वार्षिक प्रतिवेदन
ANNUAL REPORT
2004-2005

भाकृअनुप
ICAR

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

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

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Front Cover

Mexican prickly-poppy (*Argemone mexicana* L., Papaveraceae) popularly known as *Satyanashi* is an alien invasive weed, common in north India. The seeds of this plant are similar to those of mustard and rapeseed. An intake of *Argemone mexicana* seed/oil, even in small doses, causes dropsy (a lethal disease affecting the heart and blood vessels), the symptoms of which include swelling of the joints (Oedema), skin pigmentation, acute nausea and vomiting.

Inside Back Cover

Kisan Mela organised on 5th March 2005 which was graced by Shri Kantilal Bhuria, Hon'ble Minister of State for Agriculture, Govt. of India and Shri Digvijay Singh, Former Chief Minister, Madhya Pradesh.

PREFACE

The National Research Centre for Weed Science is a nodal centre for research and training in weed science in the country. It is also mandated to serve as a repository of information and to provide consultancy in the field. Over the last five years, the Centre has been very successful in strengthening the research infrastructure with new equipments/facilities worth about Rs. 25 million. Through V-SAT and LAN, all the scientists have been provided with internet facilities. Similarly, development of infrastructure such as farm roads, electrification, construction of farm store etc. has been made. All the work items approved in the X plan (valuing Rs. 22 million) are at various stages of implementation and are expected to be completed by 2006. The improved working environment is expected to substantially enhance the quality of research output by the scientists in the future.

The year is eventful for the Centre in getting about five externally funded research projects from diverse organizations like ICAR, DBT and ISRO. The Centre has also offered training in research on weed management to about 17 scholars of different Universities, as done in the past. The Centre has made significant progress in the transfer of proven weed management technology in both cropped and non-cropped situations through on-farm trials and field demonstrations and by organizing *kisan goshties* and *kisan melas*.

The Centre has continued its excellent past record of popularizing the biocontrol of Parthenium by Mexican beetle, *Zygogramma bicolorata* throughout the country. A National *Parthenium* Awareness Day was initiated by the Centre on 4th September 2004 which was enthusiastically celebrated all over the country. About 1 lakh beetles were supplied as a nucleus culture to different stakeholders. Large scale demonstration on management of *Parthenium* through integrated approach is being taken up under a DBT sponsored project at eight locations all over the country. The Centre has brought out several publications like technical bulletins and extension folders during the year.

I am pleased to present the Annual report of National Research Centre for Weed Science for the year 2004-05 which I sincerely hope would be of use to all those involved in the field of weed management. I welcome suggestions for improvement in our future research efforts.

N.T. Yaduraju
Director

ACKNOWLEDGEMENT

The encouragement and valuable support given by Dr. Mangala Rai, Secretary, DARE and Director General, ICAR, in the development of the Centre is gratefully acknowledged. Thanks are also due to Dr. J.S. Samra, Deputy Director General (NRM) and Dr. Gurbachan Singh, Assistant Director General (Agro), NRM for their valuable advice and guidance. The keen interest and suggestions by Dr. J.S. Kolar, Chairman and other members of the Research Advisory Committee in guiding the research activities of the Centre is greatly acknowledged. The scientists of the Centre are appreciated for their untiring enthusiasm in conducting the research and supplying the material for this report. The painstaking efforts of the Editorial Committee comprising Dr. B.T.S. Moorthy, Dr. D.K. Pandey, Dr. R.P. Dubey and Dr. M.B.B. Prasad Babu in compiling and editing the report, are commendable. Thanks are also due to Dr. M.S. Raghuvanshi and Mr. Sandeep Dhagat and other technical and administrative staff for their help in bringing out this publication.

N.T. Yaduraju
Director

Contents

मुख्य अंश

इस वर्ष केन्द्र ने अनुसंधान एवं तकनीकी हस्तांतरण में विशेष प्रगति की है । अनुसंधान के अंतर्गत मुख्य क्षेत्रों में खरपतवार प्रबंधन हेतु अपनाई गई पद्धति में प्रतियोगी फसलों, अन्तवर्तिय फसलें, भूमि सूर्यीकरण, माल्चिंग, सस्यक्रम आदि, संसाधन संरक्षण तकनीकीयों जैसे-जीरों जुताई एवं फसल अवशेष प्रबंध, शाकनाशियों के उपयोग एवं उनके भूमि में अवशेष संबंधित अनुसंधान कीटों द्वारा खरपतवारो का जैवकीय नियंत्रण आदि पर परीक्षण किये गये । साथ ही साथ खरपतवारों की जीव विज्ञान एवं पारस्थितिक कार्यिकी से संबंधित अनुसंधान अध्ययन भी किया गया । केन्द्र ने इस साल भी गाजरघास को खाने वाले मेक्सिकन बीटल का पूरे भारत में प्रभावी तौर पर विस्तार एवं वितरण जारी रखा । इसके अलावा, केन्द्र ने विशेष किसानों हेतु उन्नत खरपतवार प्रबंधन तकनीकीयों का कई प्रक्षेत्रों पर परीक्षण एवं प्रदर्शन किए, तथा किसान मेले एवं किसान दिवस आयोजित किए गए । और इन सबके अलावा केन्द्र ने वर्ष भर कई प्रकाशनों एवं तकनीकी पुस्तिकाओं एवं फोल्डर्स का प्रकाशन किया ।

इस वर्ष के दौरान मुख्य अनुसंधान परिणाम इस प्रकार है :

(अ) कल्चरल पद्धति द्वारा खरपतवार प्रबंधन-

गेहूँ की खरपतवार प्रतियोगी किस्मों पर परीक्षण में यह पाया गया कि इसकी तीन किस्में क्रमशः डब्ल्यू एच 147, डी एल 803-3 एवं राज 3777 सभी ज्यादा उपज देने में काफी प्रभावी दर्ज की गई । जहां पी बी डब्ल्यू 343 एवं सुजाता ने जंगली जई जैसे खरपतवार की वृद्धि को रोकने में सहायक सिद्ध हुए । वहीं डी एल 788-2, एच डी 2285, पी बी डब्ल्यू 343 एवं राज 3765 जंगली जई की सघनता को कुछ हद तक सहन कर सके । धान की फसल में, इसकी 48 किस्मों को इनकी उपज हेतु परीक्षण किया गया जिसमें साथी 34-36 को एक निंदाई में सर्वोत्तम पाया गया । चने की किस्मों में, जेजी-16 एक खरपतवार चिनोपोडियम अलबम से प्रतियोगिता करने में काफी प्रभावी माना गया ।

सरसों की फसल में जौ, जई एवं बरसीम को अंतः वर्तिय फसलों के रूप में खरपतवारों की वृद्धि को रोकने हेतु प्रभावी माना गया । जहां सरसों के साथ बरसीम को अंत; फसल के रुप में लेने से सरसों की सबसे ज्यादा उपज दर्ज की । अरहर में बरबटी (काऊपी), उड़द एवं सोयाबीन नामक फसलें अंतवर्तिय फसलों के रुप में प्रभावी माना गया ।

तिल-टमाटर पद्धति में, 45 दिन का भूमि सूर्यीकरण को के साथ गोबर के खाद एवं इसके बिना तथा फसल अवशेष के साथ परीक्षण करने पर खरपतवार नहीं पनपे । परंन्तु भूमि सूर्यीकरण मे मेउीकागों एवं विसिया जैसे खरपतवारों के अंकुरण एवं वृद्धि पर कोई प्रभाव नहीं पडा।

(ब) संसाधन संरक्षण तकनीकी

केन्द्र ने संसाधन संरक्षण गतिविधियों के अन्तर्गत जीरो टिलेज, फसल अवशेष प्रबंधन आदि पर कई अनुसंधान कार्य किये गये। धान-गेहूँ सस्यक्रम में, गेहूँ में जीरो टिलेज अपनाने से गेहूँ का मामा तथा चीनोपोडियम जैसे खरपतवार जहां नहीं के बराबर पाये गये वहीं जंगली जई एवं मेडिकागो की सघनता में वृद्धि पाई गई । सोयाबीन पर आधारित सस्यक्रम में, गेहूँ की सामान्य उपज एवं अलसी की उपज में बढ़ोत्तरी दर्ज की गई । जीरो टिलेज के अपनाने से दालों एवं तेलों की फसलों की उपज में सामान्य बढ़ोत्तरी दर्ज की गई ।

रोपाई की धान में जहां संसाधनों की बहुतायत में आवश्यकता होती है वहीं उपरांव धान में पानी के संरक्षण हेतु मजदूरी में कम व्यय एवं उर्जा संचयन को ध्यान में रखते हुए इसमें जीरो टिलेज की संभावनाओं पर अनुसंधान किया गया । उपरांव धान में पहली खरपतवार बढ़त को गायफोसेट (0.5 प्रतिशत) नामक शाकनाशी के उपयोग से एवं जीरो टिलेज करने से परम्परागत पद्धधि की अपेक्षा अच्छी उपज प्राप्त की गई ।

अवशेष प्रबंधन पद्धधियों जैसे अवशेषों के बिना, उन्हे जलाना एवं जमीन में मिलाने से भी धान के खरपतवारों पर कोई विशेष प्रभाव नहीं देखा गया । परन्तु गेहूँ में यदि धान के अवशेषों के डाले बिना ही मेडीकागों हिस्पीडा एवं कुल खरपतवारों की संख्या में बढ़ोत्तरी होती है । धान की फसल में गेहूँ के अवशेषो को जमीन में मिलाने से उपज में कमी दर्ज की गई तथा वहीं गेहूँ की फसल में धान का अवशेष मिलाने से गेहूँ की फसल में बढ़ोत्तरी दर्ज की गई । धान की फसल में हर्रा ढ़ेईचा मिलाने से सवॉ नामक खरपवतार के अंकुरण में 50 प्रतिशत तक कमी दर्ज की गई । इसका ताजा अर्क भी संवा के अंकुरण एवं इसके अंकुरो के लिए विषाक्त साबित हुआ । तत्व साघनो को ध्यान में रखते हुए लेन्टाना के अवशेष विशेषतः फसल अवशेषों एवं हरे ढ़ेईचे की अपेक्षा अधिक उपयोगी एवं अर्थिकीय पाया गया ।

(स) शाकनाशी उपयोग एवं इनके अवशेष

धान में, फिनाक्साप्राप नामक शाकनाशी को 56.25 g/ha की दर से 3 से 4 सप्ताह के बीच उपयोग करने से खरपतवारों की संख्या एवं शुष्क पदार्थ में अर्थपूर्ण कमी दर्ज की गई । सोयाबीन में, फ्लूमाक्सीयान नाम नये शाकनाशी का उपयोग करने से चौड़ी पत्ती वाले खरपतवारों की संख्या का प्रभावी नियंत्रण किया गया । धान में शाकनाशियों के मिश्रण जैसे ऐसीटाक्लोर, बेनसल्फ्यूरान मिथाईल 25 प्रतिशत डब्ल्यू पी 100 g/ha की दर से काफी प्रभावी पाया गया । प्याज की फसल में आवही फ्लूराफेन (30 दिन बाद) के बाद हेलाक्सीफॉप 100 ग्रा/हे का उपयोग करने से प्याज की सबसे जयादा उपज प्राप्त हुई ।

सोयाबीन में, उच्च 450 लीटर/हे एवं मध्य व्हालूम 225 लीटर/हे छिड़काव से खरपतवार नियंत्रण क्षमता सबसे अधिक आंकी गई ।

इस वर्ष शाकनाशी रसायनों के अवशेषों से संबंधित प्रयोगशाला में आधुनिक तकनीक की मशीनरीज एवं अन्य सुविधाओं के होने से इसके एनालिसिस से संबंधित अनुसंधान का सुचारू रूप से कार्य शुरू हो गया है । ब्यूटाक्लोर नामक शाकनाशी के अवशेषों हेतु एक अध्ययन से यह विदित हुआ कि इसका क्षेत्रीय एवं प्रयोगशालीय परिस्थितियों में इसका अवशेष जमीन में क्रमशः 18 एवं 20-23 दिन रहता हैं । जिसकी मात्रा जमीन में लगभग 0.635 माइक्रो ग्राम प्रति ग्राम मिटटी जो की उपयोग के 24 घंटे बाद 0.032 माइक्रो ग्राम प्रति ग्राम मिटटी कटाई के वक्त रह जाता है । जबकि एक अन्य अध्ययन में मेट्रीब्यूजीन एवं एट्राजिन नामक शाकनाशी जमीन में 52 सेमी. गहराई तक वितरित पाये गये । जिसमें मेट्रीब्यूजीन की अधिकतम मात्रा (सान्द्रता) जमीन की 26-36 सेमी गहराई पर एवं एट्राजिन 50 प्रतिशत मात्रा सेमी गहराई तक पाई गई ।

सस्यक्रमों द्वारा खरपतवार प्रबंधन

धान गेहूं सस्य क्रम पद्धधि में, सवां, फाईलेन्थस, फाइसेलिस एवं कामेलिना की संख्या सबसे कम दर्ज की गई वही मोथा एवं आल्टरनेनथेरा सेसिलिस उपरांव धान में सबसे कम पाये गये । ब्यूटाक्लोर के लगातार उपयोग से या इसके एवं एनीलोफॉस के एक वर्ष छोड़ दूसरे वर्ष उपयोग करने से मोथे एवं कामेलिना की संख्या में अर्थपूर्ण कमी आती है । गेहूँ पर आधारित सस्यक्रमों में, मेडिकागो हिस्पीडा नामक शाक सोयाबीन, गेहूँ सस्यक्रम पद्धति में सबसे कम दर्ज किया गया । गेहूँ की उपज सोयाबीन गेहूँ सस्यक्रम की अपेक्षा उपरांव धान-गेहूँ सस्यक्रम में सबसे ज्यादा दर्ज की गई ।

जैविकी एवं पारिस्थितिक कार्यिकी

धान-गेहूँ के सस्य क्रम में, नत्रजन की मात्रा देने से धान की प्रतियोगी क्षमता सवां की अपेक्षा बढ़ती है । वही गेहूँ के साथ जंगली जई, गुल्ली डंडा की अपेक्षा ज्यादा प्रतियोगी होती है । गाजरघास अंकुरण हेतु 24 सेल्सियस तापमान आवश्यक पाया गया ।

हाइड्रोक्वीनोन नामक पौध विषाक्त धान एवं कारा नामक पौधो हेतु क्रमशः 5 मिली माइक्रोन तथा 0.075-0.10 मिली माइक्रोन लीथल पाया गया ।

बढ़ी हुई कार्बन-डाई आक्साईड सी-3 खरपतवारों में सी-4 खरपतवारों की अपेक्षा अधिक प्रकाश संश्लेषण दर दर्ज की गई । खरीफ मौसम के सी-3 खरपतवार जैसे *जेन्थियम स्ट्रूमेरियम* एवं *आल्टरनेनथेरा सेसिलिस* जिनमें प्रकाश संश्लेषण की प्रक्रिया बढ़ी हुई दर्ज की गई तथा बड़ी साइप्रस रोटण्डस तथा सिसलिया जो कि सी-4 खरपतवार है, में कोई अधिक प्रभाव नहीं देखा गया । जबकि रबी मौसम के खरपतवारों जैसे पार्थेनियम, सोनकस आरवेनसिस तथा चिनोपोडियम अलबम में प्रकाश संश्लेषण प्रक्रिया अधिक दर्ज की गई वहीं लेथाईरस, गुल्लिडंडा एवं एवेना लूडोविसियानान नामक खरपतवारों में यह प्रक्रिया बिल्कुल नहीं दर्ज की गई ।

खरपतवारों का जैवकीय नियंत्रण

इस वर्ष केन्द्र ने गाजरघास हेतु मेक्सिकन कीड़े का बहुत ही प्रभावी प्रदर्शन किया गया एवं साथ ही साथ लगभग एक लारव कीड़े नये स्थानों में भेजे गए । कीड़ो के ज्यादा उत्पादन एवं इसके वितरण हेतु विधिका स्टेण्डर्डाईजड किया गया ।

जबलपुर में पार्थेनियम का मेक्सिकन बीटल द्वारा नियंत्रण प्रभावी किया गया । इस कीड़े की स्थापना का विभिन्न प्रदेशों जैसे उत्तरांचल, उत्तरप्रदेश, पंजाब, हरियाणा एवं दिल्ली में अवलोकन किया गया । सामान्यतः किसानो द्वारा बनाई गई पार्थेनियम की खाद की अपेक्षा अन्य विधियॉ जिसमें गोबर की खाद द्वारा, मिटटी द्वारा एवं यूरिया के द्वारा बनाई गई खाद ज्यादा अच्छी होती है । एक प्राथमिक अध्ययन में, यूरोमाईसीज नामक सूक्ष्म जीव द्वारा यूफोरबिया जैनीकुलाटा खरपतवार का प्रभावी नियंत्रण किया गया ।

