and root and shoot growth of rice showed that 5 and 10 per cent leachates significantly reduced the root and shoot growth of rice. This effect was found to be irreversible and could not be recovered after washing off the leachates with distilled water. Germination was however not effected.

decomposing leachates but stimulated by *P.minor* leachates. But the mixed decomposing extract of wheat and *P.minor* stimulated the root growth of rice. The growth of *Echinochloa colona* was also adversely affected by wheat leachates but stimulated by *Phalaris* leachates. Their mixed extract stimulated root growth of both rice and *Echinochloa colona.*

The mixed straw decomposing extract thus produced new effects on rice and *Echinochloa colona* so far as germination and shoot growth is concerned. In other cases, the effect of *P. minor* straw prevailed over the effect of rice straw.

d. Effect of decomposed leachates of wheat and *P.minor* straw on rice and *Echinochloa colona*

The decomposed effect of wheat was found to be highly toxic to germination, root and shoot growth of rice, but it has stimulatory effect on root and shoot growth of *Echinochloa colona. Phalaris minor* straw had also strong inhibitory effect on germination and root growth of rice and *E. colona.* Mixed decomposed straw extract of wheat and *P. minor* had strong inhibitory effect on germination of rice and stimulatory effect on *E. colona.*

It was inferred that decomposed effect of wheat and *P. minor* straw was found to be highly toxic to the germination of rice and stimulatory to that of *E. colona.* Hence its effect has importance in rice wheat cropping system that inhibits crop and stimulates weed germination and the effect of weed residue on the crop prevails over that of crop residue. So the control of weed or its eradication for better crop growth justifies as regards to allelopathic effect is concerned.

e. Effect of decomposing and decomposed wheat and *Phalaris minor* straw on rice and *Echinochloa colona* in pot-culture experiments.

In this experiment the straw of wheat and *Phalaris* were in sole or mixed form were incorporated in the soil. The seeds of rice and *Echinochloa colona* in sole or mixed combination were sown either on the day of residue incorporation or 15 days after it. It was observed that the decomposing mixed residue of wheat and *P. minor* had stimulatory effect on the height of rice in mixed culture at early stage but became inhibitory at latter stage of growth: But for *E. colona* it was more or less the reverse .The dry weight of rice was also reduced significantly in the later stage but that of *E. colona* was stimulated. The mixed decomposed residue of wheat and *P. minor* had strong inhibitory effect on the plant height of rice at 20, 40, 60 DAS. The adverse effect on plant dry weight was milder at 20 DAS but strong at 40 and 60 DAS. The plant height of E.colona was not affected at 20, 30, and 60 DAS. The dry weight accumulated was however, adversely affected at 20 and 30 DAS but stimulated at 40 and 60 DAS.

f. Evaluation of mutual allelopathic effect of rice and *Echinochloa colona* in field condition

Rice and *Echinochloa colona* (shama) were grown in pure and mixed cultures with uniform plant densities (100 plants/m2) and in different proportions rice: shama like 1:1,1:2 and 1:4. It was observed that by keeping crop density

fixed and increasing weed density, the crop plants showed significant reduction in height, as compared to rice in pure cultures at 20DAS, but this trend was reduced with increasing DAS.The crop dry weight was significantly influenced at 20DAS,but subsequently decreased at 30 40 and 60 DAS.The difference between treatments were significant at 20 and 30 DAS only. With increasing weed density there was corresponding decrease in dry weight after 100 weeds/m^2. This showed that after a particular density of weed, the allelopathic effect if any had no further adverse effect on the crop plant. With increasing weed density from 100-400 plants/m^2, there was no much difference in weed height at 20DAS. But the plant height of other dates of sowing was considerably reduced with increasing weed density. There was no significant difference between treatments at 20 DAS. But subsequently the differences were quite significant. This showed that, the competition among weeds for nutrition was not apparent, since increasing weed density from 100-400 had no linear effect on dry weight. Whatever adverse effect was there might be assigned to be due to allelopathy.

Evaluation of bio-herbicidal potential of neem (*Azadirchta indica* A. Juss) through tissue culture on selected monocots and dicot species.

Azadirachta indica, A.Juss. (neem) has been a natural source of bio-pesticide against insect pests, nematodes and fungal pathogens. Its bio-herbicidal potential, particularly its selectivity against monocotyledonous and dicotyledonous species has not been explored. The present investigation revealed neem as a possible source of selective bio-herbicide against rice and its most problem weed *Echinochloa colona (L.)* Link. Phenolic fractions of neem leaf and bark leachaet at about 15 ppm concentration caused irreversible damage to the germination and growth of *Echinochloa colona* and also proved to be highly toxic to the germination and growth of *Parthenium hysterophorus* and *Brassica napus,* but was found to be less toxic to rice. This milder toxic effect on rice was found to be recoverable. It was explored that the bioactive agents of neem could be produced more efficiently *in vitro,* in leaf and stem calli grown in MS medium, which was quantitatively estimated to be double the amount of that parent in the corresponding native tissue. Suspension culture with permeablizing agent triton x-100 also released significantly high amount of phenolics (7.8% of intracellular phenolics) and other secondary metabolites to the culture medium; thereby opening up the possibility of using immobilized cell technique in bio-fermentors for the in house production of such compounds in large scale. Induction of nutritional stress was also found to be very effective in increasing the production of phenolic fractions including quercetin and azadirachtin as measured by the helps of TLC, HPLC and UV/visible spectrophotometry. It is hoped that further work may lead to the isolation of compounds from neem with selective herbicidal property against crop-weed ecosystem, particularly those of rice-*E. colona.*

Germination and dormancy study in *Cyperus iria* and *Cyperus difformis*

Freshly harvested *Cyperus iria* seeds did not germinate under standard germination testing conditions for 16

days. However, subsequent exposure to light caused germination in 14 per cent seeds. The seeds did not germinate in dark even after storage at ambient temperature for a year. All seeds (98 per cent) germinated on exposure to light after elapsing one year.

The seeds of *Cyperus difformis* also failed to germinate immediately after harvesting. β -Mercaptoethanol (5 mM), ammonia (500 ppm), $Agno_3$ (5 mM), ethrel and β-mercaptoethanol (0.1 mM each), and guaiacol (10 mM) improved the germination.

Germination and dormancy of *Ischaenum rugosum*

Freshly collected seeds of *I. rugosum* species did not germinate in the dark. Light exposure caused germination in 13±5.5 percent seeds. Salicylhydroxamic acid (SHAM) up to 1 mM caused germination in the dark in about 15% seeds. This together with light exposure resulted in 18.5 per cent germination. Thiourea (0.5-10 mM) and β-mercaptoethanol (0.1-10 mM) also promoted germination of the seeds both in light and in the dark to 85-100 and to 56-90%, respectively.

Standardisation of isolation and separation of terpenoids from *Lantana camara*

Lantana camara leaf residue was prepared, extracted using solvents, fractionated into various fractions and cromatographic separation followed. The fractions are being further isolated and purified for identification and for their structural elucidation the constituents will be evaluated for herbicidal activity.

Phytotoxicity of 0-, m- and p-anisic acid on aquatic weeds

Under standard test conditions conducted outdoors the allelochemical 0-anisic acid was lethal to all ten representative aquatic weeds namely floating species *Eichhornia crassipes, Salvinia molesta, Pistia stratiotes, Spirodela polyrhiza, Azolla nilotica* and *Lemna pausicostata* and submerged species *Hydrilla verticillata, Ceratophylfum demersum, Najas graminea* and *Chara* sp. at and above 5 mM. The toxicity symptoms in the floating species were wilting starting from margins of older leaves followed by loss of chlorophyII, desiccation, root flaccid and death and decay successively. The toxicity symptoms in submerged species were dull green appearacne followed by chlorosis, flaccid texture, fragmentation of leaves followed by death and decay. Time (days) required for toxicity appearance at lethal dose was less than a day. The treated plants were killed in about 5 days. Response of the aquatic weeds to m-anisic acid was almost similar. However, p-anisic acid though showed similar response, but had higher toxicity. Lethal dose for all the aquatic weeds was 2.5 mM.

Phytotoxicity of 0-, m- and p-coumeric acid on aquatic weeds

0-Coumeric acid was lethal to the floating species at 5 mM and to submerged weeds at 1 mM. Typical symptoms associated with toxicity at lethal dose for the floating weeds were wilting starting from margins of leaves followed by loss of chlorophyll, desiccation, root flaccid and death and decay successively. Toxicity symptoms in the submerged species were dull green appearance, chlorosis, flaccid

texture followed by death and decay. Time (days) required for toxicity appearance at lethal dose was about 2 days. The treated plants were killed at the lethal dose in about 5 days. M-Coumeric acid showed similar response except it was uniformly lethal for the weeds at 5 mM baring *Chara* sp., which was killed at 1 mM. p-Coumeric was lethal to the floating weeds at 5 mM and to submerged weeds at 1 mM except for *Chara* sp. which was killed at 0.5 mM. Thus, the allelochemical appears to be relatively more toxic to this species.

Effect of caffeine anhydrous on aquatic weeds

Toxicity of caffeine anhydrous an allelochemical appears to be similar to both floating and submerged aquatic weeds (lethal dose 5 mM) except that floating species viz., *Lemna pausicostata, Spirodella polyrhiza* and *Azolla pinnata* were killed at relatively higher dose (10 mM). The toxicity symptoms almost resembled with that of the other phenolic allelochemicals.

Biological Weed Control

Use of pathogens for weed control

Survey of pathogens

In search of suitable plant pathogens for biological management of *Parthenium hysterophorus, Phalaris minor* and *Echinochloa spp*, a survey was conducted at NRCWS farm during the months of August to December.

From infected samples of *Parthenium hysterophorus, Echinochloa* spp. fungi like *Fusarium* sp., *Curvularia* sp, *Helminthosporium* and *Alternaria alternata* were isolated. No pathogen could be observed from *Phalaris minor*.

Effect of *Gliocladium virens* on *Echinochloa* spp

Effect of *Gliocladium virens* grown on the medium containing sorghum grain (0.4%)+0.1 per cent Ammonium nitrate + 1 per cent sucrose was studied on seed germination, root and shoot growth of *Echinochloa* spp. Maximum inhibition of seed germination 94.78 per cent, root length 63.6 per cent was observed in seeds spray treatment with 0.4 per cent solution of *Gliocladium virens*. Addition of sucrose in culture inhibit root length by 63 per cent and shoot length by 44.55 per cent.

Effect of *Gliocladium virens* and *Trichoderma viride* on *Echinochloa* spp. in direct seeded rice

A field experiment was carried out to find out the effect of different formulation of *Trichoderma viride* and *Gliocladium virens* on *Echinochloa* spp. in directed seeded rice.

Germination of rice was inhibited maximum by *Trichoderma viride* seed treatment + soil application (*Trichoderma viride* neem oil cake 100 g/m^2) + spray *Gliocladium virens* 8 g/l + mustard oil 10 per cent]. Number of panicles in *Echinochloa* spp was reduced and there was no adverse effect on rice crop.

Effect of *Gliocladium virens* and *Trichoderma viride* on *Phalaris minor* in wheat

Inhibition of seed germination of *Phalaris minor* (30 per cent) and inhibition of root and shoot growth observed in treatment *Trichoderma viride* (Ecofit 4 g/kg seed treatment) + soil

application of *Trichoderma viride* grown on neem oil cake + spray of *Gliocladium virens* 8 g/lt water + Mustard oil 10 per cent was observed under field condition. There was no adverse effect on seed germination of wheat crop.

Effect of *Trichoderma viride and Gliocladium virens* on *Echinochloa* spp in rice

Maximum inhibition of seed germination 85.1% and root/shoot growth 27.38 per cent, fresh weight of root 0.29gm, and shoot weight 1.567 gm, dry weight root 0.060 g of *Echinochloa spp* was observed in treatment T.v seed treatment 4g/kg + soil application 100g/sq.m (*T. viride* grown on neem oil cake) + spray *G. virens* 8gm/litre +mustard oil 10 per cent. There was no adverse effect on seed germination of paddy crop.

A pot experiment was carried out to find out the biocontrol potential of of *T. viride* and *G. virens* in different methods of application on *Echinochloa* spp indirect seeded rice. Out of fifteen treatments in all the treatments maximum inhibition of seed germination 79.30 per cent was observed in *T. viride* seed treatment 4gm /kg +soil application (*T. viride* grown on neem oil cake 100g/m^2+spray of *G. virens* 8 g/l + mustard oil 10 per cent. There was no adverse effect on seed germination of paddy. It also reduce the fresh weight of root 0.049 gm, dry weight 0.097 g of *Echinochloa* spp. There is no significance difference between root length and shoot length of *Echinochloa* spp in different treatment.

Effect of different population of marigold on survival of *Parthenium hysterophorus*

A field experiment was carried out to find out the suitable density of marigold for management of *Parthenium hysterophorus*. *Parthenium* and marigold were grown in different ratio i.e. 50:0 (control) 50:25, 50:50, 50:75, 50:100, 50:125, 50:150, 50:175 and 50: 200, respectively. Marigold could inhibit plant height, number of branches/ *Parthenium* plant. The regeneration of *Parthenium* was reduced but, marigold 125 to 200 with 50 parthenium plant could completely inhibit its regeneration /germination. It clearly indicates that marigold can reduce *Parthenium hysterophorus* population if timely and properly grown.

Use of insects for weed control

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

Insects belonging to family Hemiptera, Coleoptera, Lepidoptera and Homoptera, were collected from various weeds during surveys but none of the species was different than the previous year's collection.

Good attack was noticed on Physalis minima vernacularly called 'Panchcuta' by a coccinellidae beetle *Henosepilachna vigintioctopunctata* (F.). Mild infestation of Bactra sp. on Cyprus rotundus was observed. Two types of insects were recorded on Lantana camara, out of which tingid bug (*Teleonemia scrupulosa*) damage was appreciable but overall impact of this exotic insect was not very severe. About 22 insect species belonging to different orders were recorded from different weeds available in Jabalpur and adjoining area but none of the species was different. The

damage on the plants was more severe during September. At one place, hundred percent damage was observed.

After first monsoon rains, adults of shoot and root borer *Nupserha lenita* began 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 and dry weight of the attacked plants when compared to non-attacked plants.

Developmental studies of insects on weeds

Life cycle studies of turtle beetle *Aspidomorpha miliaris* and *A. sanctacercecis* were completed on *Ipomoea fistulosa* weed. *A. miliaris* could complete its life cycle on *Ipomoea fistulosa* and *Ipomoea balata* but the development of another species of turtle beetle *A. sanctacercecis* was doubtful on *Ipomoea balata*. However, it was found that if newly hatched larvae were released on *Ipomoea 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 a preferable host for both the beetles.

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

Mass rearing and release of Mexican beetle through public awareness programme at Jabalpur

Studies were made to mass rear the population of *Zygogramma bicolorata* in laboratory and in out side cages. Making the cages with the help of bamboo sticks and mosquito net clothes, efforts also made to mass rear the beetle in open land. It was seen that this method is very cheap in comparison to rear in the laboratory rearing. The advantage of this method was to save labour and cost apart of more fertile females. Further study is in progress.

It was felt that to manage *Parthenium* through biological control agents, public awareness is necessary. Hence an awareness campaign was initiated in and around Jabalpur involving various government organisations, NGO's, colony residents, school management and gram panchayats during July to September, 2001. At the meeting places, thousands of beetles were released in the presence of local residents. Methods of mass production of beetles were also demonstrated.

Monitoring was also done at the released site and encouraging results on *Parthenium* control were obtained. Those areas were also monitored where thousands of beetles were released at different places of Jabalpur. At some places, beetles were found to establish well.

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

Alligator weed is a perennial aquatic plant and is a native to South America. In India, it was first reported in 1965 from Bihar and West Bengal and by 1971 from Northeast and Bangalore. In 1993, it was reported as a fast spreading weed from Kerala and by 1995 from Pune. In 1996, it was reported from the ponds of Jabalpur and adjoining area.

Spread of Alligator weed at Jabalpur

For knowing the spread of alligator weed, surveys were made at Jabalpur and suburb areas. During initial survey in 1994, it was observed that all the prominent ponds of Jabalpur were severely infested with water hyacinth and the existence of alligator weed was at very low level mostly on the bank side. During the survey in 2001, it was found that almost every water stream leading to pond was infested with alligator weed. The spread of alligator weed was not only alarming in ponds but also in low land area of Jabalpur. In low land area like on both the sides of road and railway track, un-constructed plots in residential colonies where water stays for longer duration, weed was spreading fast. Many recently made low land areas due to human interference were found severely infested with the alligator weed The spread was also noticed in wastewater channels of residential colonies. Survey revealed that, this weed has spread its tentacles in every aquatic body but with varying intensity. A few ponds were fully infested with alligator weed. This weed was found in aquatic as well as in terrestrial form.

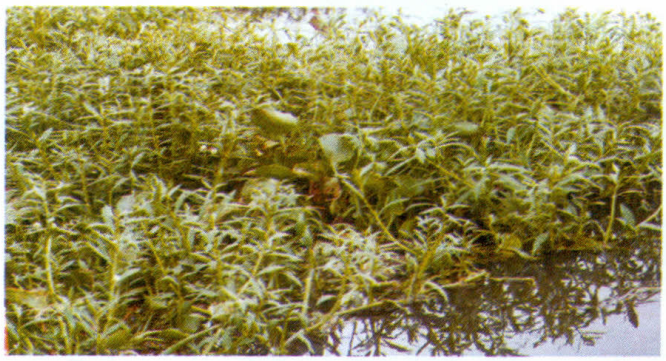


Fig.-15 a : Menace of alligator weed in pond b-Single plant

The reason of fast spread of alligator weed in aquatic bodies was due to the decrease of water hyacinth infestation owing to well establishment of water hyacinth weevil *Neochetina* spp. It was observed that since initial survey in 1994, due to continuous attack of the weevil population of water hyacinth has decreased corresponding to the increase of the population of weevils and the niche vacated by the water hyacinth is being rapidly replaced by alligator weed. By the end of 2001, all the ponds were found infested with this weed.

The alarming spread of alligator weed in ponds and low land areas adversely affected human access, flow of water and fishing in the ponds. Its terrestrial growth is replacing other vegetation rapidly. Its fast spread is especially important in India where its current

distribution and spread is only a fraction of its potential distribution. This has necessitated prompt control of this weed.

Presence of aquatic and terrestrial forms

During survey alligator weed was also found in low land areas that were having little morphological difference than aquatic type of alligator weed. In open water, plant forms large mats of hollow stems over the water surface with adventitious roots originating from the stem nodes. But in the terrestrial form, the weed forms a large underground network of roots as it occurs in rhizomes having plants. The terrestrial form of the plants has also infested low-lying land, smaller waterways and swamps. It is clearly a threat to the ecology of inland river system, wetlands and irrigated crops. An attempt was made to find out a strategy for controlling the weed in low land areas and water and also to find out the indigenous insects on weed and their impact in reducing the biomass of the weed.

Fig.-16 a : In vacant low land plot **b-** Surrounding houses **c-** Along side road

Survey of insect fauna on Alligator weed

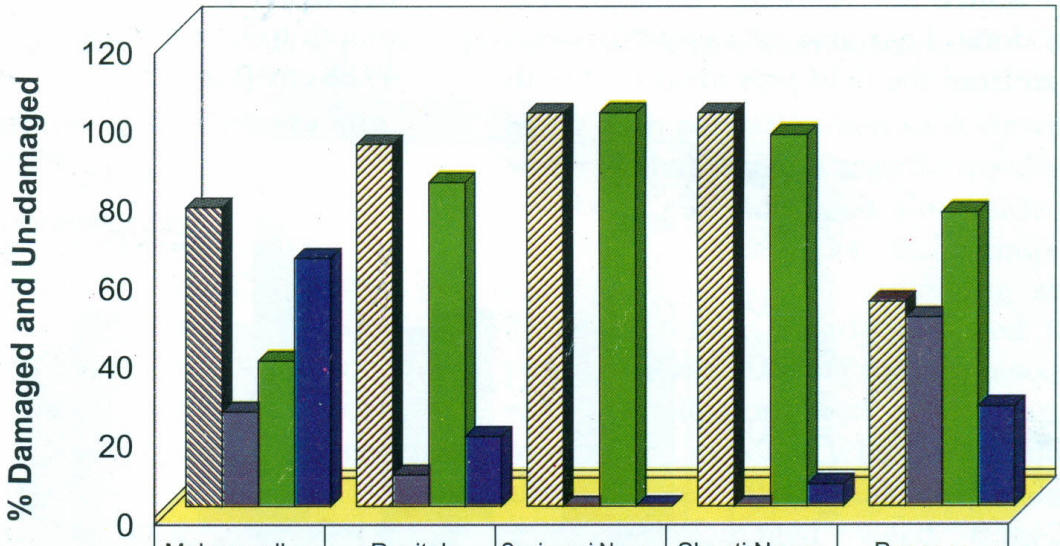
Regular surveys were made to find out the insects damaging alligator weed in different ponds in Jabalpur as well as in the low land terrestrial area. Polyphagous hairy caterpillar *Dicracia obliqua* was found to damage this weed in low land areas and aquatic bodies along with another polyphagous insect *Helicoverpa armigera* in the first week of September-October 2000. However, these insects were not found on this weed in aquatic environment. Larvae of *Prodinia litura* (Lepidoptera) were also recorded to feed voraciously on alligator weed in both the situations. Apart from this, an insect species of turtle beetle was found feeding voraciously on this weed in aquatic as well as terrestrial situation. It was identified as *Cassida* spp. Preliminary study of its life cycle was studied. Apart from turtle beetle, leaf-binding larvae of order lepidoptera were also found defoliating alligator weed during August to October but the damage was more pronounced during August-September. Larvae affix leaves of growing part with the help of saliva and feed inside. Mostly upper part of the alligator weed was damaged thus suppressing further growth. Preliminary

study of its life cycle was carried out. Initial study did not reveal any further host of this larval species. During October to March, alligator weed was almost free from any attack of insets.

Fig.-17: Damage by the leaf binder insect and also a close up of the damage

Damage potential of *Cassida* spp.

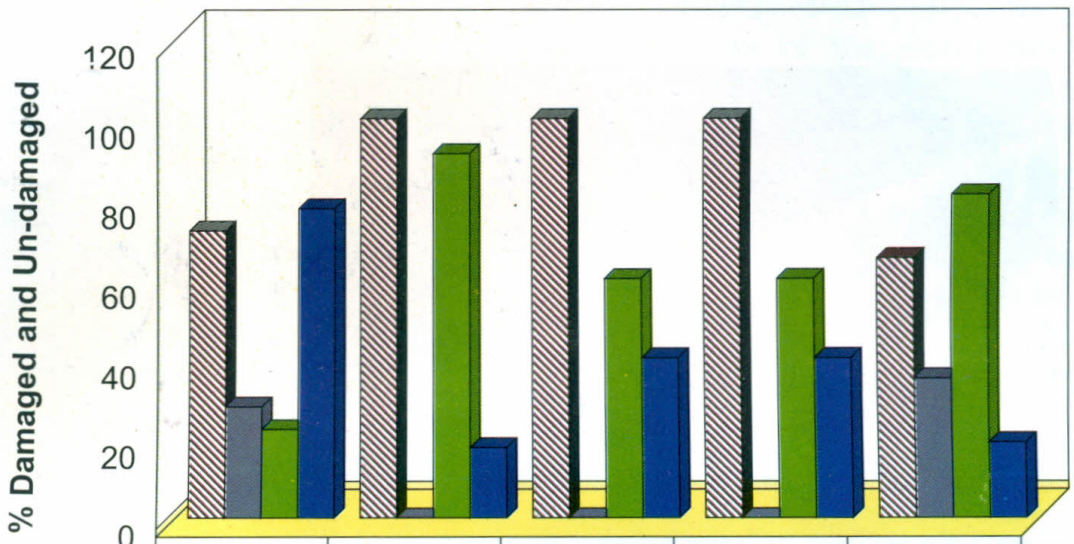
To know the damage potential of *Cassida* spp., samples of alligator weed from ponds and terrestrial forms were collected randomly during August onward from 5 prominent sites of Jabalpur. From the sampled plants, percent attack was calculated. It was seen that in infested plant, some leaves remain undamaged by the beetle. Therefore, percent damaged leaves from the damaged plants were also calculated for knowing actual damage more precisely (Fig.-18 a & b).