ट्राईकोडरमा के ए-4, ए-5, बी-1, बी-2, सी-1, डी-2 एवं एफ-2 नामक आइसोलेट्स द्वारा गुल्ली डंडा खरपतवार के अंकुरण पर विपरीत प्रभाव छोड़ा वही गेहूं के लिए काफी सुरक्षित पाया गया । *ट्राइकोडरमा विरिडी* एवं वाररेंस द्वारा *फेलेरिस माइनर* के विरूद्ध मध्यम प्रभाव दिखाया गया । एलाक्लोर, फ्लूक्लोरालिन नामक शाकनाशियों द्वारा *ट्राइकोडरमा* की अपेक्षा *स्कलेरोशियम रोलफसाई* को अर्थपूर्ण प्रभावित किया । जलकुंभी के नियंत्रण हेतु शाकनाशियों जैसे 2, 4-डी एवं ग्लाइफोसेट के साथ जैविक नियंत्रण के कीड़ो को साथ उपयोग करने से इसका प्रभावी नियंत्रण देखा गया।

अखिल भारतीय समन्वित अनुसंधान परियोजना

खरपतवार नियंत्रण केन्द्र ने इस वर्ष इसके द्वारा संचालित अ.भा.स.अनु. परियोजना-खरपतवार नियंत्रण की गतिविधियों के साथ समन्वय जारी रखा तथा अनुसंधान गतिविधियों को समय-समय पर देखा । इसके अनुसंधान परिणामों पर एक वार्षिक प्रगति प्रतिवेदन का अलग से प्रकाशन किया गया है ।

इस वर्ष भी कीड़ो की स्थापना हेतु देखरेख एवं सर्वेक्षण किया गया । साथ ही साथ कीड़ो को प्रभावी तौर पर छोंड़ने का भी कार्य किया गया ।

EXECUTIVE SUMMARY

The Centre has made significant progress in research and transfer of technology during the year. The major thrust areas of research covered were cultural methods of weed management by employing competitive crop cultivars, intercrops, soil solarization, mulching, cropping systems etc., resource conservation technologies like zero tillage and crop residue management, herbicides and their residues and biological management of weeds using insects and plant pathogens. Various aspects of biology and ecophysiology of weeds were also studied. The Centre has continued its excellent track record of popularizing the biocontrol of Parthenium by Mexican beetle, *Zygogramma bicolorata* throughout the country. In addition, the Centre has also taken up several on-farm trials and field demonstrations on proven weed management technology, conducted *kisan melas* and field days to educate farmers. The Centre has brought out several publications like technical bulletins and extension folders during the year.

The major achievements made by the Centre are summarized below.

Cultural Methods of Weed Management

Screening of 18 wheat cultivars for their weed competitive abilities under sub-optimal weed management condition revealed that three cultivars viz., WH147, DL803-3 and Raj 3777 were promising with higher yields. Wheat cultivars, PBW 343 and Sujata suppressed the wild oat more effectively while DL 788-2, HD 2285, PBW 343 and Raj 3765 were relatively more tolerant to wild oat infestation. Among the 48 upland rice cultivars screened for their yield potential under sub-optimal weed management condition, cv. Sathi 34-36 proved to be the best under one hand weeding condition. Chickpea variety, JG-16 was found to be a better competitor with *Chenopodium album* as compared to JG 315 and JKG 92337.

Barley, oat and berseem were effective as intercrops in suppressing the weeds in mustard, with mustard + berseem intercropping combination giving the highest mustard yield as compared to mustard sole cropping. In pigeonpea intercrops like cowpea, blackgram and soybean were effective.

In sesame-tomato system, soil solarization for a period of 45 days with FYM, without FYM and crop residue reduced the emergence of weeds. Soil solarization failed to check the emergence of *Medicago hispida* and *Vicia sativa*.

Resource Conservation Technologies

The Centre continued to make investigations on resource conservation technologies such as zero tillage, crop residue management etc. In transplanted rice-wheat system, the population of *Phalaris minor* and *Chenopodium album* decreased and *Avena sterilis* spp. *ludoviciana* and *Medicago hispida* increased in wheat, irrespective of the tillage. In soybean-based cropping systems, zero tillage in both the seasons resulted in comparable yield of wheat and significantly higher yield of linseed as compared to conventional tillage. Zero tillage gave higher yields in winter season oilseeds and pulses *viz.*, chickpea, pea, linseed, lentil and mustard as compared to conventional tillage.

Investigations were started to explore the possibility of practicing zero tillage in direct-seeded rice with a view to conserve water and reduce labour and energy requirement which otherwise are essential for raising a transplanted crop. In direct-seeded rice, killing first flush of weeds before sowing by application

of glyphosate (0.5%) and zero till drilling of rice yielded better than conventional tillage, transplanting or puddled broad cast sowing.

Residue management methods viz., removal, burning and incorporation, did not affect weeds in transplanted rice while removal of rice residues resulted in highest *Medicago hispida* and total weed population in wheat. The yield of rice was lowest under incorporation of wheat residue where as the yield of wheat was highest. Green manuring with *Sesbania* reduced the germination of *Echinochloa colona* by 50% during the early stages up to nine DAS. The aqueous leachates from *Sesbania* were also toxic to the germination and seedling growth of *Echinochloa colona*. *Lantana* biomass proved to be a practical and economical substitute to crop residues as well as to *Sesbania* as a nutrient source.

Herbicide Use and Residues

In transplanted rice, application of fenoxaprop (56.25 g/ha) applied between 3 and 4 weeks after transplanting proved effective in significantly reducing the weed population and weed dry weight. Flumioxazin, a new herbicide was found promising for the control of broad leaved weeds in soybean. Acetachlor + bensulfuron methyl 25% WP @ 1000 g/ha was a better herbicide as compared to butachlor and pretilachlor for weed control and realizing higher yields in transplanted rice. Sequential application of haloxyfop 100 g fb oxyfluorfen 200 g/ha at 30 DAT gave the highest bulb yield in transplanted onion, as compared to their single application.

In soybean, the weed control efficiency was better with high volume (450 l/ha) and medium high volume (225 l/ha) sprays compared to low volume (50 l/ha) and very low volume (20 l/ha) spraying.

With the rejoining of Residue Chemist and upgrading of the laboratory facilities the herbicide residue analysis work was streamlined. Half-life of butachlor was found to be 18 days under field conditions and 20 to 23 days under laboratory condition. The residue level of butachlor in soil was found to be 0.635 ìg/g, 24 h after application, which decreased to 0.032 ìg/g by harvest. Metribuzin and atrazine were found distributed in soil up to a depth of 52 cm. Maximum concentration of metribuzin was recovered from 28-36 cm depth while that of atrazine (45% and 48%) from 0-4 cm depth. About 80% of applied pendimethalin was distributed in 0-12 cm soil depth and 45% butachlor in 0-4 cm.

Weed Management in Cropping Systems

The population of *Echinochloa colona*, *Phyllanthus niruri*, *Physalis minima* and *Commelina communis* was lowest under transplanted rice-wheat cropping system, while that of *Cyperus iria* and *Alternanthera sessilis* under direct-seeded rice-wheat system. Continuous use of butachlor 1.5 kg/ha or alternate year use of butachlor 1.5 kg/ha and anilofos 0.4 kg/ha significantly reduced the emergence of *Cyperus iria* and *Commelina communis*. In wheat-based systems, the infestation of *Medicago hispida* is lowest under soybean-wheat system. The grain yield of wheat was highest under direct-seeded rice-wheat system followed by that of soybean-wheat.

Biology and Eco-physiology of Weeds

Supply of nitrogen increased the competitive ability of rice as compared to *Echinochloa colona*. Wild oat became more competitive with wheat as compared to *Phalaris minor* with nitrogen supply. A temperature of about 24°C was found suitable for the germination of *Parthenium* seeds. Hydroquinone, a phytotoxin was found lethal to rice at 5 mM and to green musk chara (*Chara zeylanica* Willd.) at 0.075-0.10 mM.

The elevated CO_2 increased the photosynthetic rate in C_3 weeds as compared to C_4 weeds. Among the *kharif* weeds the rate of photosynthesis increased in *Xanthium strumarium* and *Alternanthera sessilis*, while no considerable change was observed in *Cyperus rotundus* and *Caesulia axillaris* (C_4 weeds). Among the *rabi* weeds photosynthesis was higher in case of *Parthenium hsyterophorus* followed by *Sonchus arvesis* and *Chenopodium album*, while the increase was not considerable in case of *Lathyrus sativa*, *Phalaris minor* and *Avena ludoviciana*.

Biocontrol of Weeds

The Centre was actively engaged in popularizing the management of *Parthenium* by Mexican beetle, *Zygogramma bicolorata*. About one lakh beetles were dispatched to newer areas. The protocols for mass rearing of the beetle as well as their packaging for dispatch were standardized. The survey and monitoring of the establishment of the beetle were continued and augmenting the beetle population for effective control were attempted. The beetle was found to effectively control *Parthenium* in Jabalpur and its suburbs in the 5th year of its release. The establishment of the beetle was also observed in parts of Uttaranchal, Uttar Pradesh, Punjab, Haryana, and Delhi. Layering method of *Parthenium* composting by giving different treatments like dung slurry, soil and urea was superior to the method usually practiced by farmers.

Euromyces sp., causing rust disease, was found to be an effective pathogen for the biocontrol of *Euphorbia geniculata*, in the preliminary studies.

Trichoderma isolates A4, A5, B1, B2, C1, D2 and F2 inhibited germination of *P. minor* and were safe to wheat. *Trichoderma viride* and *Trichoderma virens* gave moderate response against *P. minor*.

Alachlor and fluchloralin did not inhibit *Trichoderma* sp. while they drastically reduced the mycelial biomass of *Sclerotium rolfsii*.

Integration of herbicides like 2,4-D and glyphostate with the bioagent *Neochetina* spp., proved to be effective for early control of water hyacinth.

AICRP on Weed Control

The Centre coordinated and monitored the activities of AICRP on Weed Control which is operating at 22 SAUs. A separate Annual report has been brought out highlighting the achievements of the Project.

INTRODUCTION

The National Research Centre for Weed Science (NRCWS) was set up in 1989 as a nodal centre for basic as well as applied research in weed science under the aegis of ICAR. The Centre also coordinates the activities of the AICRP-WC with a network of 22 cooperating Centres located in different agro-climatic zones covering the entire country. The Centre has a well-qualified and multidisciplinary team of scientists engaged in different aspects of weed management research. The Centre is located between 22.49° and 24.8° North latitude, 78.21° and 80.58° East longitude and at an altitude of 411.78 metres above the mean sea level. Jabalpur comes under the agro-climatic region of Kymore Plateau and Satpura Hills and lies in the rice-wheat cropping zone of the state.

MANDATE

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

LABORATORIES

The Centre has six air conditioned laboratories well equipped with modern scientific instruments like GLC, GC, HPLC, IRGA, Atomic Absorption Spectrophotometer, Canopy analyzer, UV-Visible double beam spectrophotometer, universal research microscope with photographic attachment, stereo zoom research microscope, nitrogen auto analyzer, leaf area meter with colour image analysis system, high speed refrigerated centrifuge, Millipore filter assembly, multi-probe soil moisture meter, Chlorophyll meter, GPS etc. The Centre also has a freezing microtome for histo-pathological studies and a lyophilizer for making myco-herbicidal formulations. The Centre has a well developed agricultural engineering workshop with facilities for fabrication, designing and development of weed control tools and implements. In addition to these, facilities for

herbicide screening, field facility, net/poly house, quarantine insectory and containment facility, and quarantine net house for research on transgenics and an automatic weather station to record the daily weather data is also available. are also available.

Recently the Centre has also acquired two controlled environmental chambers to facilitate research under controlled conditions, four open top chambers for studies on crop-weed competition under elevated CO_2 conditions, as well as a pneumatic boat for survey and surveillance of aquatic flora and fauna.

ARIS Cell

Centre's ARIS cell is well equipped with computers, VSAT and LAN facilities. Specialized software like ARCInfo for GIS analysis, ERDAS Imagine for satellite image analysis besides the routinely used software for data analysis are also available. All the scientists are provided with internet facility also.

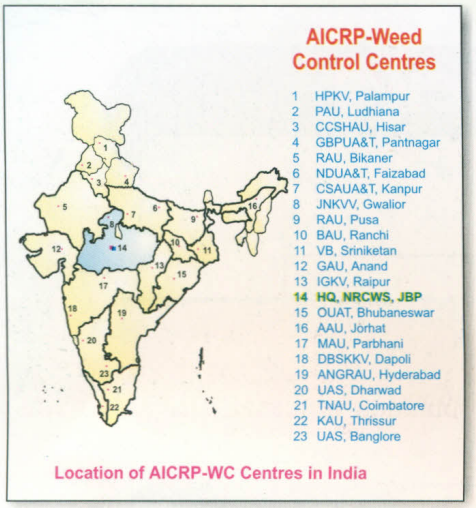
Library

At present the library is having a total collection of 1255 books. It has modern facilities such as CAB-PEST and CAB-SAC CD-ROMs and Current Contents on Diskette (CCOD) on biological sciences. The library subscribes to 65 Indian and 17 foreign journals. Reprographic and documentation facilities such as lamination and spiral binding machines are available for preparation of documents and reports.

Research farm

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


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



Location of AICRP-WC Centres in India

AICRP-Weed Control

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

Staff and Finance

NRCWS has a sanctioned cadre strength of 27 scientists, 28 technical, 13 administrative and 23 supporting staff. The current staff position as on 31.03.2004 was 18 scientists including one post of RMP, 25 technical, 10 administrative and 23 supporting. The annual budget of the Centre for the year 2003-2004 is indicated in the table. The Centre also generates resources through the sale of farm produce and testing of new herbicide formulations provided by the industries.

Staff position as on 31.3.2005

Categories	Sanctioned	Filled	Vacant	Addl. Sanctioned*
Research Management Position (RMP)	01	01	-	-
Scientific	26	17	09	-
Technical *	28	25	03	7
Administrative*	13	11	02	1
Supporting*	23	23	-	2
Total	**91**	**76**		**10**

* 10 posts under Technical, Administrative and Supporting have been approved in the EFC meeting of the Centre held at the council.

Budget and expenditure for the year of 2004 -05 (Rs. in Lakhs)

Sl. No.	Head	Plan			Non Plan		
		Proposed R.E	Expen-diture	Percent Expdt.	R.E	Expen-diture	Percent Expdt.
01.	Estt. Charges	10.00	9.97	99.70	159.30	123.82	77.73
02.	O.T.A.	0.00	0.00	0.00	0.05	0.05	100.00
03.	T.A	2.00	2.00	100.00	1.30	1.24	95.38
04.	Other charges	153.00	152.62	99.75	50.00	50.00	100.00
	Matching Grant	0.00	0.00	0.00	50.00	49.98	99.96
05.	**Works**						
a.	Approved Works	70.00	69.49	99.27	0.00	0.00	0.00
b.	Maintenance of office building	0.00	0.00	0.00	5.85	5.70	97.44
c.	Maintenance of residential quarter	0.00	0.00	0.00	3.00	2.91	97.00
06.	Other	1.00	0.81	81.00	0.00	0.00	0.00
07.	IT	10.00	10.01	100.10	0.00	0.00	0.00
08.	HRD	1.00	0.98	98.00	0.00	0.00	0.00
	TOTAL	**247.00**	**245.88**	**99.55**	**269.50**	**233.70**	**86.72**
09.	**AICRP-WC**	**400.00**	**392.38**	**98.10**	-		
	NEH Region	30.00	30.00	100.00	-		
10.	Pension	-	-	-	7.00	6.56	93.71
11.	Personal Loans & advances	-	-	-	31.00	30.89	99.65

RESEARCH HIGHLIGHTS

Weed management through genotypes and cultural practices

Weed competitive crop cultivars

Performance of wheat varieties under optimal and sub-optimal weed management practices

To find out a suitable wheat cultivar for sub-optimal weed management condition, a field experiment was conducted with 3 weed management practices in main plots and 18 wheat varieties in sub plots fitted in a split plot design replicated thrice. The major weed flora were, *Vicia sativa, Medicago hispida, Lathyrus aphaca, Cichorium intybus, Chenopodium album, Physalis minima, Asphodelus tenuifolius, Phalaris minor* and wild oats. The variety WH147 proved superior with higher yields under both unweeded and single hand weeded condition. In general, 3 varieties WH147, and DL803-3 were promising with higher yields and weed competitive abilities. Most of the varieties tested produced near potential yields under single hand weeded condition.

Grain yield (t/ha) of different wheat varieties under various weed management practices, winter season 2003-04

Variety	Weedy	Hand Weeding once	Weed free	Mean
HI 1077	5.94	6.30	6.00	6.80
PBW 343	5.42	5.90	6.20	5.84
UP2382	5.44	5.80	6.10	5.78
GW273	5.75	6.00	6.30	6.00
DL803-3	6.36	7.00	7.30	5.35
GW173	5.01	5.40	5.65	5.35
DL788-2	5.04	5.50	5.80	5.44
Lok-1	5.00	5.40	5.80	5.40
AKW-1	4.59	5.00	5.30	4.94
Raj3777	6.05	6.40	6.70	6.38
HD2285	4.10	4.50	4.80	4.46
HD2402	4.70	4.80	5.10	4.48
Raj3765	4.68	4.90	5.30	4.96
Sonalika	4.86	5.11	5.40	5.12
HD 8381 (Malwa Shree)	4.37	5.19	5.50	5.02
HD8498 (Malwa Shakti)	5.12	5.60	5.90	5.54
Sujata	5.49	6.00	6.30	5.92
WH 147	6.56	7.00	7.40	6.97
Mean	5.23	5.65	5.94	-
LSD (P=0.05)	***V: 0.38***	***Others : NS***		

Competitiveness of different chickpea varieties against *Chenopodium album*

A field experiment was conducted with three chickpea varieties in main plots tested at five densities of *C. album* in sub plots fitted in a split plot design replicated thrice. There was gradual decline in seed yield of chickpea with increasing densities of *C. album* from 0-200/m^2. Among the varieties JG-16 was a better competitor with *C. album* as compared to JG 315 and JKG 92337.

Seed yield (g/m^2) of chickpea varieties under different densities of *Chenopodium album*

Density of *C. album* (no/m^2)	JG-315	JKG-92337	JG-16	Mean
0	683.3	550.0	770.0	667.8
25	576.7	470.0	676.7	535.5
50	506.7	376.7	560.0	520.0
100	450.0	316.7	543.3	436.7
200	386.7	300.0	509.7	398.8
Mean	520.7	402.7	611.9	

Weed competitive rice cultivars

Screening of upland rice varieties for their yield potential under sub optimal weed management condition was taken up. Among the 48 rice varieties tested, Sathi 34-36 performed best with grain yield of 417 g/m^2 under one hand weeding condition.

Among the three varieties tested, Vandana (171.1 g/m^2) performed better compared to Kalinga-III (131.7) and Annada (123.6) under different levels of competition offered by *Echinochloa colona*. Rice plant height was an important character influencing competition with weeds. Plant height of Vandana was 72.8 cm at 60 DAS whereas it was 66.2 cm in Kalinga-III and 46.0 cm in Annada.

Evaluation of wheat varieties against wild oat under zero tillage

Thirteen wheat varieties were tested for their relative suppressive ability on wild oat in zero tillage condition. Results revealed that cv. PBW 343 and Sujata suppressed the wild oat more effectively than other cultivars. The cultivars *viz.*, DL 788-2, HD 2285, PBW 343 and Raj 3765 were relatively more tolerant to wild oat infestation as compared to others. DL 803-3 was the most susceptible cultivar for wild oat.

Population and dry weight of wild oat as affected by wheat cultivars

Variety	Wild oat population (no/m²)*	Wild oat dry weight (g/m²)*		
		Weedy	Clodinafop	Mean
HD 2285	11.77	10.81	3.56	7.19
DL 803-3	16.75	12.63	5.19	8.91
Sonalika	13.16	10.95	5.05	7.99
Raj 3777	14.52	11.76	5.78	8.77
WH 147	11.88	10.17	3.52	6.85
DL788-2	13.56	11.77	4.48	8.13
Raj 3765	12.64	10.11	5.88	7.99
PBW 343	15.34	8.77	4.53	6.65
Sujata	11.56	9.73	3.83	6.78
HD 2402	12.53	12.08	4.97	8.53
Lok-1	13.21	10.76	5.52	8.14
GW 273	13.62	12.01	4.07	8.04
GW 173	8.23	9.94	6.03	7.98
LSD (P=0.05)	***2.11***			***1.48***

** Values subjected to square root transformation*

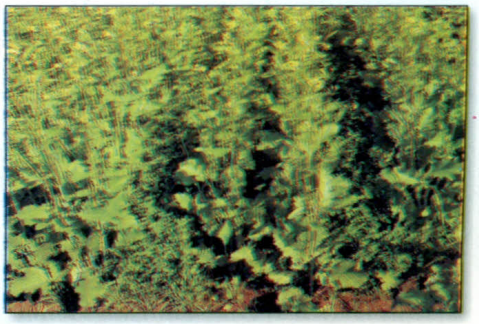
Grain yield (kg/ha) of wheat as affected by cultivars and weed control measures

Cultivars	Weed control measures				% Reduction in weed free over weedy check
	Weedy	Clodinafop	Weed- Free	Mean	
HD 2285	3100	4400	4900	4133	36.73
DL 803-3	1000	4767	5333	3767	81.25
Sonalika	2667	4167	4500	3778	40.73
Raj 3777	2067	5367	6133	4522	66.29
WH 147	2300	4767	4967	4011	53.69
DL788-2	2833	4300	4450	3861	36.40
Raj 3765	2500	4283	4450	3744	43.82
PBW 343	2733	4633	4800	4056	43.06
Sujata	2200	4600	4867	3889	54.80
HD 2402	2067	4933	4933	3978	58.10
Lok-1	2253	4967	5233	4151	56.95
GW 273	1800	4567	5767	4044	68.79
GW 173	2367	4783	5167	4106	54.19
LSD(P=0.05)	***2299***	***4656***	***5038***	-	-

LSD (P=0.05): V-540; WC- 259; V x WC- 935 (Sig)

Intercropping and weed management

Influence of intercrops on weed suppression and yield of mustard



Three intercrops i.e., barley, oat and berseem were evaluated in mustard to know their weed suppressing ability. The major weed flora observed were *Euphorbia geniculata, Avena ludoviciana, Medicago denticulata, Physalis minima, Paspalum* sp. and *Vicia sativa*. The current (second) year results indicated that all the three test intercrops were effective in suppressing the weeds in mustard. Highest mustard yield was obtained from mustard + berseem intercropping combination (2134 kg/ha) even as compared to mustard sole cropping (1859 kg/ha).

Influence of intercrops for weed management in pigeonpea

A field experiment on pigeon pea with six intercropping systems in main plot and three weed control treatments in sub plot, in a split plot design replicated thrice was conducted during *kharif* season of 2004.The major weed flora observed were *Echinochloa colona, Commelina benghalensis, Alternanthera sessilis, Physalis minima, Phyllanthus niruri, Cyperus iria, Dinebra sp. Euphorbia geniculata* etc. Cowpea, blackgram and soybean, among intercrops were most effective in suppressing weeds. However, highest pigeonpea equivalent yield was obtained with pigeonpea + sorghum, pigeonpea + cowpea and pigeonpea + blackgram.

Treatments	Weed population (no/m^2)*	Weed dry weight (g/m^2)*	Seed yield (kg/ha)	Pigeon pea Equivalent yield (kg/ha)
Intercropping System				
Pigeon pea sole 60cm	10.1	10.4	2889	2889
Pigeon pea + Sorghum	8.8	10.0	2715	3515
Pigeon pea +Sesamum	9.2	10.4	2453	2557
Pigeon pea +Cowpea	5.2	7.4	2849	3310
Pigeon pea +Soybean	6.2	8.4	2306	2406
Pigeon pea +Blackgram	5.3	7.6	2763	3081
LSD(P=0.05)	0.4	0.5	85	
Weed Control				
Pendimethalin 1.0 kg/ha Pre emergence + 1 Hand Weeding	6.4	5.5	3107	
1 Hand weeding	7.6	6.2	2799	
Unweeded	9.3	14.8	2080	
LSD(P=0.05)	***0.2***	***0.4***	***83***	

** Values subjected to square root transformation*

Soil Solarization

Long term effect of soil solarization on weed dynamics in sesame-tomato cropping system

A field experiment was conducted to assess the effectiveness of soil solarization with and without FYM on the emergence of weed flora in sesame. Results indicated that soil solarization for a period of 45 days with FYM, without FYM and crop residue reduced the emergence of *Echinochloa colona, Cyperus iria, Phyllanthus niruri,* and *Commelina communis* in sesame and *Avena sterilis, Cichorium intybus* and *Physalis* minima in tomato. But soil solarization failed to check the emergence of *Medicago hispida* and *Vicia sativa*. Similar trend was also observed with total weed population and weed dry matter production. Among the weed control treatments, application of pendimethalin ether at recommended or half of recommended dose significantly reduced the emergence of *Echinochloa colona* only. Higher seed yield of sesame and fruit yield of tomato were recorded with soil solarization.

Effect of soil solarization on weed growth in sesame in sesame-tomato system

Treatments	Weed population (no/m²)*	Weed dry weight (g/m²)*	Seed yield (kg/ha)
Solarization			
Non-solarization (NS)	7.52	11.87	80
Non-solarization +FYM	7.40	11.64	79
Non-solarization +Wheat straw	6.67	10.89	72
Soil solarization (SS)	1.24	4.43	226
Soil solarization +FYM	1.31	3.65	215
Soil solarization +Wheat straw	2.69	4.86	161
LSD (P=0.05)	***1.31***	***2.87***	***41***
Weed control			
Weedy check	5.48	9.61	130
Pendimethalin 0.63 kg/ha	4.04	7.04	161
Pendimethalin 1.25 kg/ha	3.89	7.03	126
LSD (P=0.05)	***0.92***	***2.0***	***29***

** Values subjected to square root transformation*

Effect of soil solarization on weed growth and yield of tomato in sesame-tomato system

Treatments	Weed population (no/m²)*	Weed dry weight (g/m²)*		Tomato yield (t/ha)
		60 DAS	Harvest	
Solarization				
Non-solarization	9.57	12.53	22.91	11.18
Soil solarization	5.78	5.69	12.77	20.75
Soil solarization +FYM	5.49	8.08	12.46	24.83
Non-solarization +FYM	10.03	13.26	22.87	11.88
LSD (P=0.05)	1.19	1.46	2.31	5.10
Weed control				
Weedy check	9.39	11.87	19.81	14.45
Pendimethalin 0.63 kg/ha	7.12	9.09	17.37	16.48
Pendimethalin 1.25 kg/ha	6.78	8.71	16.07	20.55
LSD (P=0.05)	1.03	1.26	2.00	4.42

** Values subjected to square root transformation*

Tillage and weed management

Influence of tillage and weed control methods on weed dynamics in wheat under transplanted rice-wheat cropping systems

Results of the third year experiment indicated that irrespective of tillage, the population of *Phalaris minor* and *Chenopodium album* decreased and *Avena sterilis* spp. *ludoviciana* and *Medicago hispida* increased over time. Clodinafop at 0.06 kg/ha *fb* 2,-4 D 0.50 kg/ha effectively controlled both grassy and broadleaved weeds and produced higher grain yield of wheat.

Tillage	Grain yield (kg/ha) of wheat			Mean
	Weedy	Isoproturon	Clodinafop	
Zero tillage (Early sowing)	1075	2681	5094	2950
Zero tillage (Normal sowing)	2244	2419	4456	3040
Deep tillage	1045	2370	3925	2447
Mean	1455	2490	4492	
LSD (P=0.05): Tillage-458; Herbicide-428; AiBi-AiBj-742; AiBi- AjBi-757				

Influence of tillage on weed dynamics in soybean based cropping systems

During third year winter season, population of all the *rabi* weeds was significantly higher in linseed than wheat except *Euphorbia geniculata* which was not affected. Based on the results of three years, it is concluded that zero tillage in both the seasons resulted in comparable yield of wheat and significantly higher yield of linseed as compared to conventional tillage.

Tillage system	Grain yield (kg/ha)							
	Wheat				Linseed			
	2001-02	2002-03	2003-04	Mean	2001-02	2002-03	2003-04	Mean
No tilled - No tilled	3691	5125	3492	4103	1019	1314	1706	1346
No tilled - Tilled	4013	4861	3471	4115	924	982	1464	1123
Tilled - No tilled	3509	4278	3681	3823	732	1069	1383	1061
Tilled - Tilled	3656	4649	4283	4196	1158	1037	1544	1246
LSD (P=0.05)	***361***	***577***	***NS***		***361***	***222***	***114***	

Evaluation of winter oilseeds and pulses under zero tillage

Keeping the success of zero tillage in wheat after transplanted rice in view, winter season oilseeds and pulses *viz.*, chickpea (JG-315), pea (JP 885), linseed (JL 23-10), lentil (L 40-70) and mustard (Pusa Bold) along with wheat (WH-147) were evaluated for their performance under ZT conditions. Results revealed that tillage has variable effect on population and dry weight of weeds in different crops. Seed yield of all the crops was higher under ZT than CT. This clearly indicated that not only wheat but winter season oilseeds and pulses could also be grown successfully under ZT conditions after transplanted rice.

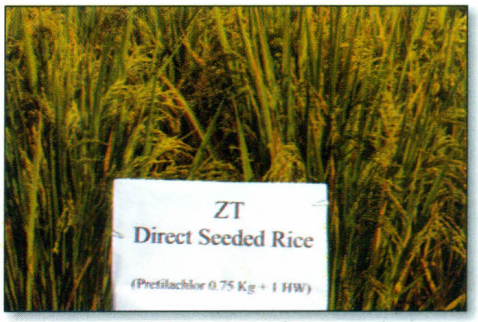
Weed population under different tillage systems

Crops/Tillage systems	Weed population (no/m²)					
	Medicago hispida	*Chenopodium album*	*Physalis minima*	*Vicia sativa*	Others	Total
Wheat (Tilled)	153	19	5	1	1	179
Wheat (Zero tillage)	64	2	1	0	0	68
Mustard (Tilled)	206	11	3	3	2	225
Mustard (Zero tillage)	109	7	4	0	0	120
Linseed (Tilled)	21	15	15	8	0	59
Linseed (Zero tillage)	34	52	7	74	0	169
Chickpea (Tilled)	125	13	3	0	0	141
Chickpea (Zero tillage)	83	21	3	2	11	122
Pea (Tilled)	13	6	9	0	0	28
Pea (Zero tillage)	11	35	6	5	5	62
Lentil (Tilled)	10	35	0	11	1	57
Lentil (Zero tillage)	5	36	0	12	0	53

Weed biomass and yield of various crops as influenced by different tillage systems

Crop	Weed biomass (g/m^2)		Grain yield (kg/ha)	
	Till	No Till	Till	No Till
Wheat	39.5	27.6	3500	4063
Chickpea	27.2	96.6	1475	2150
Pea	53.5	14.6	2198	3055
Lentil	42.3	51.3	2380	2573
Mustard	65.0	94.0	1050	1313
linseed	47.2	42.9	1178	2075

Integrated weed management in zero till direct seeded rice



Direct seeding of rice is gaining popularity in many areas of Asia due to shortage of labour during the transplanting season, increasing costs, water scarcity, etc. Weed management is the major concern in direct - seeded rice. Weed problems could successfully be managed by using broad-spectrum herbicides. The high costs of weed control could be a major constraint to the widespread adoption of direct-seeding methods, especially dry seeding. The cost of weed control could partially or completely be compensated with savings in tillage operations in zero tillage. As the zero till DSR facilitates timely sowing of wheat, even a slight loss in rice productivity is compensated by increased wheat yields, implying no loss in system productivity.

Results of the field experiments revealed that killing first flush of weeds before sowing by application of glyphosate (0.5%) and zero till drilling of rice yielded better than conventional tillage, transplanting or puddle broad cast sowing. The weeds in all rice cultures were managed with pretilachlor 0.75 kg/ha as pre-emergence + 1 hand weeding at 30 DAS.

Weed management through herbicides

Fenoxaprop-p-ethyl against grasses in transplanted rice

Application of fenoxaprop at 56.25 g/ha reduced the weed population and weed dry weight by 63%. A higher dose, though recorded lowest weed population but slightly phytotoxic effect was noted on the crop, which recovered later. The grain yield of rice crop was the highest under weed free situation followed by fenoxaprop application. Weed free plot produced the significantly highest grain yield of 5.89 t/ha over all other treatments and gave an advantage of 110% over weedy check. Fenoxaprop treated plots also produced higher yields and gave an increase of 88.6, 90.0 and 92.8% under the dose of 45, 56.25 and 112.5 g/ha, respectively, over weedy check.