	Mahanandha	Ranital	Sanjeevni Nagar	Shanti Nagar	Panagar
Damaged plants (%)	76	92	100	100	52
Un-damaged plants (%)	24	8	0	0	48
Damaged leaves(%)	36.9	82.3	100	94.4	74.7
un-damaged leaves (%)	63.1	17.7	0	5.6	25.3

Site

Fig. - 18 a : Per cent of damaged plants by *Cassida* spp. at Jabalpur during August

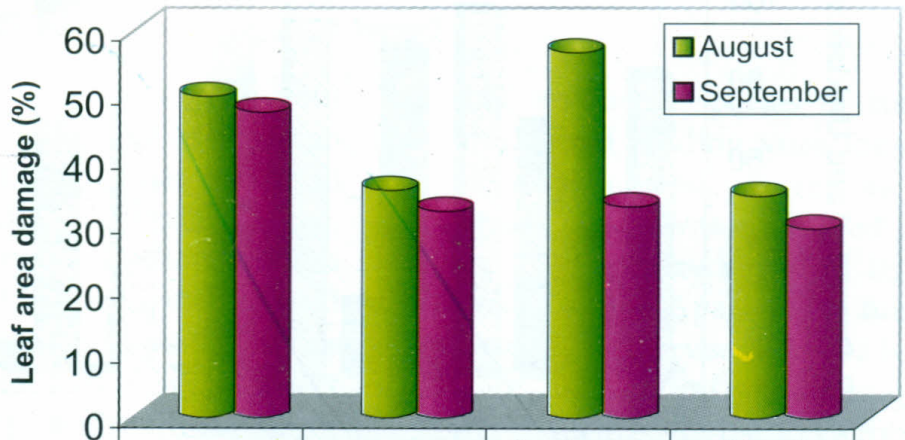


	Mahanandha	Ranital	Sanjeevni Nagar	Shanti Nagar	Panagar
Damaged plants (%)	72	100	100	100	65
Un-damaged plants (%)	28	0	0	0	35
Damaged leaves(%)	22.35	91.3	59.9	59.9	81
un-damaged leaves (%)	77.55	17.7	40.1	40.1	19

Site

Fig.- 18 b: Percent of damaged leaves by *Cassida* spp. during September

From the sampled plants from field, leaf area study for knowing damage was also done. Leaf area of sampled plants taken from the field was measured with the help of leaf area metre. The percent damage varied place-to-place and month-to-month ranging from 32.11 to 49.88 cm^2 (Fig.-19).



	Mahanadha	Ranital	Sanjeevni Nagar	Shanti Nagar
August	49.88	35.49	56.68	34.39
September	47.61	32.11	32.99	29.64

Site

Fig.- 19 : Per cent leaf area damage by *Cassida* spp.

Population dynamics of *Cassida* spp

From different marked sites at Jabalpur, a population study was initiated from August 2001 onwards. From the sampled plants, population of larvae, adult and pupae of *Cassida* spp. were counted. The average population varied from place-to-place and month-to-month. The trend of average population during August and September 2001 at different places of Jabalpur. (Fig.-20).

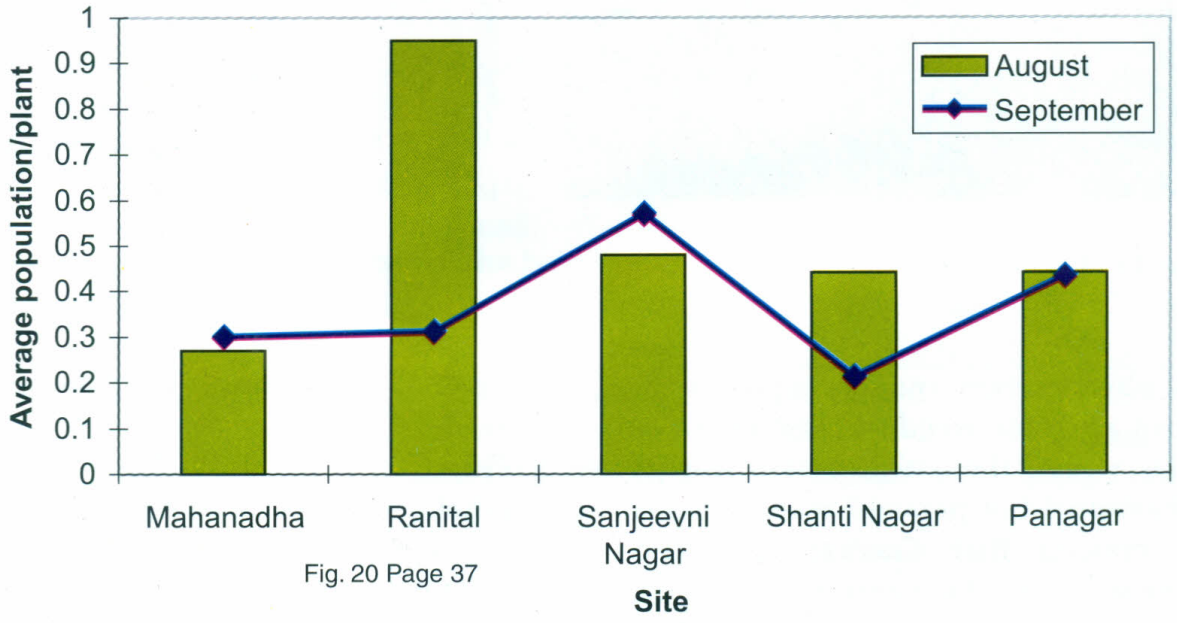


Fig. 20 Page 37

Fig.-20: Trend of *Cassida* spp. population at different sites in Jabalpur

Attack of parasitic weed *Cuscuta* spp. on alligator weed

During the survey, in one of the ponds of Jabalpur, parasitic weed *Cuscuta* sp. was found entangled with alligator weed and suppress the growth. At one spot, the attack of *Cuscuta* sp. was so severe that the growth of alligator weed was completely depressed in comparison to adjoining weeds. After a month, at the same spot water became visible. The attacked and dried weed along with parasitic weed sank down in water 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 (Fig.-21).

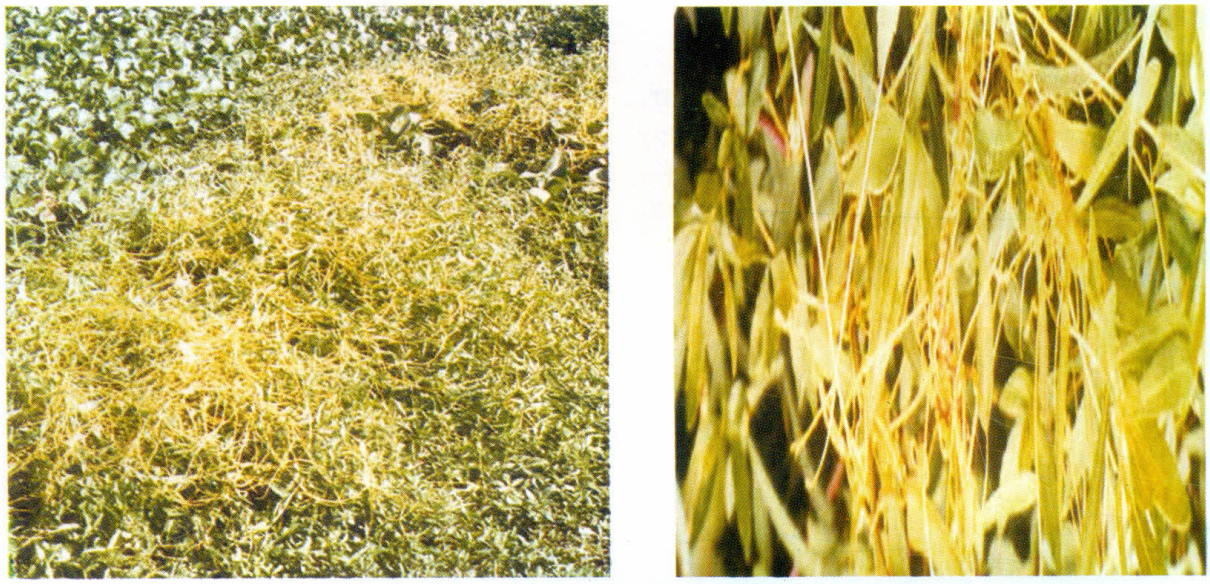


Fig.- 21 : *Cuscuta* spp. spread on alligator weed and close up of *Cuscuta* spp entangling alligator weed

This phenomenon can be exploited to control alligator weed at least in water bodies where there will be no fear of further spread of parasitic weed. It was also noticed that *Cuscuta* spp. also entangled water hyacinth but the effect on water hyacinth was not appreciable. It was observed that *Cuscuta* spp. preferred alligator weed to water hyacinth. After above-mentioned preliminary observations, plants of *Cuscuta* spp. were taken out from the infested pond and released in three other two ponds of Jabalpur during March-April 2001. By the end of September, *Cuscuta* was found to establish in some pockets in both the ponds. Further studies are in progress.

Effect of herbicide on *Cassida* spp

The effect of herbicide 2,4-D was less in initial 24 hours after spray except in higher dose but mortality enhanced by 72 hours in all the doses. Effect of 2,4-D on the mortality of insect was more when it was applied on insects resting on weed than the spray on insect alone or leaf alone. Similar results were obtained with glyphosate also but mortality of insects begins to appear within 24 hours except in lower doses. These preliminary studies reflect that despite different mode of action, herbicide may also cause mortality to insects feeding on the weed. Detailed study is needed to find out the safe time of herbicide spray on the weed.

Mechanical Weed Management

Design improvement and prototype development of different improved weeding tools and implements.

Prototypes of selected weeding tools and implements were developed after incorporating suitable design improvements and complete design details and manufacturing drawings have been prepared under this project. The developed weeding tools are IARI crescent hand hoe, wheel hoe with big wheel (600 mm), wheel hoe with small wheel (300 mm), IIT-WAM 82 a multi-weeder, NRCWS herbicide wick applicator, twin wheel hoe, IARI crescent hand hoe, three tined hand cultivator. These improved weeders were evaluated in field condition in soybean crop. The field experiment was laid out in randomized block design with 8 treatment and three replications. The weed control efficiency based on number of weeds per m^2, fresh weight (g/m^2) were worked out and shown in Table-16.