Treatments (g/ha)	Weed population (no/m²)*	Weed dry weight (g/m²)	% Weed control efficiency	Grain Yield (t/ha)	% increase in yield over weedy check
Fenoxaprop at 45	7.32	25.0	61.0	5.28	88.6
Fenoxaprop at 56.25	6.89	23.5	63.2	5.32	90.0
Fenoxaprop at 112.5	6.78	17.0	73.4	5.40	92.8
Weed free	0.71	-	100	5.89	110.0
Weedy check	8.71	64.0	-	2.80	-
LSD (P=0.05)	***0.67***	***6.42***	***-***	***1.21***	***-***

**Values are subjected to square root transformation*

Flumioxazin- A promising herbicide for soybean

The experimental field was infested with *Echinocloa colona, Echinocloa crusgalli, Alternanthera sp., Commelina communis, Cyperus rotundus, Euphorbia geniculata* and *Physalis minima.* The weed population recorded at 60 days after sowing revealed that the post emergence application of flumioxazin at all the rates reduced the population of weeds. The treatment flumioxazin (Sumisoya) had shown good control of broad-leaved weeds in soybean and had suppressing ability over grasses. Activity of flumioxazin against monocot (*Echinochloa crus-galli, Cyperus rotundus* and *Commelina benghalensis*) and dicot (*Parthenium hysterophorus, Physalis minima, Euphorbia geniculata* and *Xanthium strumarium*) weeds, increased with increase in application rates being maximum at 90 g/ha applied either as pre-plant incorporation or pre-emergence to soybean. However, it could not surpass weed free and pre-emergence application of metribuzin (500 g/ha) as far as weed control is concerned. Pre-emergence application of flumioxazin at 90 g/ha produced the similar yield (1183 kg/ha) to that of metribuzin (1220 kg/ha) applied at 500 g/ha as pre-emergence to soybean but both former treatments were inferior to weed free which produced the maximum seed yield (1363 kg/ha) and proved significantly superior over all the weed control treatments. The pre-emergence and pre-plant incorporation of flumioxazin did not show any phytotoxic effect on crop. The study revealed that appreciable control of broad leaved weeds could be obtained by the application of flumioxazin in soybean.

Treatments (g/ha)	Weed population* (no/m²)		Weed dry weight (g/m²)	Yield (kg/ha)
Flumioxazin30 PPI	3.80	4.40	269.6	831
Flumioxazin 45 PPI	3.34	3.84	172.0	936
Flumioxazin 60 PPI	2.73	2.73	133.5	964
Flumioxazin 90 PPI	2.40	2.27	105.3	980
Flumioxazin 30 PE	3.97	3.80	235.6	848
Flumioxazin 45 PE	2.53	2.95	101.3	1012
Flumioxazin 60 PE	2.18	2..01	60.0	1068
Flumioxazin 90 PE	2.19	1.46	32.3	1183
Metribuzin 500 PE	1.85	1.55	30.1	1220
Weed free	0.71	0.71	-	1363
Weedy check	4.55	5.36	454.6	506
LSD (P=0.05)	***0.34***	***0.47***	***28***	***60.8***

**Values are subjected to square root transformation*
PPI- Pre-plant incorporation, PE Pre-emergence

Bioefficacy of acetachlor + bensulfuron methyl 25% WP against weeds in transplanted rice

The experimental field was dominated by *Caesulia auxillaris* (34%), *Cyperus iria* (30%), *Echinochloa colona* (20%), *Alternanthera sessilis* (4%) and others (12%). Among the herbicides tested, acetachlor + bensulfuron methyl 25% WP @1000 g/ha resulted in broad spectrum weed control and recorded the lowest weed population and dry weight as compared to traditional herbicide i.e., butachlor. The study clearly indicated that acetachlor + bensulfuron methyl 25% WP @ 1000g is a better herbicide as compared to butachlor and pretilachlor in controlling weeds and realizing higher productivity of transplanted rice.

Treatments	Dose (g/ha)*	Weed population (no/m²)	Weed dry weight (g/m²)	Rice		
				Plant height (cm)	Panicles (no/m²)	Grain yield (kg/ha)
Acetachlor + bensulfuron methyl 25% WP	250 g	59.3	73.5	88.1	137.0	3215
Acetachlor + bensulfuron methyl 25% WP	375 g	53.3	70.4	89.9	141.5	3965
Acetachlor + bensulfuron methyl 25% WP	500 g	46.6	64.3	92.3	153.5	4015
Acetachlor +bensulfuron methyl 25% WP	625 g	47.3	59.9	94.8	166.7	4565
Acetachlor + bensulfuron methyl 25% WP	1000 g	42.3	42.1	97.2	175.8	5480
Pretilachlor 50%EC	1000 ml	58.7	100.2	89.2	134.5	3480
Butachlor 50% EC	2500 ml	48.0	81.4	93.4	161.8	4050
Unweeded control	-	92.3	152.3	90.1	116.0	3030
LSD (P=0.05)		***12.5***	***30.3***	***7.2***	***24.5***	***505***

**On commercial product basis*

Unweeded treatment

Haloxyfop 100 g fb Oxyfluorfen 200 g/ha

Effect of single and sequential application of herbicides on weeds and yield of transplanted onion

A field experiment was conducted during *rabi* 2003-2004 to evaluate single and sequential application of herbicides for weed control in onion. The major weeds observed were *Avena* sp., *Medicago denticulata, Chenopodium album* and *Phalaris minor*. Among the herbicide treatments, oxyfluorfen 200 g/ha 3 DAT followed by oxyfluorfen 200 g/ha 30 DAT and haloxyfop 100 g/ha 10 DAT followed by oxyfluorfen 200 g/ha 30 DAT controlled the weeds most effectively as evidenced by weed dry weight of 2.3 and 2.5 g/m^2, respectively at 45 DAT. The study revealed that highest bulb yield of 49.1 t/ha was obtained from the sequential application of haloxyfop 100 g fb oxyfluorfen 200 g/ha 30 DAT.

Mechanical weed management and spary application techniques for herbicides

Design and development of improved weeding tools and machines

Engine powered aquatic weed cutter

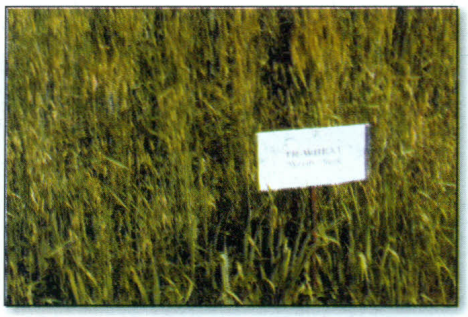
The testing and evaluation of engine powered aquatic weed cutter/harvester was carried out in Adhartal pond. The machine was improvised and refined during the year. The machine after modifications and refinements is functioning satisfactorily. The mechanical weeding tools with improved design were fabricated at the Centre's workshop for farmers use. Few units of the improved weeding tools were distributed during 'Kisan Mela' at the centre in the month of March 05. The manufacturing drawing of improves weeding tools namely big-wheel hoe, wheel hoe, twin wheel hoe, NRCWS wick applicator, crescent hand hoe and multi-weeders were multiplied and sent to different organizations for their manufacturing locally.

Studies on spray application techniques for herbicides

In soybean, better weed control efficiency was achieved in case of high volume (450 l/ha) and medium high volume (225 l/ha) sprays compared to low volume (50 l/ha) and very low volume (20 l/ha) spraying. The seed yield of soybean varied between 4820 to 5350 kg/ha which was comparable to the grain yield obtained under weed free check (5570 kg/ha), while in wheat, application of metribuzin controlled weeds effectively with a weed control efficiency of 64 to 89%. The study revealed that weed control achieved in all the spray application treatments was almost same. In case of 2,4D, the weed control efficiencies achieved were found varying between 85 to 98% on weed count basis and 94 to 99% based on fresh weight.

Weed management in cropping systems

Weed dynamics in rice-wheat systems



Studies on weed flora shift under two rice-based cropping systems *viz.* (direct-seeded rice and transplanted rice-wheat) as influenced by continuous use of herbicides revealed that both the cropping systems significantly influenced the emergence of *Echinochloa colona, Phyllanthus niruri, Cyperus iria, Physalis minima, Commelina communis* and *Alternanthera sessilis*. Lowest population of *Echinochloa colona, Phyllanthus niruri, Physalis minima* and *Commelina communis* were recorded under transplanted rice-wheat cropping system while, *Cyperus iria* and *Alternanthera sessilis* were recorded under direct seeded rice-wheat cropping system. So far as the total weed population and its dry matter production is concerned, lowest weed growth was recorded with transplanted rice-wheat system.

Continuous use of butachlor 1.5 kg/ha or alternate year use of butachlor 1.5 kg/ha and anilofos 0.4 kg/ha significantly reduced the emergence of *Cyperus iria* and *Commelina communis*. However, all the herbicides reduced the emergence of weeds over to weedy check. Similar trend was also recorded with weed growth pattern.

Treatments	Population/m²					
	Echinochloa colona	*Phyllanthus niruri*	*Cyperus iria*	*Physalis minima*	*Commelina communis*	*Alternanthera sessilis*
Cropping systems:						
Transplanted rice-Wheat	10.89	6.87	9.55	2.35	2.46	2.56
Direct seeded rice-Wheat	11.83	15.82	4.74	4.36	6.17	0.96
LSD (P=0.05)	***1.62***	***1.62***	***2.10***	***1.09***	***1.37***	***0.95***
Herbicides:						
Butachlor 1.5 kg/ha	10.76	11.55	4.60	3.03	3.58	1.53
Anilofos 0.4 kg/ha	10.05	11.49	9.45	3.10	5.03	1.85
Alternate use of Butachlor & anilofos	10.85	11.58	5.30	3.51	3.55	1.65
Weedy check	13.67	10.76	8.73	3.77	4.50	2.01
LSD (P=0.05)	***2.29***	***NS***	***2.97***	***NS***	***NS***	***NS***

Influence of wheat-based cropping systems and herbicides on weed dynamics in wheat

Studies on weed dynamics as influenced by continuous or in rotation use of herbicides under wheat-based cropping systems revealed that none of the cropping systems influenced the population of all weed species except *Medicago hispida* and its lowest population was recorded under soybean-wheat system. However, continuous or in rotation use of herbicides significantly reduced the population different weed species as compared to weedy check. Continuous or rotational use of clodinafop 60 g/ha fb 2,4-D 0.5 kg/ha significantly reduced the population of *Avena sterilis*, *Medicago hispida* and *C.album*. Significantly lowest weed dry weight was recorded under soybean-wheat system at harvest over the rest of the cropping systems. None of the cropping systems significantly influenced the grain yield of wheat. However, highest grain yield of wheat was recorded under direct seeded rice-wheat systems followed by soybean-wheat.

Effect of herbicides and wheat-based cropping systems on weed dynamics in wheat.

Treatments	Weed population (no/m²)*			
	Avena sterilis	*Medicago hispida*	*Chenopodium album*	*Cichorium intybus*
Cropping systems				
Soybean-wheat	8.13	4.01	1.57	1.75
Direct seeded rice-wheat	8.03	5.18	1.96	2.04
Transplanted rice-wheat	8.91	5.90	2.11	2.13
LSD (P=0.05)	***NS***	***1.04***	***NS***	***NS***
Herbicides				
Sulfosulfuron 25 g/ha	10.98	5.16	2.15	1.47
Clodinafop 60 g/ha *fb.* 2,4-D	2.85	3.87	1.01	1.36
Alternate use of clodinafop 60 g/ha & sulfosulfuron 25 g/ha	1.70	4.47	1.47	3.05
Weedy check	17.90	6.62	2.91	2.02
LSD (P=0.05)	***2.36***	***1.20***	***0.90***	***NS***

** Values subjected to square root transformation*

Effect of herbicides and wheat-based cropping systems on weed population, weed dry matter and grain yield of wheat

Treatments	Weed population (no/m²)*	Weed dry weight (g/m²)*		Grain yield (Kg/ha)
		60DAS	Harvest	
Cropping systems				
Soybean-wheat	10.40	3.89	7.21	3279
Direct seeded rice-wheat	10.71	3.77	9.49	3304
Transplanted rice-wheat	12.53	4.38	10.24	3163
LSD (P=0.05)	1.90	NS	2.31	NS
Herbicides				
Sulfosulfuron 25 g/ha	13.78	5.44	13.03	2983
Clodinafop 60 g/ha *fb.* 2,4-D	5.30	1.26	4.19	3572
Alternate use of Clodinafop 60 g/ha &Sulfosulfuron 25 g/ha	6.13	1.77	3.01	3728
Weedy check	19.65	7.59	15.68	2711
LSD (P=0.05)	***2.19***	***1.22***	***2.67***	***437***

** Values subjected to square root transformation*

Among the weed control treatments, rotational application of clodinafop 60 g/ha and sulfosulfuron 25 g/ha gave the highest grain yield of wheat.

Crop residue management in rice-wheat cropping system

Among the different crop residue management methods viz., removal, burning and incorporation, there was no significant effect of wheat residue management on weeds in transplanted rice. However, the removal of rice residue significantly resulted in highest population of *Medicago hispida* and total weed population in wheat. The weed populations under burning and incorporation were at par. Combined use of Isoproturon 1 kg/ha + 2,4-D 0.5 kg/ha significantly reduced *Medicago hispida* and total weed population in wheat. The yield of rice was lowest under incorporation of wheat residue, whereas the yield of wheat was highest under the same treatment.

Effect of wheat residue management on weeds and yield in transplanted rice

Treatment	*Echinochloa colona* (no/m²)*	Total Weed population (no/m²)*	Dry weight (g/m²)*	Grain Yield (kg/ha)
Residue Management				
Removal	6.24	8.78	4.19	4765
Burning	5.65	6.74	3.80	5152
Incorporation	6.38	10.27	4.02	4389
LSD (P=0.05)	***NS***	***NS***	***NS***	***595***
Weed control				
Weedy	6.70	10.12	4.11	4747
Butachlor 1.5 kg/ha	5.48	7.08	3.90	4800
LSD (P=0.05)	***0.83***	***2.21***	***NS***	***NS***
N levels (kg/ha)				
60	5.27	7.75	3.62	4360
120	6.33	8.43	3.94	4900
180	6.67	9.11	4.46	5000
LSD (P=0.05)	***0.94***	***NS***	***0.66***	***445***

** Values are subjected to square root transformation*

Effect of rice residue management on weeds in wheat

Treatment	*Medicago hispida* (no/m²)*	*Phalaris minor* (no/m²)*	Total Weed population (no/m²)*	Grain Yield (kg/ha)
Residue Management				
Removal	7.37	4.23	6.10	3800
Burning	5.43	3.28	4.70	4150
Incorporation	5.25	3.03	4.53	4550
LSD (P=0.05)	***1.80***	***NS***	***1.20***	***258***
Weed control				
Weedy	7.82	3.72	6.09	3929
Isoproturon + 2,4-D	4.22	3.32	4.20	4351
LSD (P=0.05)	***1.43***	***NS***	***1.34***	***449***
N levels (kg/ha)				
60	5.17	3.07	4.85	3770
120	6.21	3.35	5.15	4410
180	6.67	4.12	5.50	4900
LSD (P=0.05)	***0.99***	***0.87***	***NS***	***504***
WC x N levels	Sig	NS	NS	NS

** Values are subjected to square root transformation*

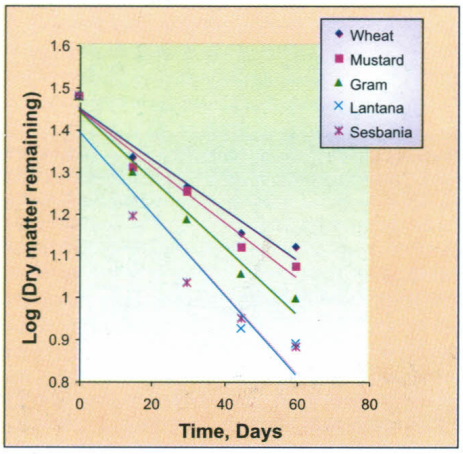


Fig.1 Decomposion of crop and weed residues in soil.

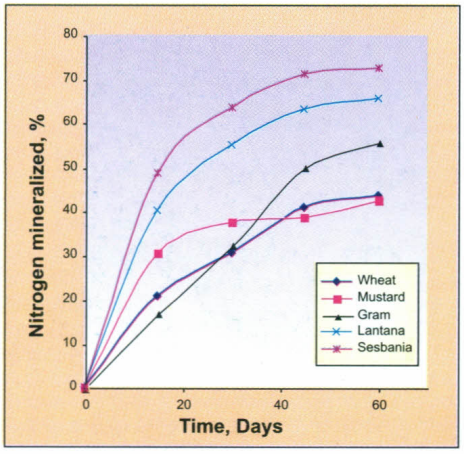


Fig.2 Mineralisation of N from crop and weed residues.

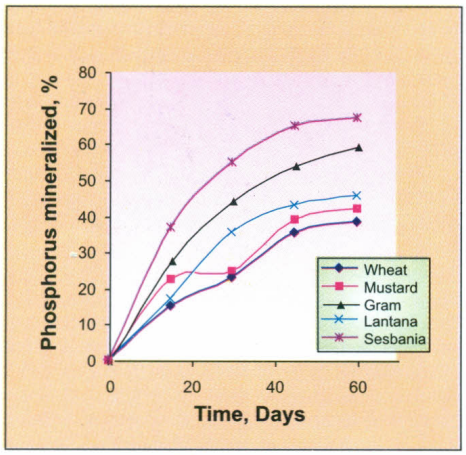


Fig.3 Mineralisation of P from crop and weed residues.


Water hyacinth mulched plots

Nutrient mineralization from *Lantana* and some crop residues in soil

Nutrient release pattern from wheat, mustard, chickpea, *Lantana* and *Sesbania* residues was studied in rice field condition by following nylon mesh bag technique. The plant materials were chopped into smaller pieces of 2-3 cm sizes and taken separately into the nylon bags (20 cm X 30 cm) @ 30 g dry matter/bag. The bag dimension permitted the straw to be spread in a thin layer within the bag, thereby ensuring close contact between the organic residues and soil. It was observed that *Sesbania* and *Lantana* were more easily degradable than the wheat, mustard and chickpea residues as the former showed relatively greater loss in total weight, especially during initial period of decomposition, than the latter residues. The results also indicated that *Lantana* is superior to wheat, mustard and chickpea residues, and comparable to that of *Sesbania* in respect of the ability of supplying N, P and S. During first 15 days, 20.7, 30.3, 16.8, 40.0 and 48.9% of total N present respectively in the wheat, mustard, chickpea, *Lantana* and Sesbania residues was mineralized. By the end of study, 43.4, 42.5, 55.7, 65.7 & 72.5% of the total initial N; and 38.5, 42.2, 59.4, 45.5 & 67.3% of the total P were mineralized from the respective plant residues. The absolute quantity of P was mineralized by 60 d from *Lantana*, *Sesbania*, chickpea, wheat and mustard residues was 1.14, 1.03, 0.65, 0.42 and 0.38 g/kg, respectively. *Lantana* proved to be a better organic source of P than the crop residues and *Sesbania*. S mineralization was also faster from *Lantana* than wheat and mustard residues. The total amount of S mineralized during the given period of decomposition from the corresponding residues was respectively 0.53, 0.54, 0.73, 0.95 and 2.01 g/kg. Mustard was inferior to all other residues in this respect. *Lantana* grows vigorously in wastelands and is not eaten by cattle. Thus the *Lantana* biomass could be a more practical and economical substitute to crop residues as well as to *Sesbania* as a nutrient source. Application of butachlor did not show any effect on the decomposition of these residues in field.

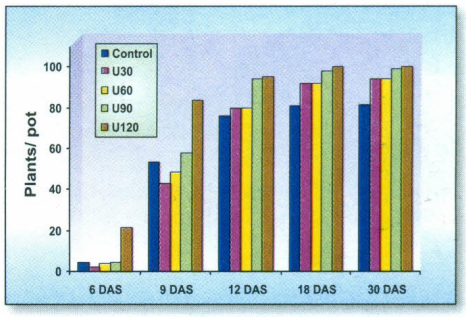
Water hyacinth mulching on weed infestation and tuber yield of potato

Mulching significantly controlled weed infestation and increased tuber yield of potato. The weedy plots were heavily infested with *Medicago hispida, Chenopodium album, Vicia sativa, Cichorium intybus* and *Physalis minima*. Weed growth was noticed in the metribuzin (0.5 kg/ha) treated plots at later stage of potato growth. Mulched plots remained weed free throughout the growth period. Compared to weedy, earthing-up metribuzin, rice straw and water hyacinth mulching increased tuber yield by 2.44, 2.22, 2.25 and 3.50 times, respectively. The metribuzin, earthing and rice straw mulch treatments were similar to each other in terms of tuber

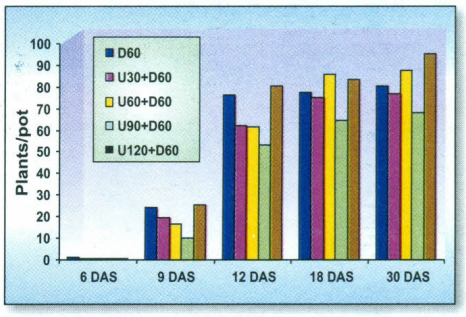
yield. The water hyacinth mulching treatment was found to be superior to both conventional earthing-up and metribuzin treatments in this respect. Compared to earthing-up and mulch treatments, the percentage of total tuber yield discoloured due to solar radiation was relatively more when metribuzin alone was used as a weed control measure. It may be concluded that mulching with water hyacinth biomass could eliminate weeding and conventional earthing-up operations besides significantly increasing tuber production in potato.

Effect of *Sesbania* green manure on *Echinochloa colona*

In a pot experiment to find out the effect of nitrogen with and without *Sesbania* green manure on germination of *Echinochloa colona*, it was observed that with the increasing doses of N through urea alone @ 30, 60, 90 and 120 kg N/ha (without green manuring) stimulated the weed germination and increased its population in increasing trend over the control. On the contrary, N application through *Sesbania* alone @ 10 t/ha reduced the germination of *Echinochloa colona* to an extent of 50% compared to control in the early stages of 0-6 & 6-9 DAS. However, at 12 DAS onwards the weed population in *Sesbania* alone treated pot was higher and exceeded the plant population level of control and remained at par at 30 DAS. But the addition of same rate of *Sesbania* (10 t/ha) with N (30, 60 and 90 kg N/ha) through urea further reduced the *Echinochloa* population as compared to urea alone at all the stages of germination. The treatment $U_{90} + S_{10t}$ showed lowest population than even control at all stages germination. To support this, observations on the effects of leaf and root residues of *Sesbania* were also taken in petri dish bioassay studies. All the concentrations of aqueous *Sesbania* were found to be very toxic to germination and seedling growth of *Echinochloa colona* both in filter paper and soil also.



Without GM



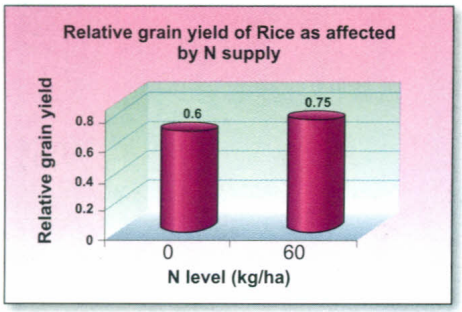
With GM

Effect of N with and without dhaincha green manure on emergence of Echinochloa colona

Aqueous Sesbania leachate (%)	Filter paper			Soil		
	per cent germination	Root length (cm)	Shoot length (cm)	per cent germination	Root length (cm)	Shoot length (cm)
Control	100	2.84	2.28	100	2.18	2.84
1	100	2.08	2.70	100	2.08	2.32
2.5	100	1.22	1.24	100	1.22	1.72
5.0	100	1.20	1.20	100	1.10	1.40
10	0	0	0	80	0.90	1.02
LSD(P=0.05)	***27.53***	***0.99***	***1.18***	***14.23***	***0.90***	***0.98***

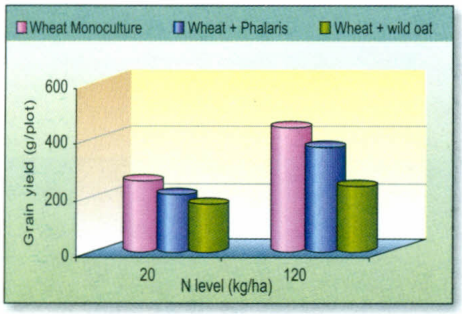
Biology and Eco-physiology of Crop Weed Competition

Nutrient supply and crop-weed competition



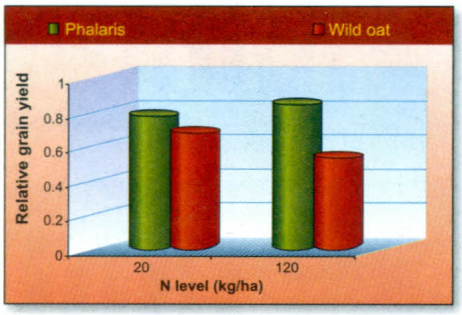
Effect of nitrogen on competition between rice and *Echinocloa colona*

Field experiments in microplots to study the effects of nitrogen (N) supply on interspecific competition between rice and *E. colona* revealed that application of N increased the leaf area and plant height of rice and *E. colona*. The relative grain yield of rice was <1 indicating greater effect of interspecific competition than the effects of intraspecific competition. The relative grain yield of rice increased with N supply which shows that rice is more competitive than *E. colona* at higher level of N supply.



Effect of nitrogen on competition between wheat and weeds

Application of 120 kg N/ha increased the plant height and leaf area of both wheat as well as weeds with as compared to that of 20 kg N/ha. Initially up to 60 DAS, the height of *P. minor* was lower than that of both wheat and *A. ludoviciana* which at 90 DAS has crossed the height of wheat. The leaf area of wheat in mixture with *A. ludoviciana* was lower than that in *P. minor*. The leaf area of wheat was initially higher than that of both weeds but at later stages *A. ludoviciana* crossed that of wheat as well as *P. minor*.



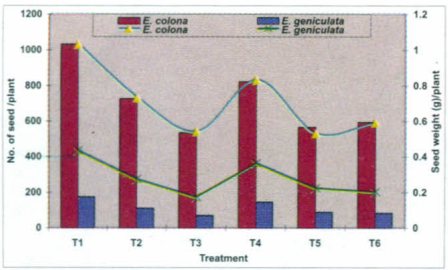
Grain yield of wheat increased significantly with the application of 120 kg N/ha over 20 kg N/ha. The relative grain yield of wheat was <1 in both the experiments, indicating interspecific competition for these species. Among the two weed species wild oat is more competitive with wheat as compared to *P. minor*.

Effect of varying densities of *Cuscuta* on *rabi* pulses and oilseed crops

Three experiments were conducted with ten treatments each replicated thrice in a RBD. It was observed that increasing densities of *Cuscuta* caused higher reduction in yield in both test crops. The loss in yield with increasing densities of *Cuscuta* from 0.25 to 7/m^2 ranged from 20 to 95% in case of lentil and 28 to 99% in chickpea and 52 to 99% in niger.

Seed production of weeds

Observations were recorded on seed production potential of two major *kharif* weed species (*E. colona* and *E. geniculata*) in direct-seeded rice. Seeds at different intervals during maturity stage of five randomly selected plants were recorded and total seed weight/plant was determined. It is revealed from the data that the number of seeds per plant for both the dominant species viz. *E. colona* and *E. geniculata* were significantly higher under the sole crop without any weed control treatment. The application of both pre and post emergence herbicides (butachlor and 2,4-D) reduced the number of seeds and seed weight/plant.

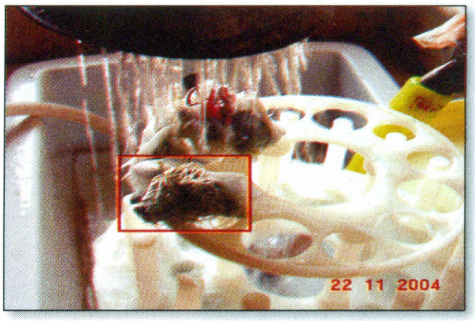


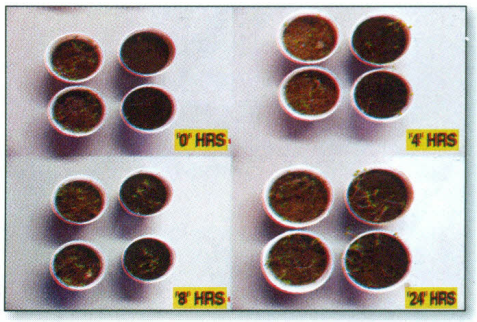
T1 = Rice sole; T2 = Rice sole + Butachlor;
T3 = rice + Butachlor + 2,4-D + 1Hand Weeding;
T4 = Rice + sesbania + 2, 4-D;
T5 = Rice + Sesbania + 2, 4-D + 1 1Hand Weeding;
T6=Rice+sesbania+ Butachlor +2,
4-D+1 1Hand Weeding

Weed seed bank studies in rice wheat system

The emergence of six major *kharif* species from July 2004 to September 2004 and major *rabi* weed species (*P. minor, C. album, M. denticulata and A. ludoviciana*) were recorded during October-November. The results indicated that maximum number of seedlings of *E. colona* and *C. communis* emerged from 5-10 cm soil depth (5.3/kg soil) and 2.7/kg soil respectively. However, the population of *C. communis* was not observed under butachlor in rice and clodinafop followed by 2-4,D in wheat from 5-10 and 10-15 cm soil depth. The emergence of *P. minor* was mostly concentrated up to 0-10 cm soil depth and maximum population was recorded from surface soil (0-5cm). Application of butachlor in rice and clodinafop followed by 2,4-D in wheat lowered weed seed population by 30-40%.The population of *C. album* and *A. ludoviciana* was greatly influenced by the sequential application of herbicide.

Dormancy and viability in *Parthenium hysterophorus* seeds





An experiment was conducted to study the dormancy and germination in *Parthenium hysterophorus* seeds. The seeds were kept in nylon bags and were subjected to running water under tap water flow for different lengths of time (2, 4, 8 & 24 hrs) and the germination was tested. It was observed that the per cent germination increased with increase in duration of time under water flow. In control, 4 & 8 hrs flow treatments, the germination occurred on the 3rd day after sowing but the germination was 20% in control (no water flow) 60% in 4 hrs flow and 90% in 8 hrs flow. In case of continuous water flow for 24 hrs the seeds germinated within one day in the nylon bags itself and the germination was 100%. The germination might be inhibited by the toxicant present in the seed coat itself and germination was enhanced due to the removal of toxicants by the running water. This might be the possible reason that *Parthenium hysterophorus* flourishes soon after the monsoon season. This observation has also been confirmed by the germination tests under sandy and clayey soils. The germination per cent was higher in sandy soil (95%) than in the clayey soil (25%), probably because of the leaching of toxicants easily in the sandy soil. This character i.e. auto inhibition of seed germination in *Parthenium* seeds may increase their persistence especially in bulk soils

Germination of parthenium seeds collected at monthly intervals

The parthenium seeds were collected from the surrounding area of the center and tested for germination in the dark at different temperatures. The seeds were removed subsequently to the temperature which gave maximum germination in the test. The final germination was counted by 16 days in each case by using standard germination test prescribed by

Seed lot collection month	Germination (%) in the dark by 16 days at		
	10°C	24°	30°C
April 2004	35±12.2	89±6.6	38±8.4
July 2004	8±1.0	96±3.0	14±3.2
August 2004	35±9.1	93±9.0	25±1.5
September 2004	35±10.0	79±10.4	27±9.5
November 2004	54±2.0	83±2.3	42±11.7
December 2004	1±1.7	85±4.0	18±8.5

The values are means of three replications ± SD.

International Seed Testing Association (1995). The results showed that the seeds collected from the weed stands in different months germinate well at about 24°C. The seeds poorly germinate at 10 and 30°C; and the seeds which fail to germinate at 10°C, do germinate on subsequent incubation at 24°C. Those seeds which fail to germinate at 30°C, do germinate on subsequent incubation at 24°C. Thus, suitable temperature of about 24°C is one of the critical factors for germination of majority of the seeds of the weed. The requirement of exposure of seeds to temperatures about 24°C seems to govern eco-physiological behavior of the weed and resultant weed incidence.