Table - 16 : Weed control efficiency with different weeders in soybean

Treatment	Weed control efficiency (%) (population basis)	Weed control efficiency (%), Fresh Weight	Yield (q/ha)
Wheel Hoe (Big)	49.3	44.7	2.88
Wheel Hoe (small)	57.2	51.7	2.72
IIT multi-weeder	61.0	58.6	3.00
Crescent Hoe	55.8	52.8	1.84
Three-tyned hand cultivator	53.7	58.4	2.08
Twin Wheel hoe	44.9	48.5	2.72
No control measure	-	-	2.72
Weed free	53.7	60.5	2.72

The weed control efficiency attained was highest in case of IIT design multi-weeder based on nos of weeds/ sq.m (61 %) and fresh weight (58.6%) basis followed by wheel hoe (small) i.e. 57.2 % and 51.7 %. The weed control efficiency attained in case of IARI crescent hand hoe and three-tyned hand cultivator varied closely, which indicated the comparable performance. Similarly the weeding efficiency attained in case of twin wheel hoe and wheel hoe (big) varied losely resulting their comparable performance. The field capacity of the six weeders is varying from 0.11 to 0.14 ha/hr. The speed of operation of different weeders varied from 1.89 m/min to 2.45 m/min. The highest speed of operation has been attained in case of IIT design multi-weeder i.e. 2.45 m/min followed by wheel hoe (big) i.e. 2.16 m/min, IARI crescent hand hoe (2.05m/min), wheel hoe (small) i.e. 1.97 m/min, three tyned hand cultivator (1.96 m/min) and twin wheel hoe (1.89 m/min). The highest field capacity attained was in case of IIT design multi-weeder i.e. 0.14 ha/hr. The highest yield has been obtained in case of hand weeded plot whereas in other treatments comparable plot yield has been obtained.

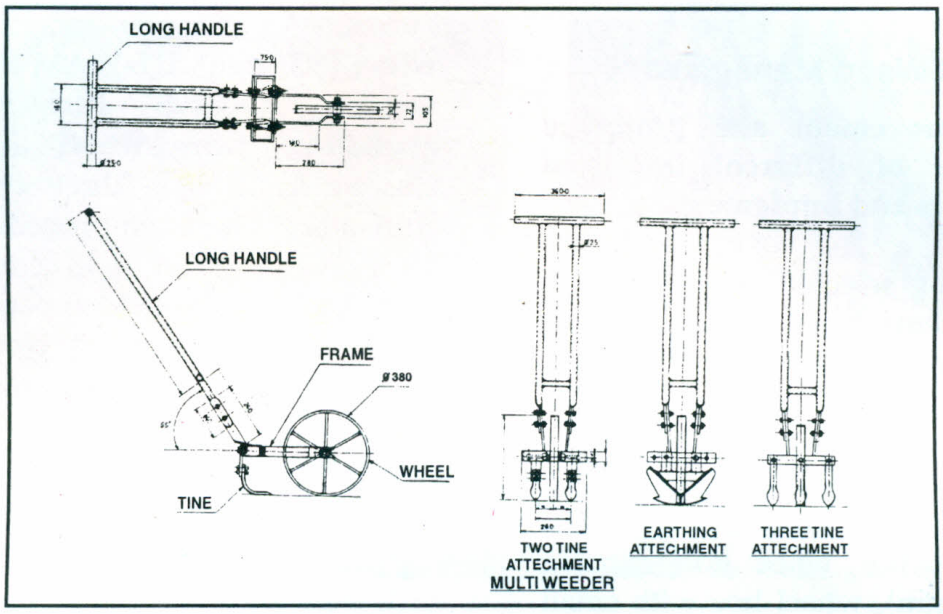


Fig .- 22 : A orthographic design of Multi-weeder

Design, development and evaluation of engine powered aquatic weed cutter/harvester for small water bodies.

Design and development of a small unit of self-propelled engine powered aquatic weed cutter/ harvester was carried out for use in small and big water bodies, canals and ponds. The machine was structured-in on a motorized boat structure with its different units and components on it. The engine powered aquatic weed cutter/harvester developed consisted of main frame, two hull structures, a cutting unit, an engine Mitsubhishi AD-8 engine, power transmission from engine to cutter bar and engine to propeller fan, steering system, propeller fan unit, rudder plate for easy turning of the unit, ground transport wheels, engaging and disengaging levers for power transmission to cutter bar and propeller fan etc. The unit was tested in actual aquatic conditions in JNKVV 's Adhartal farm pond. The preliminary tests of the engine powered aquatic weed cutter/harvester indicated the following performance results.

(i) Transport wheels provided in engine-powered weed cutter/ harvester performed well in ground transport of the unit as well as in aquatic conditions These wheels are removed as soon as the machine floats in water. Their removal is easy and requires 15-20 minutes of time.

(ii) The engine powered aquatic weed cutter / harvester has been found floating well in aquatic conditions. The half portion of machine remains sink in water and other top half portion in air, besides one operator one more person can sit on the hull structures.

(iii) The cutting unit of the machine has been found performing well in submerged condition inside the water. The machine is not suitable for cutting of floating weeds as the cutter bar is placed 0.5 m below the water level and weeds are at the surface of water and hence the

cutter bar is below the weed surface.

(iv) The propeller unit of the engine powered aquatic weed harvester is pushing well the whole machine. Although the speed of machine movement is not high but for proper cutting of aquatic weeds, speed of operation of the machine required should be slow. The capacity of the propeller for throwing water is required to be enhanced to make the speedy movement of the machine.

(v) The turning movement of the self-propelled engine powered aquatic weed cutter/harvester is performing well satisfactorily. The machine is able to move and turn with the shift in position of rudder plate fixed at the rear portion of the machine.

(vi) The engine selected for the machine is Mitsubhishi AD-8 engine of 8 hp, light in weight and its rpm is also low to suit the design requirements. The utilization of engine power in the powered aquatic weed cutter/harvester is optimum.

(vii) During weed cutting operation of the unit, problem of slipping of V-belts has been experienced causing power loss of engine power. This faults needs to be rectified.

(viii) The problem of splashing of water has been observed due to moving components of the machine. This fault is also needs rectification by providing suitable covers around the moving parts and components.

(ix) The problem experienced in the preliminary tests of the machine is being rectified to improve the performance of the engine-powered aquatic weed cutter/harvester.

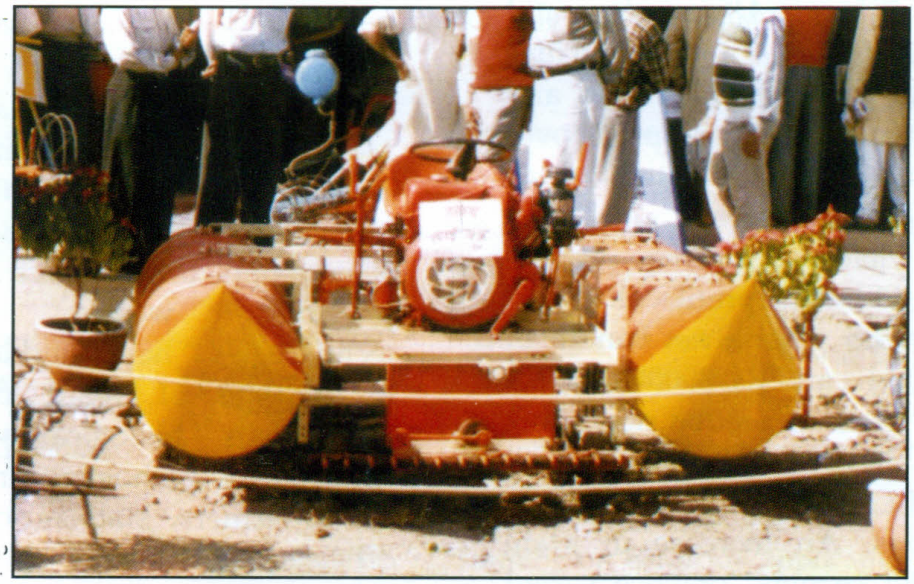


Fig .- 23 : A self-propelled engine powered aquatic weed cutter

3 TRANSFER OF TECHNOLOGY

Sustenance of agriculture depends not only on development of technologies but also their effective transfer. The yield of crops is low and the wide gap in adoption of weed management technologies by the growers is one of the major constraints. In order to acquaint the farmers with the proven weed management technologies, demonstrations on rice and soybean crops were conducted in nearby villages of Jabalpur during *kharif* season 2001.

Rice

On-farm field demonstrations on proven weed management technologies were conducted to see the performance of pretilachlor and anilophos in four different locations under transplanted rice and almix at six locations in direct-seeded rice. Fields were infested mainly with the weed flora *Echinochloa colona, Commelina communis, Cyperus, Phyllanthus, Eclipta, Alternanthra* and other broad leaf weeds. Two herbicides gave effective control of weeds and increased the grain yield and profit over farmers practice. In transplanted rice, an increase of 34 to 37 percent and 22 per cent in grain yield over farmers practice were recorded with pretilachlor and anilophos, which gave a net benefit of Rs. 5500-6200/ ha and Rs. 3000-4800/ha, respectively. In direct seeded rice, almix was found very effective against all weeds except *Echinochloa colona* in all the demonstrations. An increase in grain yield over the farmers' practice varied from 8 to 56 percent depending upon the intensity of weeds. The net return over farmers' practice under this treatment varied from Rs. 2000 to 7500/ha.

Soybean

Similarly in soybean eight field demonstrations were conducted at farmer's fields in different location to see the performance of proven herbicides *viz.* chlorimuron, chlorimuron plus fenoxaprop-p-ethyl and imazythpyr at the rate of 37.5 g/ha, 750 ml/ha and 750-1000 ml/ha respectively over farmers practice. Fields were found mainly infested with *E. colona, Dinebra* sp, *Cyperus, Euphorbia, Phyllanthus, Digera arvensis* and *Parthenium hysteropherus*. All the herbicides under taken for the demonstration resulted an increase of 55 to 250 per cent yield over farmer's fields depending upon the intensity and growth of weeds. However, the low benefit over the treatment from Rs. 475/- to 3300 /ha was recorded because of in general poor yield performance of crop due to heavy rains and delayed sowing.

Kisan Mela

NRCWS participated in state level *Kisan Mela* at Krishi Upaj Mandi, Jabalpur during 15 -18 December 2001. Where an impressive stall of the NRC-Weed Science depicting research high lights on proving weed management technologies, new herbicides tested, proto type of weed control tools, implements, biological weed control using plant pathogens, insects. About 25,000-farmers, state-agriculture deptt. officials, students, functionaries, entrepreneurs along with dignitaries visited the stall and discussed with the experts about the different types of weed problems for which related folders, bulletins were also distributed to them.

4 EDUCATION AND TRAINING

Training programme attended by the scientists and other staff

Name & Designation	Duration	Training title
Dr. P. J. Khankhane Scientist (SS)	21 August - 19 September, 2001	Resource management under rainfed cropping system at JNKVV, Jabalpur
Mr.R. S. Upadhyay Farm Manager	11-14 September, 2001	Production technology of sesame and niger at JNKVV, Jabalpur
Dr. M.B.B. Prasad Babu, Scientist (SS)	30 October to 9 November, 2001	GIS application in agriculture at NAARM, Hyderabad
Dr. V. P. Singh Sr. Scientist (Agro)	6-9 November, 2001	Hindi workshop at NAARM, Hyderabad
Mr. R. S. Upadhyay Farm Manager	20 November to 10 December, 2001	Recent trends in seed production management at JNKVV, Jabalpur
Dr. N. T. Yaduraju Director	21-24 December, 2001	Executive development programme in agricultural research management at NAARM, Hyderabad
Dr. P.K. Singh, Sr. Scientist (Ext)	18 – 21 January 2002	Vigilance awareness at IISR, Lucknow
Sh. Seshu Babu, AAO	18 – 21 January 2002	Vigilance awareness at IISR, Lucknow
Sh. A.K. Shrivastava, AF&AO	18 – 21 January 2002	Vigilance awareness at IISR, Lucknow
Mr. B.P. Uria , Jr. Clerk	15-17 January 2002.	Hindi workshop at Directorate of Employment and Training, Jabalpur
Dr. B.T.S. Moorthy, Pr. Scientist (Agro)	4-8 February 2002.	"Training-cum-workshop on Hindi" at NAARM, Hyderabad
Ms Poonam Chandla, SRF	13 February to 5 March, 2002	Microbial transformations in soil held at TNAU, Coimbatore
Dr. Anil Dixit Scientist (SS)	15-16 March 2002.	Training on herbicide application organized by rice-wheat consortium for Indo-Gangetic Plains New Delhi at ICAR Research Complex for Eastern Region, Patna

5 HONOURS AND AWARDS

Awards and honours

(1) Dr. N. T. Yaduraju, Director, NRCWS, Jabalpur was honoured as the Fellow of Indian Society of Weed Science for the year 2000-01.

(2) Mr. Basant Mishra, Sr. Photographer, NRCWS, Jabalpur was awarded with the "Associateship" by the India-International Photographic Council for his valuable contribution in the field of photography. He is the founder member as well as Secretary of the Central India Photographic Council (CIPC), Jabalpur.

(3) Mr. Veer Singh, Messenger won in final of carom men event in the ICAR zonal tournament held at CIAE Bhopal participated in Inter zonal tournament at IARI New Delhi during November, 2001.

Selection/promotion

Principal Scientists (w.e.f. 27 July,1998)

Dr. N.T. Yaduraju, Diretcor

Dr. B.T.S. Moorthy

Dr. L.P. Kauraw

Sh. H.S. Bisen

Senior Scientists

Dr. D. Swain

Dr. J. S. Mishra

Dr. V.P. Singh (June, 2000)

Dr. R.P. Dubey (January, 2001)

T-6

Dr. M.S. Raghuvanshi (January, 2000)

Sh. R.S. Upadhyay (January, 2000)

T-5

Sh . Sandeep Dhagat (November, 2000)

T-4

Sh. O.N. Tiwari (January, 2001)

T-3

Sh. S.K. Parey

Sh. J.N. Sen

T-2

Sh. R.K. Meena

Sh. M.K. Meena

Sh. Premlal

Sh. D.K. Sahu

Sh. Bhagunte Prasad

Retirement

Dr. L. P. Kauraw Principal Scientist (Plant Pathology) has attained superannuation on 31-03-2002. Born in 1942, Dr. Kauraw obtained his Ph. D. degree from G.B. Pant University of Agriculture and Technology, Pantnagar in 1971 and joined JNKVV, Jabalpur. In 1977, he joined in ICAR as ARS Scientist working at Central Rice Research Institute, Cuttack, on seed-borne diseases of rice. During 1991-2002, he worked on Biological control of weeds (*Parthenium hysterophorus*, *Phalaris minor* and *Echinochloa* spp) using pathogens at NRC Weed Science, Jabalpur. He was the Principal Investigator of many projects financed by DBT, CABI and ICAR. He visited many countries *viz.*, Philippines, Denmark, U.K. and U.S.A. He has published about 75 articles including research papers, bulletins and popular articles. He is well known for his work on management of *Parthenium* through marigold, use of *Trichoderma viride* and *Gliocladium virense* for the management of *P. minor* in wheat and *Echinochloa* spp in rice. NRCWS staff conducted a warm felicitation function to Dr. Kauraw and wished him a very happy, healthy and peaceful retired life.

6 AICRP- WEED CONTROL

Salient findings of co-ordinated research

The AICRP-WC started functioning since 1977-78 with 5 centres. Presently, it is operating in 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 for the year under report are summarized as follows:

- ⇨ Clefoxidim and quinclorac were found to be promising herbicides in controlling *Echinocloa colona* in rice nursery without any phytotoxicity on rice seedlings.

- ⇨ Integrated nitrogen management (75% inorganic + 25% organic by green manure) was found to minimize weed problem and sustain the yield of transplanted rice as well as improve the soil fertility by enhancing the soil organic carbon content.

- ⇨ Pre-emergence application of pretilachlor+safener 0.45 kg/ha at 2 DAS is selective for wet-seeded rice and *dhaincha* (weed smothering green manure intercrop), was also very effective against weeds and enhanced yield.

- ⇨ In rice- rice system, residue of butachlor in soil was very low in order of 0.001 to 0.004 ppm even after 5th season application continuously in both FYM and non-FYM applied plots, whereas in finger millet – groundnut system, butachlor residue was not observed in the soil even after 5th crop cycle at UAS, Hebbal.

- ⇨ Dicamba and isoproturon were compatible as tank mixture. Dicamba at 250 g/ha and at higher dose effectively controlled *Melilotus* spp., *Coronopus didymus* and *Medicago denticulata* in wheat, which are not controlled by 2,4-D and isoproturon.

- ⇨ Herbicide mixture of alachlor + atrazine (1250 + 312.5 g/ha) and acetachlor (1000 g/ha) is recommended for irrigated maize for wide spectrum weed control and to sustain yield and economics.

- ⇨ Garden hoeing or use of grubber at 25 DAS was found very effective in reducing weed infestation in sesamum.

- ⇨ In American cotton, glufocinate ammonium (0.75 and 0.90 kg/ha) applied as directed spray at 6-7 weeks provided significant control of weeds including perennials, followed by hand weeding or pendimethalin 0.75 kg/ha as pre-emergence spray.

- ⇨ Pre-sowing weed control by stale seedbed with glyphosate 2.0 kg/ha or by cultivation can reduce the pre-emergence herbicide dose to half (pendimethalin 0.5 kg/ha) or

labour need for manual weeding in cotton.

- In transplanted onion, pre-emergence application of butachlor 1.0 kg/ha and post-emergence application of oxyflurofen 0.09 to 0.12 kg/ha at 35 days after transplanting have been found more effective in reducing weed biomass.

- Intercropping of pigeonpea at 60 cm with one row of maize efficiently controlled the weed population and its dry matter and enhanced the pigeonpea equivalent yield compared to sole cropping of either crop. Application of pendimethalin 1.0 kg/ha in pigeonpea + maize intercropping system gave the maximum pigeonpea equivalent yield.

- In the intercropping system of maize+soybean (1:2 row proportion) application of butachlor 1.5 kg/ha resulted in highest weed control efficiency of 98.5 per cent recording highest soybean yield of 1983 kg/ha. Highest gross return was also obtained with this treatment.

- Amongst the new recommended herbicides, performance of clodinafop-methyl was very effective for controlling isoproturon resistant population of *Phalaris minor.*

- *Ageratum conyzoides* in groundnut is controlled by butachlor 1.0 and 1.25 kg/ha although fluchloralin and pendimethalin 1.0 and 1.25 kg/ha have shown better performance in reducing weed population in general.

- Better control of *Cyperus rotundus* was obtained with two or three split application of glyphosate (0.5 + 0.5 + 0.5 kg/ha) and two splits of glufocinate ammonium (0.45 + 0.45 kg/ha) applied in July-August than when applied in May-June.

- Biomass of weeds such as *Ipomoea carnea, Eichhornia crassipes, Mikania micrantha* and *Chromolaena odorata* could be utilized for vermicompost preparation within 45 to 60 days using either of earthworm species *Eisenia foetida* or *Amyanthes diffringens.*

7 PUBLICATIONS

A. Research papers

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Singh P.K. 2002 *Rabi* Phasalo me Kharpatwar niyantran. ***Dainik Bhasker,*** Jabalpur Jan. 28, 2002.

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D. Papers presented in seminars/ conferences/ symposia/ workshops

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Mishra, J.S., Moorthy, B.T.S. and Yaduraju, N.T. 2001. Weed Management Strategies for Medicinal and Aromatic crops. (*In*) *Souvenir*. National seminar on commercial cultivation, processing and marketing of medicinal and aromatic plants. JNKVV, Jabalpur, Nov. 27-29. p 116-117.

8 APPROVED RESEARCH PROJECTS DURING 2001-02

Project title	Name of the scientist and designation	Date of	
		Start	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, Sr. Scientist	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, Sr. Scientist	1998	2002
Screening and development of new herbicides	Dr. Anil Dixit, Scientist (SS)	2001	2005
Fate and phytotoxic efficacy of herbicides and their 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, Sr. Scientist	1999	2002
Herbicidal property of phytotoxins	Dr. D. K. Pandey, Sr. Scientist	1999	2002

Project title	Name of the scientist and designation	Date of	
		Start	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, Sr. Scientist	1998	2003
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

9 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	5.01	Cess Fund, ICAR
Phytotoxicity of allelochemicals to aquatic weeds	Dr. D.K. Pandey, Sr. Scientist	September, 2000	August, 2003	17.51	Cess Fund, ICAR
Role of insects in suppression of problematic allegator weed *Alternanthera philoxiroides* and testing of herbicides for integrated management	Dr. Sushilkumar, Sr. Scientist	September, 2000	August, 2003	7.,51	Cess Fund, ICAR
Fate and phytotoxic efficacy of herbicides and their impact on nutrient cycle in relation to soil properties	Dr. K. K. Barman, Sr. Scientist	May, 2001	April, 2004	11.69	Cess Fund, ICAR
Molecular characterization and field trials of mustard transgenic for hybrid seed production and resistance to herbicides	Dr. N. T. Yaduraju Director	2002	2005	16.46	DBT, New Delhi
Development of database on weeds.	Dr. A. K. Gogoi Pr. Scientist	April, 2001	Dec. , 2003	20.57	NATP
Evaluation and management of allelopathic influence of crops and weeds of rice-wheat cropping system	Dr. D. Swain Sr. Scientist	May, 2001	April, 2004	11.19	Cess Fund, ICAR

10 SRC, RAC, IMC AND QRT MEETINGS

Staff Research Council (SRC)

The SRC meeting was convened on June 7-8, 2001, under the chairmanship of Dr. N.T. Yaduraju, Director to review the results of on going research projects and to consider new project proposals. It was also brought to their notice that multi-disciplinary approach should be followed to rationalize the number of projects. An exercise was also made to prioritise the research work and to chalk out interdisciplinary projects of national importance. All routine and location-specific experiments have been wound up. The number of research projects has been drastically cut down to introduce Project Based Budgeting (PBB) in due course of time.

Research Advisory Committee (RAC)

The meeting of RAC was convened on 16.3.2002 under the chairmanship of Dr. S. Sankaran. The others in the committee Dr. O.P. Gupta, Dr. R.K. Malik (Members), Mr. Kishori Mahato and Mr. R.K. Prasad (Non-official members) and Dr. N.T. Yaduraju (Member Secretary) Dr. V. M. Bhan (Special Invitee) also attended the meeting. During the discussion, major emphasis was given on commercialization of weeding tools, collaboration with industries and other organizations, quality publications as well as filling up of the vacant positions to achieve the targeted goals.

Institute Management Committee (IMC)

The Xth meeting of IMC of the Centre was held on 14 December 2001 under the chairmanship of Dr. N.T. Yaduraju, Director NRCWS, Jabalpur. The members present were Dr. Gurbachan Singh, ADG (Agro), ICAR, Dr. D.L.N. Rao, Project Coordinator (BNF), IISS, Bhopal, Dr. R.K. Malik, Professor and Head, Agronomy, CCSHAU, Hisar, Dr. L.P. Kauraw, Pr. Scientist, Sh. O.N. Tiwari, IJSC Secretary, Sh. Seshu Babu, AAO, and Sh. A.K. Shrivastava, AF&AO. The committee reviewed the various research and developmental activities of the Centre and suggested a number of measures to speed up the development of the Centre. The team of the IMC also visited the experiments being carried out at the poly house.

Fig. - 24 : IMC members visiting the net house experiments

Quinquennial Review Team (QRT)

The QRT consisting of Dr. S. Sankaran (Chairman), Dr. R.C. Rajak (Member) and Dr. L.P. Kauraw (Member Secretary) reviewed the work done at NRCWS during the past 5 years (1995-2000). The team appreciated the research being done at the Centre and emphasised the need for multi-disciplinary research to fulfill the mandate.