Herbicidal activity of plants and their constituents

Relative toxicity of hydroquinone on rice (*Oryza sativa* L. var. Kranti) and associated submerged aquatic weed green musk chara (*Chara zeylanica* Willd.) was investigated for exploring possible use of the phytotoxin as herbicide in management of the weed. The hydroquinone was lethal to rice at and above 5 mM. It was phytotoxic to green musk chara at as low as 0.01 mM and lethal at 0.075-0.10 mM. The toxicity symptoms on the weed were dull green appearance followed by loss of biomass, and bleaching and fragmentation of the plant resulting in death in 3-12 days. The treated plants showed an excessive leakage of cellular constituents reflecting loss of cellular membrane integrity. There was a loss of metabolites like starch, sugars, amino acids, phenolics, protein, phosphorus, potassium and chlorophyll a, chlorophyll b, total chlorophyll and carotenoid pigments with the advancement of the treatment and concomitant accumulation of oxidative stress as reflected by initial spurt of activity of some of the enzymes of the oxidative stress. Relatively higher toxicity of hydroquinone, a phytotoxin, to green musk chara than to rice appeared to be due to capability of the latter to withstand excessive accumulation of the chemical in the roots and inability of the chemical to reach the shoots. The phytotoxin appears to have killed the weed by causing massive damage to cellular membrane integrity, loss of metabolic activities and macromolecules, accompanied by associated starvation and accumulation of oxidative stress. Such a differential toxicity of a phytotoxin, which is short-lived in the environment, to a crop and associated weed may have potential of weed management under certain circumstances.

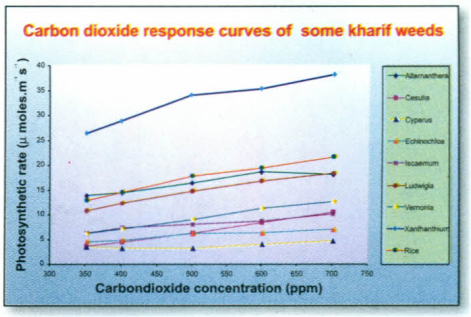
Response of weeds to elevated CO_2 and different levels of PAR

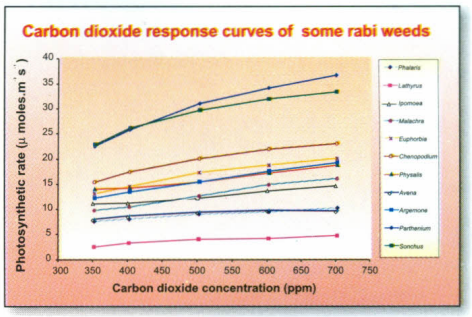
An experiment was conducted to know the response of different weeds to elevated CO_2 and to different PAR levels. The elevated CO_2 increased the photosynthetic rate in C_3 weeds as compared to C_4 weeds. Among the *Kharif* weeds the rate of increase in photosynthesis was higher in *Xanthium strumarium* when the CO_2 level was raised from 350 ppm (ambient) to 700 ppm. In case of *Alternanthera sessilis*, the photosynthesis was higher at 600 ppm. The change in photosynthesis was not considerable in case of *Cyperus rotundus* and *Caesulia axillaris* (C_4 weeds).

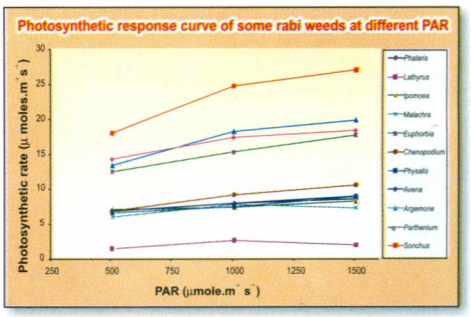
Among the *rabi* weeds photosynthesis was increased in all the weeds and it was higher in case of *Parthenium hsyterophorus* followed by *Sonchus arvesis* and *Chenopodium album*. The photosynthesis increase was not considerable in case of *Lathyrus sativa, Phalaris minor* and *Avena ludoviciana.*

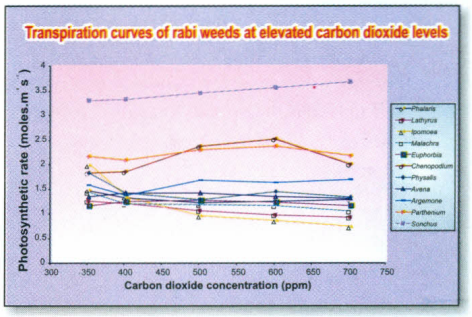
Weeds show variable response to elevated CO_2 levels in terms rate of transpiration. All the *kharif* weeds except *Xanthium strumarium* showed reduced transpiration rate with increased CO_2 levels. In case of *Xanthium strumarium* the transpiration rate showed abrupt increase with increase in the CO_2 level from 350 ppm to 400 ppm, then it has shown slight decline up to 700 ppm. Among rabi weeds the transpiration rate has shown increasing trend from 350 ppm to 700 ppm in *Sonchus arvesis* and *Argemone mexicana*. In case of *Chenopodium album* and *Phalaris minor* transpiration increased with increase in the CO_2 level up to 600 ppm and then it decreased.

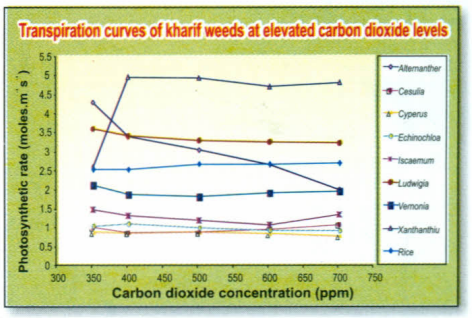
The response of *rabi* weeds to different PAR levels was tested and most of the weeds have shown increased photosynthetic rate to the increased PAR levels up to 1500 µ moles/m/s. In case of *Lathyrus sativa* the highest photosynthetic rate was at 1000 µ moles/m/s. The rate of increase of photosynthesis was higher in *Sonchus arvensis* followed by *Argemone mexicana* and *Parthenium hsyterophorus*. Unlike elevated CO_2 the PAR increased the transpiration in all the weeds except in *Lathyrus sativa*. The rate of increase was higher in *Sonchus arvensis* followed by *Phalaris minor*.







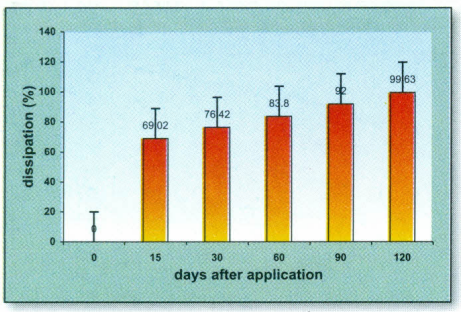




Herbicide Residues in Soil and Food Chain

Dissipation of butachlor in soil and detection of its residues in soil, rice grains and straw

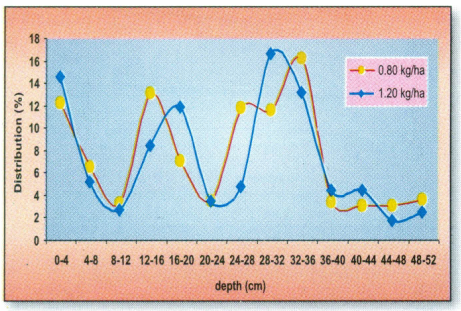
Field and laboratory experiments were conducted to evaluate the dissipation of butachlor. The residue level of butachlor in soil was found to be 0.635 µg/g 24 h after butachlor application, which decreased to 0.032 µg/g at harvest, respectively. Rice grains and straw samples contained 0.029 µg/g and 0.042 µg/g residues. Half-life of butachlor was found to be 18.11 days under field condition at 1.0 kg/ha rate and 20.2 and 23.0 days at



Dissipation of butachlor residues in rice soil under field condition.

1.0 kg/ha and 2.0 kg/ha, respectively under lab condition. Rapid dissipation of butachlor was observed during initial period and by 15 days approximately 70% butachlor had dissipated from the soil. Rapid dissipation of butachlor was found under field condition as compared to laboratory condition. By 90 days butachlor was dissipated to more than 90% and approximately 100% dissipation was achieved by 120 days.

Under laboratory condition the initial concentrations of butachlor were 2.06 and 2.75 µg/g for 1.0 kg/ha and 2.0 kg/ha application rates, respectively. There was a gradual decrease in butachlor content and by 15 and 30 days the butachlor concentration had dissipated to 1.02 µg/g, 0.90 µg/g and 0.63 µg/g, 0.85 µg/g and by the 60 and 120 days the concentrations of butachlor were down to 0.25 µg/g, 0.36 µg/g and 0.02 µg/g, 0.04 µg/g respectively at both the application rates. The DT_{50} value under lab condition was found 20.19 and 23.05 days, respectively for1.0 kg and 2.0 kg treatment. There was rapid dissipation of butachlor residues during initial period and by 15 day more than 50% butachlor had been dissipated at 1.0 kg and 2.0 kg application rates. By 120 days 99% dissipation was noticed in both the application rate.

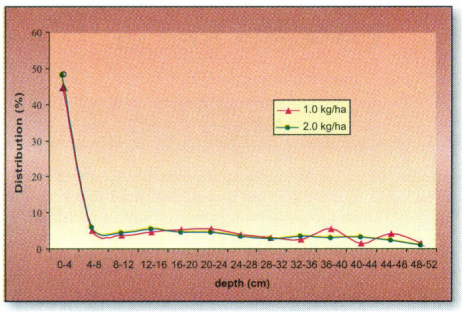


Per cent distribution of metribuzin residues at soil depth of 0-52 cm in lab study.

Determination of leaching behaviour of herbicides in sandy clay loam soil

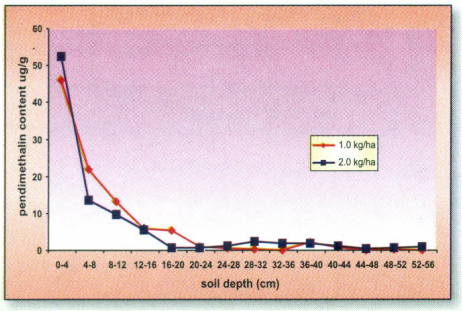
The leaching behaviour of atrazine, metribuzin, pendimethalin and butachlor was studied in laboratory using conditions using PVC pipes.

Metribuzin was found distributed in all the soil depths and maximum concentration was recovered from 28-32 and 32-36 cm depths at 0.80 kg/ha and 1.20-kg/ha treatments. Metribuzin leached down up to 52 cm depth in soil and 3.87% and 3.14% of metribuzin was recovered from the leachates at 0.80 kg/ha and 1.20-kg/ha treatments, respectively and indicating high mobility of metribuzin in the sandy clay loam soil.



Per cent distribution of atrazine residues in soil

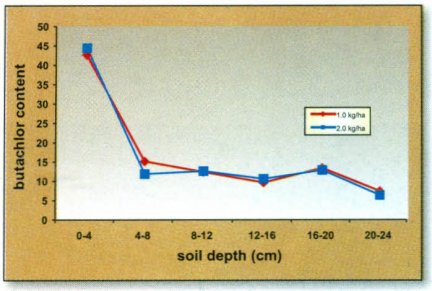
Atrazine was found distributed in all the soil depths and maximum concentration (45% and 48%) was recovered from 0-4 cm depth at both rates and only 1.3 and 2.0% atrazine was leached down to 48-52 cm soil depth. The atrazine recoveries from leachates were 1.72% and 1.41% at 1.0 kg/ha and 2.0 kg/ha treatments, respectively.



Per cent distribution of pendimethalin in soil at two application rates

Approximately 80 % of applied pendimethalin was found distributed in 0-12 cm soil depth and only 0.2 % could leach to the depth of 48-52 cm in soil column and indicating slow mobility of pendimethalin in sandy clay loam soil.

Approximately 45% applied butachlor was found distributed in 0-4 and 7% butachlor could leach to the 20-24 cm soil depths which showed greater adsorption of butachlor at the surface soil as compare to subsurface soil.



Per cent distribution of butachlor residues in soil at two application rates

Socio-economic studies on weed management technology

Any technology developed has its significance only when it reaches farmers and results in the improvement of their socioeconomic conditions. Therefore, it is important to assess the impact of adopted technology and to study the constraints that come in the path of adoption.

Herbicide use behavior among farmers

Observations on herbicide use pattern among farmers of Sihora block revealed that about 78% of the total cropped area was covered under herbicidal weed control and the rest 22% of the farmers did not apply any herbicide. The results also indicated that about 67% farmers were using half of the recommended dose of herbicide and about one fourth of them used it at the appropriate time. Lack of awareness and high cost of herbicides were found as their major problems with respect to the use of lower dose of herbicide for weed control.

Impact assessment of weed management technologies under rice-wheat cropping system

The study was carried out with 146 crop growers (73 crop growers each from adopted and non-adopted villages) in two Tehsils (Sihora and Jabalpur). In demonstration area, weed infestation was the major constraint for crop production while insect/disease incidence in non-demonstration area. Labor problems, high input cost, non-availability of improved seeds, electric supply, and natural calamities were the next ones.

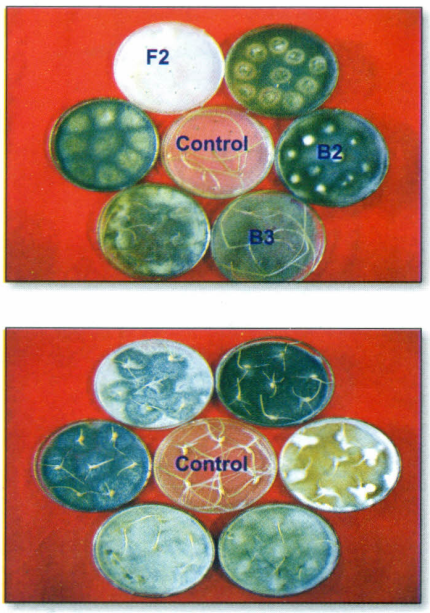
As far as level of satisfaction with weed management technologies is concerned 82% and 71% farmers in demonstrated and 5% and 4% farmers in non-demonstrated area during *rabi* and *kharif* respectively were fully satisfied. Non-availability of herbicide and labour problems in demonstration area and lack of technical knowledge in non-demonstration area were found to be major constraints in adoption of new weed management technology.

Weed management using insects and plant pathogens

Euromyces sp.- a potential bio-herbicide for *Euphorbia geniculata*

A dreaded rust disease of *Euphorbia geniculata*, an obnoxious weed has been found to appear in Jabalpur and adjoining areas since last few years. The disease appears in the month of early January, during peak cold weather. Systematic study on this weed pathogen is under progress. Pathogen has tentatively been identified as a species of *Euromyces*. Only uredinial and telial stages were found on the infected plant. Bright orange colour minute uredinial pustules appear on the lower surface of the leaves which later increase in size and cover entire leaf surface. In the same pustules teliospores develop later in the season. In advanced stage of the disease, elongated to irregular shaped, dark coloured pustules develop on the stem followed by defoliation and ultimately leading to the death of infected plants. This disease has been produced successfully on the healthy weed plants under controlled conditions. Work on the biology of this pathogen is under progress. This effective pathogen may prove a potential bioherbicide for *E. geniculata* in times to come. Further investigations for its possible use as a potential biocontrol agent of *Euphorbia geniculata* are in progress.

Effect of different *Trichoderma* species/isolates on *Phalaris minor* and wheat



Effect of different Trichoderma species/isolates on P. minor and wheat

Twenty isolates of *Trichoderma* isolated from different rhizospheric soil and two standard species i.e. *T. viride* and *T. virens* were screened for their selective inhibitory action on *P. minor* and wheat. Seed germination of *P. minor* and wheat inoculated with spore suspension of *Trichoderma* spp./isolates were tested on PDA.

Among the isolates of *Trichoderma* evaluated, local isolates i.e. A4, A5, B1, B2, C1, D2 and F2 performed best against seed germination of *P. minor* and all the isolates were very much safe to wheat. *T. viride* and *T. virens* gave moderate response against *P. minor* in the Ist Trial but were among the best in IInd Trial and also safest to wheat. The results of this experiment opened new avenues for eco-friendly application of *Trichoderma* for suppression of *P. minor* in wheat crop.

Effect of different herbicides on mycelial biomass of *Trichoderma* sp. and *Sclerotium rolfsii*

This experiment was planned to evaluate the effect of different soil applied herbicides on mycelial biomass of *Trichoderma* sp.(very popular fungal bioagent) and *S. rolfsii* (an important plant pathogen having very extensive

host range) and/or differential action of these herbicides on same bioagent/pathogen in Czapek Dox broth after an incubation period of 10 days.

The maximum biomass of *Trichoderma* sp. was found with X concentration (recommended dose) of alachlor (2 ppm) followed by 0.5X whereas this herbicide drastically reduced the mycelial biomass of *S. rolfsii* at X and 2X concentration. Another herbicide, fluchloralin was having strong inhibitory action over *S. rolfsii* whereas comparative reduction in biomass of *Trichoderma* was less by this herbicide. This differential action of alachlor (positive on bioagent and negative on pathogen) and fluchloralin (less inhibitory to bioagent and strongly inhibitory to pathogen) could be a good recommendation in an integrated crop management system (particularly weed and crop disease management) if provided by further refinements. Metribuzin at all concentrations significantly reduced mycelial growth of *Trichoderma* sp. as compared to control but produced maximum biomass of pathogen as compared to all other herbicides except control. Therefore, the use of metribuzin in heavily infested soils with *S. rolfsii* may have conducive effect on disease incidence caused by this pathogen.

Effect of different herbicides on biocontrol activity of *Trichoderma* sp. in dual culture

A laboratory experiment was conducted to know the effect of different pre emergence and pre plant incorporated herbicides on the biocontrol activity of *Trichoderma* sp. (BMIR isolate) against *S. rolfsii* using dual culture technique. At initial hours of incubation metolachlor (0.5X, X, 2X), anilophos (X, 2X), metribuzin (2X), pendimethalin (0.5X, 2X), oxadiargyl (0.5X, X), oxyfluorfen (0.5X, 2X), pretilachlor at all concentrations slightly stimulated the radial growth of bioagent in dual culture whereas at last hours of incubation (88 hours) all the herbicides in general significantly reduced the radial growth of bioagent as compared to control dual culture plates. The reduction in the radial growth of bioagent was lesser with pendimethalin (X, 2X, 0.5X), metribuzin (2X), metolachlor (0.5X) and these may be a good indication for integration of compatible herbicide with biocontrol agent *Trichoderma* sp. in a crop management system (Fig. a &b).

Optimizing *Z. bicolorata* release for the control of *Parthenium hysterophorus*

In net house conditions, augmentation of adult beetles was done @ 5,10,15, pairs/m^2 which resulted 100 % defoliation of an average 3.5 feet height of parthenium in 30, 25 and 22 days, respectively. In another experiment in net house conditions, release of 4 beetles + 25 larvae/m^2 (say as 4b+25 l) , 6 b+50

1, 8 b+75 l and 10 b+100 l/m^2 resulted in 100% defoliation of average 3.5 feet plant height in 60, 40, 30 and 22 days, respectively. In field conditions, release of adults @ 2, 3 and 5 pairs/m^2 in mid-July brought complete defoliation by the 3rd, 3rd and 2nd week of August, respectively while in control, it took mid September. This proved that through augmentation release, early defoliation of parthenium in field conditions could be achieved.

In June, good grub population of beetle was observed on parthenium at a few sites. Terminal twigs of parthenium of 30 cm length had 8 - 35 grubs of first and second instars. Therefore, upper portion of twigs were plucked and scattered over parthenium stand where population of beetle had not build-up yet. This inundative augmentation from the area of abundance to desired area caused early population build-up in that area, hence, early control than the area where such augmentation was not made.

Development of mass rearing technologies of *Z. bicolorata*

Cheap and effective technology was developed to rear beetles in different conditions. For rearing small numbers of beetles (100-500) in laboratory or houses, beetles may be developed in small glass or plastic jars. For rearing beetles between 500 to 2000 and 2000 to 10000 in number, plastic tubs, iron/wooden cages and mosquito nets and green house nets, respectively can be used. The mosquito net and green net house methods were cheap, sustainable and effective even during odd season. A publication dealing with the technique of rearing beetles and their dissemination has been prepared which is available on request.

Mass rearing techniques in jars, tubs, cages, mosquito nets and in net house

Monitoring of spread, establishment and impact of Z. bicolorata

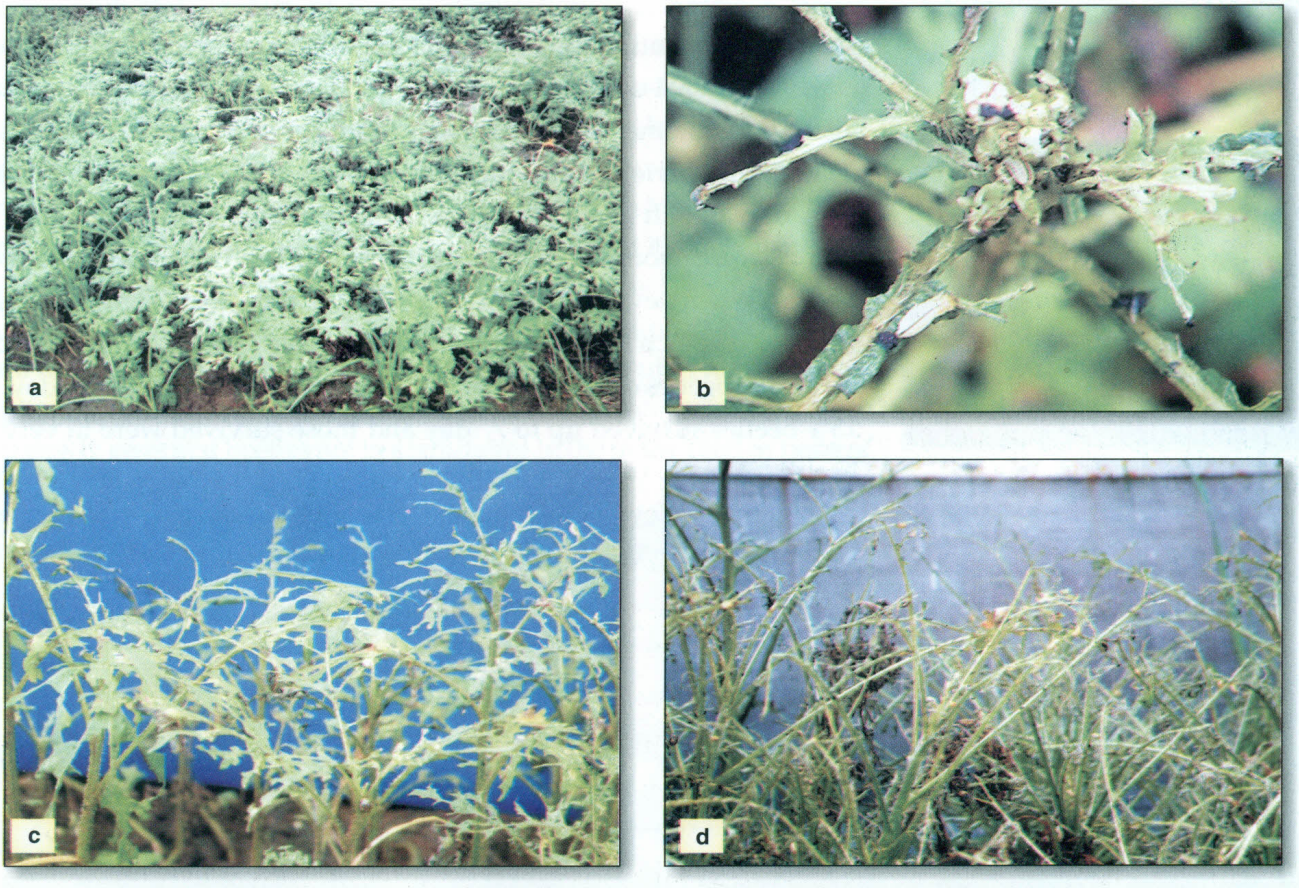
The Mexican beetle in Jabalpur and suburb area caused large-scale defoliation of parthenium in the 5th year of its release. The spread of beetle was found in more than 60 km area from the focal point of release, which is estimated to be in 3600 sq. km area. Although, defoliation of parthenium by the beetle varied from place-to-place ranging from 10 to 100%, nevertheless about 4000 hectares area was completely controlled by the beetle. In some

places population build up was so high that beetles search the parthenium amidst the crops and devoured it completely.

During a survey in 2004 large scale defoliation of parthenium by the beetle was observed at Rudrapur, Kashipur, Pantnagar, Jaspur, Roorkee, Dehra Dun, Rishikesh, Haridwar (Uttaranchal), Ghaziabad, Bijnor, Saharanpur, Meerut (Uttar Pradesh). In Punjab, the beetle was found to be well established in Jalandhar, Ropar, Ludhiana and near Wagha border of India and Pakistan. In Haryana, beetle was found established in some parts of Rohatak, Sonipat, Kaithal and Karnal. The beetle was also recovered in Delhi in 2004 from the released sites after its introduction in 2001. These regions in north and central India represent low and high temperature regime thus further strengthen the evidences of potential of Mexican beetle for biological control of parthenium throughout the country.

Defoliation of parthenium on the road side (a) and in the Rajaji National Park (b) in Saharanpur (Western Uttar Pradesh) and Haridwar (Uttaranchal).

Sequential photographs of the same site at Jabalpur (M.P) showing reclamation of the land in four years by Cassia tora due to continuous attack of Mexican beetle on Parthenium.



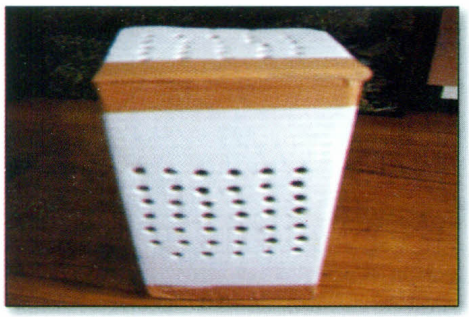
Young new flush of parthenium in August and September is nipped in the bud by the beetle.

Economic benefits of biological control by *Z. bicolorata*

A study was made at Jabalpur to find the economic benefit by the Mexican beetle after release of 6000, 7500, 7500 beetles in the year 2000, 2001 and 2002, respectively. In the fist two years, beetle could not give control except the establishment at all the sites but by the third year good establishment of the beetles was observed at many places and 100% damage on parthenium was observed in an area of about 200 hectares. By fourth and fifth year of its release, beetle spread to about 40 and 60 km area by self or by human efforts and caused 100% control in the area of about 900 and 4000 hectares, respectively besides mild to severe damage at the places of its spread.

The cost of most effective herbicide glyphosate and metribuzin at recommended doses is about Rs.1700/- and 2700/- per hectare, respectively. It is estimated that it would cost about Rs. 0.34 0.54 million for treating 200 ha and 2.43 10.8 million for 900 ha area chemically. Hence, biological control is a practical, economic and eco-friendly option for management of Parthenium. If the same area has to be removed manually or mechanically, it will be about three times more than the herbicide cost.

Packaging of Mexican beetles - standard



From experiments it has been concluded that if a consignment is likely to reach within 2-4 days, it is better to keep semi green twigs of parthenium inside the containers. But if it is likely to take more than 4 days to reach to its destination, dried parthenium twigs should be placed to avoid contamination. It was also observed that newly emerged beetles or young beetles were more susceptible to death during transition than the old beetles. When newly emerged beetles of 0-2 days were kept in containers ready to dispatch and opened at different days interval, it was found that up to 30% beetles died within 24 hrs while 85% beetles died by 4th day. Only 15% beetles survived up to 7th day and those survived were in very poor health. Hence, only old beetles (10-15 day old) should be selected for consignment. Newly emerged and young beetle can easily be recognized by the dull dusky colour and softness of the body.

Per cent mortality of Mexican beetle at different days kept in containers having different type of parthenium twigs

Treatment	% Mortality after days						
	2	3	4	5	6	7	8
Twigs with leaves	4.66	16.66	32.00	32.33	59.00	51.00	49.33
Green twigs leaves without leaves	6.00	21.00	44.00	47.33	54.66	71.33	78.66
Semi-dried twigs without leaves	4.66	27.66	30.33	30.00	66.00	64.66	75.33
Dried twigs without leaves	12.66	24.00	30.66	29.00	40.66	44.00	51.00
LSD (5%)	***6.84***	***13.57***	***13.65***	***7.25***	***13.73***	***15.35***	***4.20***

Consignment ready for dispatch in card board packing.

This plastic container with beetles should be placed in a strong card-board and packed in such a way that mouth lid remain open for aeration. Small holes on card board in lower side and on the moth side will provide more aeration to the beetle inside the containers having wire mesh windows in lower side also. Proper instruction to keep the container in vertical position should be displayed on the packing

Impact of herbicides on Mexican beetle

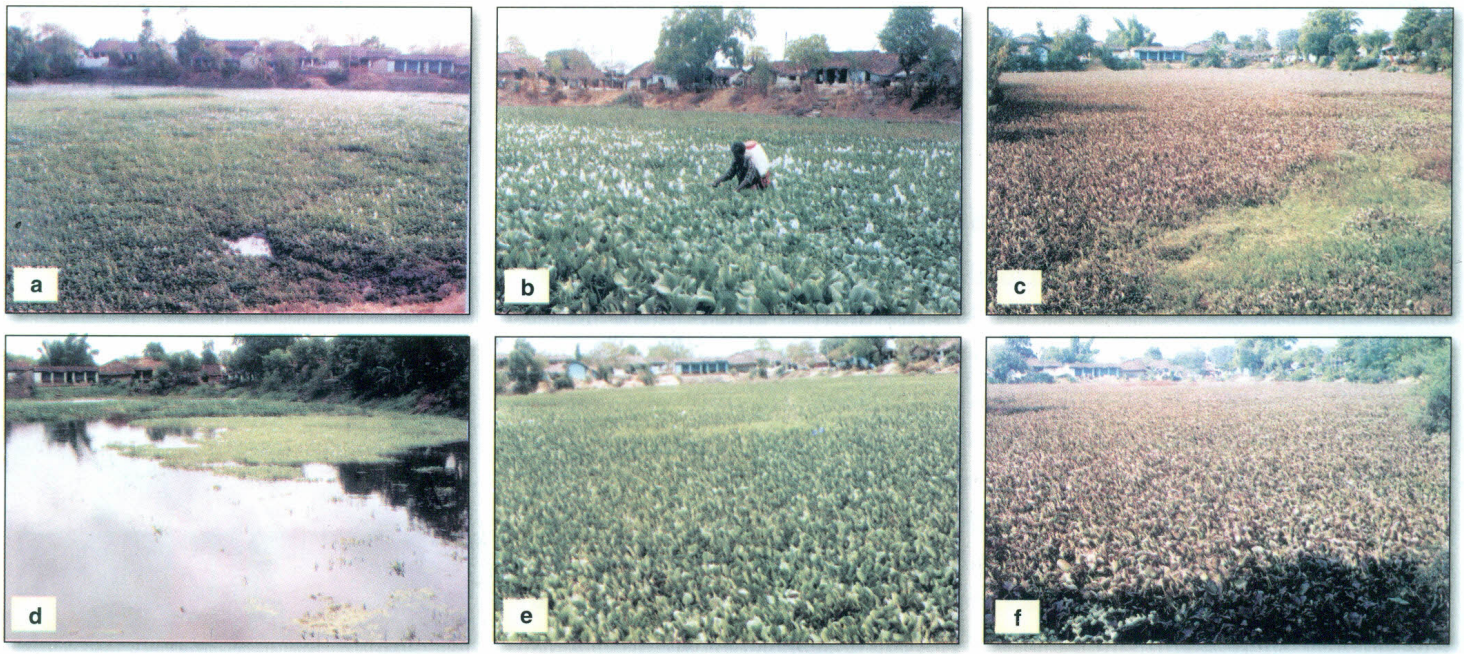
None of the herbicides was found totally safe. Among the three herbicides, 2,4-D ethyl ester caused up to 30 and 36% mortality of adults and 3rd instar larvae, respectively after 72 hrs of spray at 2.5 kg/ha dose when applied topically with leaf. In case of topical application and topical + leaves, glyphosate and metribuzin caused about 7 and 3% and 13 and 10% mortality, respectively at 2 kg/ha dose after 72 hrs. It was found that newly emerged beetles were more susceptible than the old beetles. 2,4-D, glyphosate and metribuzin at 2 kg/ha dose caused about 57, 33 and 37% mortality of newly emerged beetles which declined gradually with increase in age of the beetle. This study suggested that chemical spray of 2,4-D should be totally avoided during rainy season as it has more toxic effect on the bio-agent and may kill appreciable population of beetle which would have otherwise contributed in population build-up. This study also suggests that use of herbicides should be avoided in integrated approach when newly emerged beetles are in abundance in the in the filed as none of the herbicide is safe for freshly emerged bioagent.