11 PARTICIPATION OF SCIENTISTS IN WORKSHOPS, CONFERENCES, MEETINGS AND SYMPOSIA

S. No.	Title of the Conference / Symposium	Venue & Date	Participants
1.	Biennial Conference of ISWS	UAS, Bangalore 23-24 May 2001	Dr. N.T. Yaduraju Dr. A.K. Gogoi Dr. V.P. Singh Dr. J.S. Mishra Dr. Anil Dixit
2.	NATP workshop on Conservation Tillage in Rice-Wheat Cropping System	PAU, Ludhiana 24-26 September 2001	Dr. N.T. Yaduraju
3.	International Conference on Pesticides, Environment and Food Security	IARI, New Delhi 21-24 November 2001	Dr. N.T. Yaduraju
4.	National Seminar on Production, Processing and Marketing of Medicinal and Aromatic Plants	JNKVV, Jabalpur 27-29 November 2001	Dr.B.T.S. Moorthy Dr. J. S. Mishra Dr. D. K. Pandey Dr. D. Swain Dr.P.J. Khankhane
5.	National Seminar on Plant Physiology	UAS, Dharwad 5-7 December, 2001	Dr. N.T. Yaduraju
6.	National Symposium on Contemporary Trends in Biological Sciences	RDVV, Jabalpur 5 January, 2002	Dr. Sushilkumar Dr. K.K. Barman Dr. D. K. Pandey
7.	National Seminar on Emerging Trends in Horticulture	Annamalai University, Annamalai 14-15 February 2002	Dr. D.K. Pandey
8.	International Workshop on Herbicide Resistance Management and Zero Tillage in Rice-Wheat Cropping System	CCSHAU, Hisar 6 March 2002	Dr. N.T. Yaduraju Dr. J.S. Mishra

S. No.	Title of the Conference / Symposium	Venue & Date	Participants
9.	Workshop on Sustainable Development	Environmental Planning & Co-ordination Organization (E.P.C.P.) Bhopal on 21 January 2002	Dr. P.J. Khankhane
10.	Brain-storming Session on Organic Farming and National Seminar on Indigenous Nutrient Management Practices followed in India	Indian Institute of Soil Science, Bhopal during 30-31 January 2002	Dr. N.T. Yaduraju Dr. B.T.S. Moorthy
11.	Workshop on Scientific and Wildlife Photography	Jabalpur on 19th February and Kanha National Park during 20-23 February 2002	Mr. Basant Mishra
12.	Annual Group Meeting of AICRP-Weed Control	NRCWS, Jabalpur on Oct 8-9, 2001	Dr. N.T. Yaduraju Dr. A.K. Gogoi and all scientists

12 WORKSHOPS, SEMINARS, SUMMER INSTITUTES, FARMERS' DAY ETC. ORGANIZED AT THE CENTRE

(A) Annual group meeting of All India Coordinated Research Programme on weed control

A group meeting of AICRP-WC was held at NRC-Weed Science, Jabalpur during 8-9 October 2001. Around 75 delegates from different cooperating centres and also invited experts like Dr. S. Sankaran, Ex-VC, TNAU, Coimbatore; Dr. S.V.R. Shetty, Sr. Consultant, IARSD besides personnel from herbicide industry participated in the meeting.

Dr. G.B. Singh, Vice Chancellor, JNKVV Jabalpur in his inaugural address emphasized the need for developing integrated weed management strategies involving weed competitive crop cultivars and using biotechnological tools in weed research. He also underlined the need for evolving weed management strategies for non-crop situation, forestlands, airports, pastures, etc. Dr. S. Sankaran expressed the need for on farm trials and dissemination of proven technologies for increasing crop productivity and income of the farmers He also suggested that the weeds of different ecological zones of Madhya Pradesh should be published in the form of Atlas with coloured photographs, which will be helpful for academicians, industry people and researchers. Dr. Shetty in his address mentioned that NRCWS has to play a key role in providing leadership in weed research to meet the future challenges. He said that NRC-WS is a unique organization of its kind in the in the country and the world where solutions to critical weed problems are found out by

Fig.- 25 : Dr. G.B. Singh, VC, JNKVV, Jabalpur , inaugurating the group meeting

a multi-disciplinary group of scientists. Dr. N.T.Yaduraju, Director, NRC Weed Science presented the salient findings of the AICRP-WC for the year 2000-2001. The problem weeds in different locations and also effective herbicides for different crops and cropping systems were highlighted. During this occasion, the chief guest Dr. G.B.Singh also inaugurated new training hall at NRCWS. A Web page on AICRP-WC was launched. A Profile on AICRP-WC and Annual Report (1999-2000) related to AICRP-Weed Control and Directory of Weed Scientists in India (compiled by Dr. N.T. Yaduraju) were released during the occasion. The Principal Investigators of different AICRP-WC centres presented their research findings of the previous year and finalized the programme of work for the next year. At the end, Dr. A.K. Gogoi, Principal Scientist (Agronomy) proposed vote of thanks.

(B) NATP Workshop organized

One-day workshop on NATP funded project-Development of National Database on Weeds was held on 10 October 2001 at NRCWS, Jabalpur under the chairmanship of Dr. V.M. Bhan, an eminent Weed Scientist and Ex Director of NRCWS. The resource persons included Dr. S. Sankaran, Dr. S.K. Mukhopadhyay, Dr. O.P. Gupta, Dr. S.V. R. Shetty and other delegates from AICRP-WC. Dr. N.T. Yaduraju, Director, NRCWS welcomed the delegation. In this workshop, discussion was made to improve the database by putting relevant and useful information about the weeds. Dr. A.K. Gogoi, Pr. Investigator of the project presented the model of Database. Dr. Bhan hoped that after completion, this database would be one of the most valuable electronic tools to provide comprehensive information on weeds.

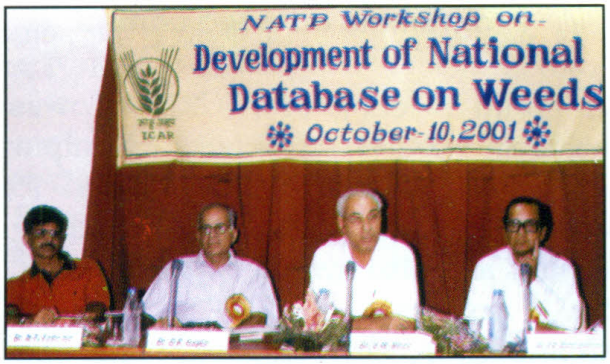

Fig.-26 : Dr. V.M. Bhan, Ex-Director, NRCWS addressing during NATP Workshop

(C) Farmers' Day organized

NRCWS organized Farmers' Day at village Surai near Belkhera on 23 October, 2001. Fifty farmers attended the function and *Kisan Gosthi*. Dr. N. T. Yaduraju, Director briefed the farmers about different extension activities and field demonstration conducted by the Centre. Scientists of the Centre explained different aspects of weed management in crop and non-crop situations as required by the farmers. They highlighted the chemical and biological control of *Parthenium* in crop and non-crop situations, use of herbicides, mechanical tools and implements for weed control in different field crops. Major emphasis was given on judicious use of herbicides. The scientists of the Centre answered many questions related to weed control problems posed by the farmers. Live demonstration was also given on the type of nozzles in herbicide spraying and methods of spraying

Fig.-27 : Farmers' day organised at nearby village and Director ineracting with interested farmers about latest trend in weed management

(D) Lectures delivered

The various personnel of the Centre delivered the following lectures in various training centres as follows:

Sl	Delivered by	Training	Subject	Venue and date
1	Dr. N.T. Yaduraju, Director	Training programme on production technology of sesame and niger at JNKVV, Jabalpur	"Weed management in sesame and niger"	11-14 September, 2001
		Training programme on recent trends in seed production management at JNKVV, Jabalpur	"Effect of agronomic practices on seed quality"	2 December, 2001
		Training programme on resource management for sustainable rainfed cropping system at JNKVV, Jabalpur	"Weed management in rainfed cropping system"	7 September, 2001
2	Dr. V. P. Singh Sr. Scientist	State Agricultural Development Officers at Farmer's Training Centre, Jabalpur.	Weed management in *rabi* crops	11 January, 2002
		-do-	Integrated weed management" on	26 March, 2002
3	Mr. Basant Mishra Photographer	Maharshi Ved Vigyan Arts and Commerce College Jabalpur	Photography application (advertising) during vocational course	21-31 January 2002

(E) Seminars, radio-TV talks delivered by the scientists of the Centre

Sl	Scientists	Topic	Date
1	Dr. Sushilkumar, Scientist (SS)	Amazing world of termites	29.09.2001
2	Dr.B.T.S.Moorthy, Pr. Scientist	Weed management in rice: Retrospect and prospects	27.102001
3	Dr. A.K. Gogoi, Pr. Scientist	Database on weeds: Relevance in weed management research	31.01.2002

(F) Training to research scholars and progressive farmers

The Centre provided a three months training to Ms. S. Madhuri and Ms. K. Sujana, M. Tech., M. Sc. students, Nagarjuna Univ., Guntur on Biotechnology involving tissue culture, herbicide assay, myco-herbicides under the guidence of Dr. L.P. Kauraw, Pr. Scientist (Pl. Patho.) and Dr. D. Swain, Sr. Scientist (Pl. Physiol.), respectively from May-July, 2001.

Scientist of the Centre exhibiting the latest trends in weed management technologies to the delegates visited the centre from Rajasthan State Govt., Kota, Rajasthan

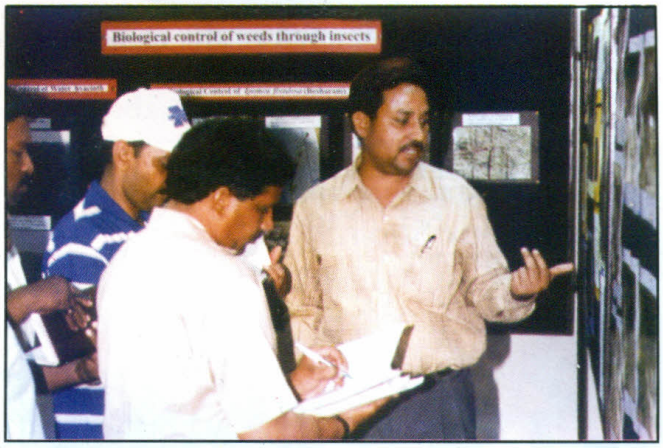

Fig.- 28 : Trainess being focussed on latest trends in weed managenment technologies

(G) Seminar-cum-training on biological control of *Parthenium*

In order to create public awareness regarding the necessity of control of allergy causing *Parthenium* weed popularly known as Congress grass or *Gajar ghas*. This noxious weed not only causes substantial losses to agriculture, forestry and horticultural crops, but also causes many health problems to man and animals. There fore it is needed to have more pro-active approach to manage this weed. Hence, a series of demonstration-cum-training programme was initiated in and around Jabalpur by involving various government organizations like MPEB, Telecom factory, NGOS, school/ colleges, colony residents, Rotary club and gram panchayat during July to September 2001. A live-cum-photo exhibition on integrated approach of *Parthenium* control was arranged at every meeting/ demonstration places and interactive session was also organized in which expertise from NRC-WS answered to various queries of the participants.

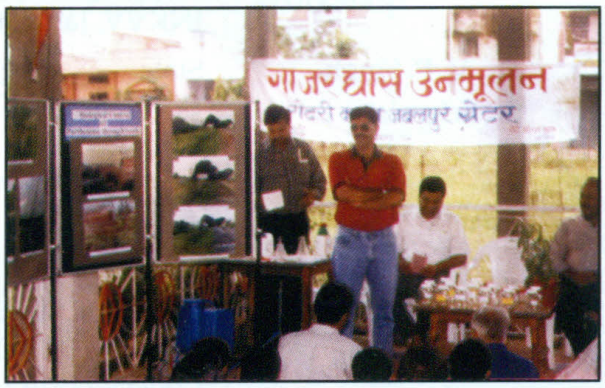

Fig.-29: *Parthenium* management campaign

Apart from this, thousands of beetles were released in the presence of participants and methods of mass production of beetles (*Zygograma biocolorata*) were also demonstrated. The culture of beetles and related literature to interested people. After seeing the overwhelming performance of the beetle, many organizations and people contacted our Centre and they were also provided beetles and literature were distributed without any cost. Biological control relatively takes more time for complete success. The effect of released beetles in field situation will be monitored in due course of time.

Fig.-30 : (a) Hand pulling of parthenium by peoples participants (b) Releasing mexican beetles

(H) National Environment Awareness Campaign

A National Environmental Awareness Campaign was organized by NRC Weed Science at Panagar, Jabalpur under the chairmanship of Dr. N.T.Yaduraju, Director on 27 March 2002. Around 75 farmers and representatives from Panchayat and Block sammiti participated in the programme. Scientists from the Centre and JNKVV, Jabalpur delivered talks on the subject.

Fig. – 31 : Environmental awareness campaign at Panagar block

13 DISTINGUISHED VISITORS

Visitors	Dates
Sh. Nitish Kumar, Union Cabinet Minister for Agriculture	9 April, 2001
Dr. R.S. Paroda, Director General , ICAR and Secretary, DARE	9 April, 2001
Dr. J.S. Samra, Deputy Director General (NRM), ICAR	9 April, 2001
Sh. Jayasri Banerjee, Member of Parliament, Jabalpur	9 April, 2001
Sh. Mahendra Singh, MP State Minister for Agriculture	9 April, 2001
Dr. B. R. Sharma , ADG (IWM) ICAR, New Delhi	18 August, 2001
Dr.G.B. Singh, Vice Chancellor, JNKVV, Jabalpur	8 October, 2001
Dr. S. Sankaran, Ex-Vice Chancellor, TNAU, Coimbatore	8 October, 2001
Dr. S.V.R. Shetty, Sr. Consultant, IARSD	8 October, 2001
Dr. V.M. Bhan, Ex-Director, NRCWS, Jabalpur	10 October, 2001
Dr. O.P. Gupta, Ex-DRS, RAU, Bikaner	10 October, 2001
Dr. S.K. Mukhopadhyay, Emeritus Scientist, VB Sriniketan	10 October, 2001
Dr. Walter Anyanga, Plant Breeder, SAAPRI, Uganda	4 December, 2001
Dr. Gurbachan Singh, ADG (Agro.) ICAR, New Delhi	14 December, 2001
Dr. R.K. Malik, Prof. & Head, Deptt. of Agronomy, CCS, HAU, Hisar	14 December, 2001
Dr. D.L.N.Rao, Project Coordinator (BNF), IISS, Bhopal	14 December, 2001
Dr. G.B. Singh, Vice Chancellor, JNKVV, Jabalpur	04 January, 2002
Dr A.S. Tiwari, Vice Chancellor, JNKVV, Jabalpur	27 February, 2002
Dr. J.P. Tiwari, Dean, College of Agriculture, Mandsore	27 February, 2002
Dr. J.S. Raghu, Dean, College of Agriculture, Gwalior	19 March, 2002
Shri Som Pal, Member (Agriculture), Planning Commission	21 March, 2002
Shri K. K. Jakhar, Ex-Minister of Rajasthan	21 March, 2002

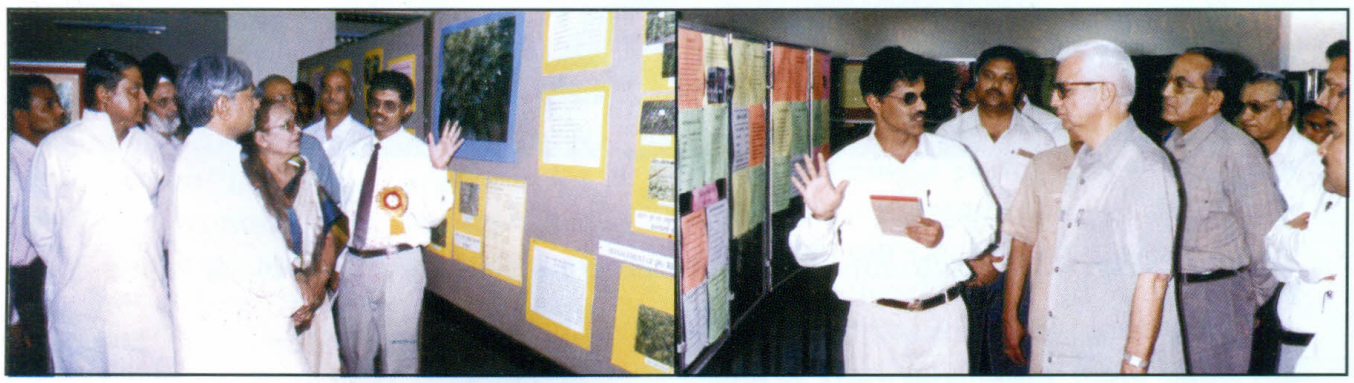

Fig.- 32 : Distinguished visitors at the Centre

14 हिन्दी सारांश

राष्ट्रीय खरपतवार विज्ञान अनुसवांान केन्द्र जबलपुर में वर्ष २००१—०२ के दौरान अनुसंधान गतिवधियां मुख्यत: शस्यक्रम में खरपतवार पर अध्ययन, फसलों एवं फसलीय सस्यक्रमों में एकीकृत खरपतवार प्रबंधन, भूमि पर शाकनासियों का प्रभाव तथा फसल खरपतवार प्रतिस्पर्धा एलिलोपेथी, जैविकीय एवं यांत्रिक खरपतवार प्रबंधन एवं इन तकनीकों का किसानों के खेतों पर प्रदर्शन पर आधारित थी । इन परिणामों का साराशं रूप इस प्रकार है :

शीत ऋतु के दौरान गेहूं की फसल को सोयाबीन, ज्वार एवं मक्के पर आधारित सस्यक्रम लेने पर इकाइनोक्लोवा कोलोना नामक खरपतवार की खरीफ मौसम में अर्थपूर्ण कमी दर्ज की गई ।

मक्के पर आधारित सस्यक्रम में कामेलिना कम्यूनिस खरपतवार की संख्या कम दर्ज की गई । एक अन्य सस्यक्रम जैसे ज्वार पर आधारित सस्यक्रम में शीत ऋतु में फेलेरिस माइनर एवं ऐवेना स्तरलिस स्पी. लूडोविसियाना नामक खरपतवारों की बढ़त देखी गई ।

सोयाबीन की फसल में, पांच स्ताह तक भूमि सूर्यीकरण के साथ अंकुरण पूर्व शाकनासी जैसे मेटोलाक्लोर (०.७५ कि.ग्रा./ हे) या निंदाई करने से मौसम पर खरपतवार नियंत्रित रहते है एवं साथ ही साथ सोयाबीन की ज्यादा उपज प्राप्त होती है । मक्के की सामान्य कतारो में बरबटी फसल को आंरिक फसल के तौर पर बोआई करने से खरपतवार की संख्या में अर्थपूर्ण कमी आती है वही मक्के की उपज में २४ प्रतिशत तक की बढ़ोत्तरी होती है ।

चांवल की कम अवधि वाली किस्म—वंदना खरपतवारो से प्रतिस्पर्धा के लिये अधिक श्रेष्ठ आंकी गई । इस किस्म की जल्द अंकुरण एवं तेज बढ़वार से उगने वाले खरपतवार छाया के कारण बढ़ नहीं पाते और यहीकारण है इसकी उपज एक निंदाई की सहायता से अच्छी प्राप्त हुई । इस किस्म को सामान्य परिस्थितियों में खरपतचार प्रंधन के लिये अनुसंशित किया जा सकता हे

सोयाबीन में, एस मेटोलाक्लोर (०..५ कि.ग्रा./हे), ऐलाक्लोर (१.५ किग्रा/हे) तथा फलूक्लोरिलिन (१.२५ किग्रा/हे.) के उपयोग से खरपतवार नियंत्रण अर्थपूर्ण दर्ज किया गया तथा दो निंदाईयों के उपज की दृष्टि से समतुल्य पाये गये ।

घान की फसल में, पायराजोझलफयूरान (२५ ग्रा/हे रोपाई के तीन दिन बाद), फेन्ट्राजामाई रोपाई के ४ दिन बाद तथा साइनोसलफयूरान; २० ग्रा./हे. रोपाई के १० दिन बाद उपयोग करने से ब्यूटाक्लोर की अपेक्षा अर्थपूर्ण प्रभावी सिद्ध हुये ।

सीधी बोयी गई धान में, फिनाक्साप्राप ६० ग्रा./हे., ब्यूटानिल जो कि ब्यूटाक्लोर एवं प्रोवेकिल नामक शाकनासियों का मिश्रण है को १.१२ + १.१२ किग्रा/हे की दर से क्लोरीयूरान + मेटसलफयूरान मिथाइल; ४ ग्राम/हे.

प्रेटीलाक्लोर; ०.२५ ग्रा./हे. तथा पायराजोसलफयूरान ०.२५ ग्रा./हे. का उपयोग खरपतवार नियंत्रण में प्रभावी सिद्ध हुये ।

गेहूं में, काटफेन्ट्राजोन २०—२५ ग्रा./हे. ३५ दिन पर का उपयोग करने से खरपतवार की संख्या एवं शुष्क पदार्थ में अर्थपूर्ण कमी दर्ज की गई । इस शाकनाशी को २,४—डी एवं मेटसलफयूरान मिथाइल के बदले में चौड़ी पत्ती वाले खरपतवारो को कम करने में उपयोग किया जा सकता है । इसके अलावा गेहूं की फसल पर कोई विपरीत प्रभाव भी नहीं देखा गया ।

इसी फसल में, मेटसल्फयूरान मिथाइल को सरफेक्टेन्ट के साथ ४ ग्राम/हे. तथा ट्राइफलोरेलिन २० ग्राम/हे अुकुरण पश्चात् उापयोग करने से चौड़ी पत्ती वाले खरपतवारों को कम करने में प्रभावी रूप से सहायक सिद्ध हुआ ।

सोयाबीन गेहूं चक्र में, गेहूं की कटाई के बाद बिना जोते सोयाबीन की बोआई करने से जोती गई स्थिति की अपेक्षा अच्छी उपज प्राप्त हुई । इस स्थिति से एक तरफ सोयाबीन की अधिक उपज ही मिलती है साथ—साथ जुताई में आने वाले खर्च से भी बचा जा सकता है ।

गेहूं की फसल में, सियोरियम इनटाइबस नामक खरपतवार के बड़ी पत्तियों एवं ज्यादा शुष्क पदार्थ उत्पादकता के कारण ज्यादा प्रतिस्पर्धा से गेहूं की उपज में लगभग ३५ प्रतिशत की कमी आती है इस की फसल में एक अन्य खरपतवार जंगली जई जो कि फसल के साथ प्रतिस्पर्धा कर फसल में लगभग ३५ प्रतिशत तक की उपज मे कमी करते है ।

सोयाबीन की फसल में, इकाइनोक्लोवा कोलोना यूकोरविया जेनीकुलावा की अपेक्षा ज्यादा प्रतिस्पर्धा में पाया गया ।

अच्छे सड़े हुये गेहूं के भूसे के अर्क का धान की अंकुरण, जड़ों एवं तने की वृद्धि पर प्रतिकूल असर देखा गया । जबकि दूसरी तरफ धान की फसल के मुख्य खरपतवार इकाइनोक्लोवा कोलोना की वृद्धि पर अनुकूल असर दर्ज किया गया । गेहूं की फसल एवं इसके मुख्य खरपतवार इकाइनोक्लोवा पर प्रतिकूल असर देखा गया ।

नीम की पत्तो एवं छिलको के अर्क के फिनोलिन मांग को १५ पी.पी.एम पर उपयोग करने से इकाइनोक्लोवा कोलोना पर प्रतिकूल असर देखा गया साथ ही साथ गाजरघास एवं ब्रासीका नेपस पर ज्यादा विषैला प्रभाव दर्ज किया गया । जबकि धान पर इसके विषैले प्रभाव का कम असर देखा गया ।

सामान्य परिस्थितियों में, एलीलो केमिकल्स (ओ. एंड एम ऐनेसिक अम्ल) पर लीथल प्रभाव देखा गया । जिन जलीय खरपतवारों को इनके द्वारा उपचारित किया गया था वे पांच दिन के अंतराल तक नष्ट हो गये तो भी पी. एनीसिक अम्ल ने भी वैसा ही प्रभाव दिखाया, परंतु इसका विषाक्तपन उन खरपतवारों पर ज्यादा दर्ज किया गया ।

सोयाबीन की फसल में जैविकीय नियंत्रण के फिक्सेसन में फलूक्लोरालिन एवं पेन्डीमिथलिन की अपेक्षा मेटलाक्लोर ज्यादा सुरक्षित पाया गया ।

जैविकीय खरपतवार नियंत्रण में, फाइजेलिस मिनिमा पर कॉक्सीनेलिडी वीटल नामक कीड़े का प्रभाव देखा गया दूसरी तरफ लेन्टाना कमारा खरपतवार पर टिनजिड बग का आक्रमण देखा गया ।

मेक्सीकन बीटल (जाइग्रोग्रामा बाइक्लोराटा) जो कि गाजरघास नष्ट करने में प्रभावी सिद्ध हुआ का बड़े स्तर पर मछरदानी एवं पिजड़ो में मल्टीप्लाई किया गया । गाजरघास को नष्ट करने हेतु जबलपुर जिले में व्यापक पैमाने पर कई जागरूकता अभियान किये गये ।

केसिडा नामक कीड़े का उऐलीगेट जलीय खरपतवार (आल्टरनेनथेरा फिलीवजराइड) पर आक्रमण देखा गया । यह खरपतवार जलीय स्थिति में अधिक गंभीर होता जा रहा है ।

सोयाबीन की फसल में, आई.आई.टी. खड़गपुर में विकसित किये गये मल्टी वीटर यंत्र से लगभग ६० प्रतिशत की खरपतवार नियंत्रण क्षमता दर्ज की गई ।

खरीफ मौसम के दौरान केन्द्र द्वारा विकसित खरपतवार तकनीकों का धान एवं सोयाबीन की फसलो में प्रदर्शन किया गया । शाकनासियों में प्रेटीलाक्लोर एवं ऐनीलोफास के धान में उपयोग करने से खरपतवार नियंत्रण अर्थपूर्ण पाया गया । जबकि सीधी बोई गई धान में, आलमिक्स काफी प्रभावी पाया गया । सोयाबीन की फसल में, नये शाकनाशी जैसे – क्लोरीमुरान, क्लोटीमुटान + फिनाक्साप्राप ईथाईल इमाजितपीर किसान की पद्धति से काफी प्रभावी सिद्ध हुये ।

15 PERSONALIA

Director
Dr. N.T. Yaduraju

Weed Management Group
Dr. B.T.S. Moorthy, Pr. Scientist (Agro)
Dr. V.P. Singh, Sr. Scientist (Agro)
Dr. R.P. Dubey, Sr. Scientist (Agro)
Dr. J.S. Mishra, Sr. Scientist (Agro)
Dr. Anil Dixit, Scientist (SS) (Agro)
Dr. M.B.B. Prasad Babu, Scientist (Soil Sci.)
Dr. P. J. Khankhane, Scientist (Soil Sci.)
Sh. J. N. Sen, Field Asstt (T-II-3)
Sh. Ajay Pal Singh, Field Asstt (T-2)
Sh. R. K. Meena , Field Asstt (T-2)
Sh. Jethuram Vishwakarma, Lab. Attnd.
Sh. Sebasten, Lab. Attnd.

Biological Weed Management Group
Dr. L.P. Kauraw, Pr. Scientist (Pathology)
Dr. Sushilkumar, Sr. Scientist (Entomo)
Sh. S. K. Tiwari, Field Asstt (T-2)
Sh. Madan Sharma, Lab. Attnd.
Sh. Pyarelal, Messanger
Sh. Chhotelal Yadav, Farm Mazdoor

Weed Physiology Group
Dr. D.K. Pandey, Sr. Scientist (Physiology)
Dr. D. Swain, Sr. Scientist (Eco-Bot)
Sh. G. Vishwakarma, Field Asstt (T-2)
Sh. J.P. Dahiya, Lab. Attnd
Sh. Shiv K. Patel, Messenger
Sh. Mahendra Patel, Security Guard

Mechanical Weed Management Group
Dr. H.S. Bisen, Pr. Scientist (Farm Machinery)
Sh. G.R. Dongre, Draftsman (T-5)
Sh. M.P. Tiwari, Mech. (T-II-3)
Sh. V.S. Raikwar, Field Asstt (T-1)
Sh. Dilip Sahu, Driver (T-1)

Residue Chemistry Group
Dr. K.K. Barman, Sr. Scientist (Soil Sci)
Smt Shobha Sondhiya, Scientist (Org. Chem.)
Sh. S.K. Bose, Field Asstt (T-2)
Sh. Gangaram, Security Guard
Sh. Santosh Kumar, Security Guard

Transfer of Technology Group
Dr. P.K. Singh, Sr. Scientist (Agril. Extn)
Sh. M.K. Bhatt, Artist – cum- Photographer (T-6)
Sh. B. Mishra, Sr. Photographer (T-5)
Sh. S.K. Parey, Tech. Asstt (T-II-3)
Sh. V.K.S. Meshram, Artist (T-5)
Sh. Santlal, Security Gaurd

Director's Cell
Dr. M.S. Raghuvanshi, Technical Officer
Smt. Nidhi Sharma, Sr. Stenographer
Sh. A.K. Bhowal, Jr. Stenographer
Sh. Ramkumar, Farm Mazdoor
Sh. Prem Lal, Driver

Coordination Group (AICRP-Weed Control)
Dr. A.K. Gogoi, Pr. Scientist (Agro)
Sh O.N. Tiwari, Tech. Asstt (T-4)
Sh Pankaj Shukla, T-II-3
Sh. Naresh Kumar Rajput, Farm Mazdoor

Administration
Sh. Ch Seshubabu, Asstt Admin.Officer (AAO)
Sh. S.K. Sharma, Asstt.
Sh. J.P. Kori, Sr. Clerk
Sh. R.Hadge, Sr. Clerk
Sh. M.K. Gupta, Jr. Stenographer (Hindi)
Sh. F. Xavier, Messenger
Sh. Veer Singh, Messenger
Sh. S. C. Rajak, Farm Mazdoor

Finance
Sh. A.K. Shrivastava, Asstt Fin. & Audit Officer
Sh. T. lakhera, Sr. Clerk
Sh. Sukha Singh, Messenger

ARIS Cell
Sh. Sandeep Dhagat, Technical Officer **(T-5)**

Library
Sh. R.N. Bharti, Librarian
Sh. S.L. Koshta, Lab. Attnd.

Farm Section
Sh. R.S. Upadhyay, Farm Manager
Sh. K.K. Tiwari, Field Asstt (T-2)
Sh. M.K. Meena, Field Asstt (T-2)
Sh. Bhagunte Prasad, Driver (T-1)
Sh. B. P. Uriya, Jr. Clerk
Sh. Jagat Singh, Farm Mazdoor
Sh. Jagoli Prasad, Farm Mazdoor
Sh. Raju Prasad Farm Mazdoor
Sh. Gajjulal, Farm Mazdoor
Sh. Rajesh, Security Guard
Sh. A.K. Tiwari, Messenger
Sh. Anil Sharma, Farm Mazdoor

16 OTHER RELEVANT INFORMATION

New laboratory-cum-administrative building inauguration

The Hon'ble Union Minister for Agriculture & Railways, Shri Nitish Kumar inaugurated the newly built laboratory-cum-administrative building of the centre on 9th April, 2001. Shri Mahendra Singh, State Agriculture Minister (Madhya Pradesh), Smt. Jayshree Banerjee, Member of Parliament, Jabalpur, Dr. R.S. Paroda, Director General ICAR & Secretary, DARE, Shri J.N.L. Srivastava, Agriculture Secretary, Govt. of India, Dr. G.B. Singh, Vice-Chancellor, JNKVV, Jabalpur, Dr. J.S. Samra, Deputy Director General (NRM), Dr. N.T. Yaduraju, Director, NRCWS and a large number of dignitaries, invitees and farmers were present on the occasion.

Besides launching of **website** of the centre, the inaugural issue of Newsletter "WEEDNEWS", a Profile of the Centre and Annual Report, etc. were also released on the occasion. In his welcome speech Dr. N.T. Yaduraju remembered the contribution of all the eminent weed scientists of the country and thanked the ICAR for recognizing the importance of weed science research in the country. NRCWS, he said, is one of its kinds not only in the country but in the world as well. The Director said that our goal is to enhance the crop productivity, profitability and stability of our farming system based on ecological ground rules. He underlined the fact that our aim is to harness science and technology for environmentally sustainable and socially equitable development.

Fig. - 33 : Launching of website by the Hon'ble Minister for Agriculture and release of Centre's publications by Hon'ble DG, ICAR and MP Jabalpur.

राजभाषा

केन्द्र की राजभाषा कार्यान्वयन समिति के तत्वाधान में 14 सितम्बर से 28 सितम्बर 2001 तक राजभाषा पखवाड़ा मनाया गया । इस कार्यक्रम में सभी वैज्ञानिकों/अधिकारियों एवं कर्मचारियों को हिन्दी में अधिकाधिक कार्य करने हेतु प्रेरित किया गया । इसके अंतर्गत विभिन्न प्रतियोगिताओं जैसे निबंध, शुद्धलेखन, टंकण, वाद-विवाद आदि का आयोजन किया गया जिसमें केन्द्र के सभी वर्गों के कर्मचारियों ने भाग लिया तथा विजताओं को पारितोषिक वितरण किया गया ।

राजभाषा कार्यान्वयन समिति के तत्वाधान में 14 सितम्बर से 28 सितम्बर 2001 तक राजभाषा पखवाड़ा ।

Annexure-I

Meteorological data during 2001-02

Months	Temperature (°C)		Relative humidity (%)		Vapour pressure (mm)		Wind velocity (Km/hr)	Rainfall (mm)
	Maxi	Mini	Morn.	Even.	Morn.	Even.		
April,2001	36.9	20.6	53	21	11.2	9.1	-	11.7
May	41.3	26.9	47	22	14.1	11.5	-	29.3
June	32.5	24.4	85	64	21.0	21.0	7.2	332.2
July	28.5	23.9	93	82	21.8	22.7	6.5	566.3
August	30.5	24.3	91	77	22.1	22.6	4.3	312.3
September	32.5	22.9	86	56	20.0	19.6	2.8	139.2
October	31.4	19.2	91	49	17.3	16.4	1.4	90.0
November	29.6	12.2	90	29	10.8	8.8	1.4	-
December	26.7	8.5	92	32	8.1	8.1	1.3	-
January,02	24.6	8.1	91	38	8.0	8.4	2.0	-
February	27.4	11.9	86	38	10.2	9.9	2.4	43.7
March	33.1	15.3	68	21	10.3	7.6	2.2	3.8
Total								1528.5