Effect of herbicides on larvae and adults of *Zygogramma bicolorata*

Herbicide	Dose (kg/ha)	% mortality	
		Larvae	Adults
2,4-D	1.0	10.00	10.00
	2.0	16.67	16.66
	2.5	33.33	30.00
Glyphosate	2.0	6.67	6.66
	2.5	7.33	10.00
	3.0	16.67	16.66
Metribuzin	1.0	10.0	0.0
	1.5	13.33	3.33
	2.0	13.33	10.00
Control	-	**0.00**	**0.00**

Integrated management of water hyacinth

About 1000 weevils of *Neochetina* spp. were released as inoculation in the pond over an area of 3000 m^2 for further population build up of the bioagent on 31st May 2003. Three herbicide sprays in 15% area resulted in early control of water hyacinth. The adult and larvae of *Neochetina* spp. recorded were about 7 and 8 per plant, respectively. By the end of March 2005, two waves of control was achieved. This early collapse of weed within a period of 21 months could be possible due to integration of herbicide with the bioagent, which would otherwise have taken minimum 24-48 months by the bioagent alone to control one cycle of water hyacinth without integrating herbicide.



Sequential photographs of integrated management of a pond infested with water hyacinth. (a) Pond before treatment, heavy flowering (b) release of weevils and spray of chemicals (c) one wave of collapse (d) new growth of water hyacinth (e) and pond again infested but flowers could not be developed (f) second wave of collapse.

Utilization of Parthenium for compost making

In earlier study, it was observed that a lot of seeds of parthenium remain viable if compost is prepared by most popular NADEP methods. Two methods of composting were evaluated. In one method collected parthenium biomass was dumped into the pits without any treatment (farmer practice) and after filling, the pits were sealed. In improved method, different treatments were given. In one layer of 50 kg parthenium dung slurry, soil and urea treatment were given. The pipes having small holes for aeration were put in the pit for creating aerobic condition. The pits were opened after 4 months.

There was a marked difference in the seed germination, which was very high in the compost prepared by NADEP method than the sunken pit method. Compost prepared by layering method giving different treatment like dung slurry, soil and urea was superior than the method usually practiced by the farmers.

Sunken pit method with holed pipe for aeration (a) proved superior than the NADEP method (b) where large number of seeds remain viable (c) heap of parthenium compost

TRANSFER OF TECHNOLOGY

Technology Transfer is as important as that of technology development for sustenance of agriculture. One of the major constraints in utilization of weed management technologies is its low adoption level. NRCWS is regularly carried out extension activities throughout the year with a view to demonstrate the performance and profitability of proven weed management technologies among farming community.

The following field demonstrations/on-farm trials on proven weed management technologies were carried out during the year.

Season/Crop	Number
Kharif	
Rice	25
Soybean	6
Rabi	
Wheat	29
Lentil	6
Chickpea	4
Zero tillage	6
Non-cropped situations	
Ipmoea carnea	5
Parthenium hysterophorus	5

Kisan Goshti/Field day

NRCWS organized several *kisan goshtis*/Field days with the help of Gram Panchayats, progressive farmers, block samitis and students at different places during the year. During the programmes, farmers were explained about the importance of weed management practices, chemical and biological control of weeds in crop and non-crop situations, use of mechanical tools and implements for weed control in field crops etc.

Stalls depicting the latest weed management technologies as well as research findings of NRCWS were also put up during different conferences like 'International conference on soil water environmental quality issues and strategies' held at IARI, New Delhi and 'International conference on sustainable crop production in stress environments: management and genetic options' at JNKVV, Jabalpur.

Large Scale Demonstration on Management of *Parthenium* through Integrated Approach

Two locations, one each in rural and urban settings with heavy infestation of *Parthenium* have been selected for large-scale demonstration of management options under a DBT project. The most competitive plants showing suppression effect on *Parthenium* were *Cassia tora, Hyptis suaveolens, Amaranthus spinosus, Achyranthus aspera, Sida acuta, Xanthium strumarium etc.* In natural conditions in Jabalpur rural and urban area, *Cassia tora* was widespread and predominant among the other flora. Identification of suppressing ability parameters like plant biomass, density, plant height, seed production/plant, dispersal ability etc., was also taken up. About 2.5 quintal seeds of *Cassia tora* were collected during October -November for large scale demonstration of the replacement of *Parthenium* by *Cassia tora*.

Supply of *Z. bicolorata* beetles

About 1 lakh adult beetles were supplied as a nucleus culture to different KVKs in the states of Chhatisgarh, Madhya Pradesh, Haryana, Punjab, Orissa, Bihar and Jharkhand; 14 centres of All India Coordinated Project on Weed Control; two municipalities, many farmers and NGOs. There was overwhelming response from the farmers for the beetles that reflected the effectiveness of the bioagent in suppression of *Parthenium* in the areas of their release.

Parthenium Awareness Day - organised

One-day *Parthenium* Awareness campaign on the eve National *Parthenium* Awareness Day was held by the Centre on 4th September 2004 in the Siroli village. This programme was enthusiastically attended by several NGOs, farmers, school children, officials from State and Central Agricultural Departments and members of residential associations. Dr. D.P. Singh, Vice Chancellor, JNKVV, Jabalpur and the Chief Guest of the function explained the ill effects of *Parhtenium* on human and animal health. Dr. N.T. Yaduraju, gave a brief account of *Parthenium* menace and ways to control it.

Radio / TV talks

Dr. J.S. Mishra delivered a radio talk on "Biological control of *Parthenium*" on 15 December 2004.

EDUCATION AND TRAINING

Training programme attended by the scientists and other staff

Participants	Title of the programme	Venue and period
R.K. Meena, T-2 and A.K. Bhowal, Jr. Steno	*Gahan Hindi Prashikshan -cum- Karyashala*	NAARM, Hyderabad, 13-17 July 2004
Dr. M.B.B. Prasad Babu, Scientist (SS)	Introduction to LAN/WAN Technologies at ERNET INDIA	ERNET, New Delhi, 20-24 September 2004
Chandra Bhanu	Advances in Weed Management	GBPUA &T, Pantnagar, 23-03-2004 to 21-04-2004

HONOURS AND AWARDS

Dr. N. T. Yaduraju, Director, NRCWS, Jabalpur has been nominated as member of an expert committee of the scheme "Science and Technology for Women" of Department of Science and Technology, Government of India, for a period of three years.

Dr. N.T. Yaduraju, Director, NRCWS, Jabalpur has been nominated as member of the Research Advisory Committee of Project Directorate on Biological Control, Bangalore.

Dr. Sushilkumar, Sr. Scientist of the Centre was honoured for his significant contribution in multiplying, releasing and popularizing the Mexican beetle for *Parthenium* control in the country.

The Centre celebrated its 15th foundation day on April 22, 2004. On this occasion some staff members namely, Dr. Sushilkumar (Sr. Scientist), Dr. J.S. Mishra (Sr. Scientist), Sri. Balwant Rai (AAO), Sri. Sandeep Dhagat (Tech. Officer), Sri. J.P. Kori (Sr. Clerk), Sri. R.K. Meena (Tech. Asstt.), Sri. O.N. Tiwari (Tech. Asstt.), Sri. Veer Singh (Messenger) and Sri. Ram Kumar (Farm Mazdoor) were honoured for their outstanding work and Dr. N.T. Yaduraju, Director, Dr. B.T.S. Moorthy, Principal Scientist (Agronomy), Sri. H.S. Bisen Principal Scientist (Agril. Engg.), Sri. Balwant Rai (AAO) and Sri. A.K. Shrivastava (AF&AO) were honoured for successful completion of 25 years of their services in ICAR.

Sports

During the ICAR Zonal Tournament held at IARI, New Delhi from 22-26 November, 2004, Mr. Veer Singh of the Centre stood first in Carrom event.

ALL INDIA COORDINATED RESEARCH PROGRAMME - WEED CONTROL

Emergence of *Orobanche* on *Parthenium* during December

Emergence of *Orobanche* in clusters in potato

Infestation in potato lowered yields by 50% during February

NRC-Weed Science coordinates the network research with State Agricultural Universities for generating location specific technologies for weed management in different crops, cropping and farming systems and also non-crop situations through its All India Coordinated Research Programme on Weed Control (AICRP-WC) operating at 22 Centres spread through out the country. The yearly achievements of AICRP-WC are published separately in its annual report. The summary of salient research achievements of the programme during the current year is presented below:

Weed Survey and Surveillance

Phalaris minor a relatively new weed in Gujarat was recorded in several wheat fields in Banaskantha, Mahesana. Gandhinagar, Ahmedabad and Kheda districts of Gujarat. In Northern plain, hot sub-humid region, incidence of non-grassy weeds like *Caesulia axillaris*, *Commelina* spp. and sedges such as *Cyperus difformis*, *Fimbristylis miliacea* are increasing in transplanted rice. Severe infestation of bull rush (*Scripus luberosus*) was noticed in several areas in Haryana. Occurrence of *Orobanche* on potato and parthenium was noticed in Kolar district of Karnataka.

Herbicide resistant biotypes and their management

Continuous use of butachlor and isoproturon in rice-wheat in Northern plain, hot sub-humid region for a period of 14 years did not result in the development of resistant bio-types of *Echinochloa colona and Phalaris minor*.

Integrated weed management in specific crops

In Eastern plateau and Eastern Ghats eco-region, *Sesbania rostrata* may be used as green manure between two lines of direct seeded rice to minimize the weed infestation and it also provided green biomass of 3-3.5 t/ha.

In northern plain and central highlands the post-emergence application of sulfosulfuron 25g/ha or clodinafop 60 g/ha proved effective against *Phalaris minor* in wheat. Glyphosate + Zero tillage and conventional tillage increased grain yield and suppressed weed growth in late sown wheat in Eastern plain, hot sub-humid eco-region.

In studies on efficacy of herbicides to control weeds in garlic significantly lower dry matter was recorded with oxyfluorfen 0.2 kg/ha and alachlor 1.0 kg/ha fb hand weeding at 25 DAP which resulted in higher garlic bulb yield in Deccan Plateau & Eastern Ghats, Hot-summered Eco-region

Integrated weed management in cropping system

Application of pretilachlor 0.75 kg ha^{-1} was found effective for control of weeds in autumn rice of Assam & Bengal plains, hot humid eco-region. In succeeding winter rice, narrow spacing (15cm X 15cm) followed by one hand weeding was equally effective with butachlor 1.25 kg/ha+ Almix 4 g/ha. Soil solarization for 45 days during April and May in Eastern plateau and eastern ghats eco-region increased the soil temperature about 6°C more as compared to non solarized and stale seed bed plots resulting in better weed control.

Residues management

Continuous application of butachlor +,2,4-DEE mixture or pretilachlor + 2,4- DEE mixtures in Deccan Plateau & Eastern Ghats, hot-summered eco-region did not result in building up of butachlor residues in post-harvest soils and in paddy grain. There was no detectable herbicide residue in soil and produce at crop harvest in rice-wheat system where herbicides have been used for 11 years in northern plain and central highlands. Ground water analysis from farmers fields in northern plain and central highlands did not show any residue of isoproturon and butachlor where herbicide has been used for last many years. In Kerala, it was observed that monitoring of herbicide residues has become necessary in the aquatic systems as residues of 2,4-D up to 0.08-1.95 µg/l were observed in water under paddy fields.

Weed utilization

Pheretima asiatica, a local earthworm species of Eastern plain, hot sub-humid eco-region was found to have high potential in vermicomposting. Combination with partial decomposed cow dung and chopped dry *Xanthium* gave better nutrient composition in vermicompost.

Training on weed utilization for vermicompost preparation

On Farm Trials : Non-cropped situation

Effective control of *Chromolaena* was obtained with glyphosate 1.0 kg/ha + surfactant 0.1% as it recorded lowest population. Application of glufosinate ammonium @ 400 g/ha as post-emergence on active growth stage was found more effective for management of *Convolvulus arvensis* in non-cropped area of central highlands and kathwon. Split application of glyphosate provided good control of *Sorghum halepense* while glufocinate ammonium provided good control of *Imperata cylindrica* in lawn in Northern plain and central highlands. Application of glyphosate 1.5 kg/ha or metribuzine 0.3% at flowering stage effectively controlled *Parthenium hysterophorus* in non-cropped areas of Northern plain, hot sub-humid region.

Biological control

Parthenium hysterophorus can be controlled effectively by introducing *Zygogramma bicolorata* (Mexican beetle) in Northern plain, hot sub-humid region. *Passicum maximum* had better suppression of *Parthenium* than *Cassia ceresia* in Punjab.

Parasitic weeds

Protected spray of glyphosate at 0.5, 0.75, 1.0 and 2.0 % (product basis) or paraquat at 0.3, 1.05 and 0.75% applied after emergence of *Orobanche aegyptium* during first week of February did not prove effective in controlling crop in western plain and Kutch peninsula, hot arid eco-region. *Striga asiatica* was effectively controlled with application of 2,4-D at 5 g/l + urea 20 g/l at 90 DAP in sugarcane in Tamil Nadu.

Adoption and awareness of weed management technologies

About 89% farmers of Punjab use herbicides in *kharif* season, 86% applied herbicides at recommended rates. Butachlor and pretilachlor are most popular rice herbicides. In *rabi* 94% farmers apply herbicides. The new herbicides i.e. clodinafop, sulfosulfuron and fenoxaprop are used by 42, 22 and 8% farmers, respectively.

Parthenium Day organized

All the 22 Centres organized Parthenium Awareness Day on 4th Sep, 2004. It received overwhelming response from public, school children, NGO's and local administration. The programme was a grand success in creating awareness about harmful effects of parthenium and ways and means to control it.

Publications

(A) Research papers

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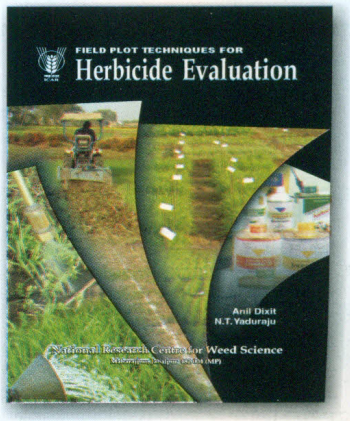
New Publications

The following new publications have been brought out by the Centre

Title of publication	Author (s)
Tillage and Weed Management	J.S. Mishra
Soil Solarization-A Novel Technique of Weed Management	V.P. Singh and Dr. N.T. Yaduraju
Integrated Weed Management in Rice Under Different Ecologies	B.T.S Moorthy
Herbicide Manual	N.T. Yaduraju and Anil Dixit
Practical Manual on Herbicide Bioassay	K.K. Barman, Nasreen G. Ansari and N.T. Yaduraju
Shaknashi Rasayanon ka Upyog-Disha Nirdesh	V.P. Singh, Anil Dixit, J.S. Mishra and N.T. Yaduraju
Twenty Five Years PG Research Under AICRP-WC	A.K. Gogoi, N.T. Yaduraju, B.T.S. Moorthy, R.P. Dubey and V.P. Singh
Field Plot Techniques for Herbicide Evaluation	Anil Dixit and N.T. Yaduraju
Biological control of water hyacinth	Sushilkumar
Biological control of Parthenium using Mexican beetle	Sushilkumar



Institute publications being released

APPROVED RESEARCH PROJECTS DURING 2003-04

Code	Projects	Principal Investigator
A	**Herbicide as a tool in weed management**	
1101	Testing of new molecules	Dr. N. T. Yaduraju
1201	Long term effects of herbicides in cropping systems	Dr. V.P. Singh
1301	Influence of herbicides on soil micro-flora, soil fertility and productivity	Dr. K.K. Barman
1401	Improving efficacy of herbicides through herbicide mixture, adjuvant etc	Dr. Anil Dixit
1501	Studies on herbicide application techniques	Er. H. S. Bisen
1601	Herbicide residues in soil and food chain	Dr. Shobha Sondhia
B	**Weed biology and eco-physiology**	
2101	Biology of major weeds	Dr. V.S.G.R Naidu
2201	Weed flora shift in cropping systems	Dr. V.P. Singh
2301	Eco-physiology of crop-weed competition	Dr. J.S. Mishra
2401	Weed herbarium and collection, conservation and utilization of weed biodiversity	Dr. D. Swain
2501	Effect of nutrient supply on crop-weed competition	Dr. M.B.B. Prasad Babu
2601	Germination, dormancy and ageing of weed seeds	Dr. D.K. Pandey
C	**Development and evaluation of integrated weed management techniques /practices**	
3101	Role of weed competitive crop cultivars in IWM	Dr. B.T.S. Moorthy
3201	Design, development and evaluation of mechanical weeding tool as a component of integrated weed management techniques and practices	Er. H.S. Bisen
3301	Effect of tillage and weed control measures on weed dynamics in different cropping systems	Dr. J.S. Mishra
3401	Role of intercrops and cover crops in weed management	Dr. R.P. Dubey
3501	Studies on effect of crop residue management on weeds in rice-wheat cropping system	Dr. P.J. Khankhane
3601	Evaluation of improved weed control technologies on farmers' fields	Dr. P.K. Singh
D	**Bio-pesticides and biocontrol of weeds**	
4101	Herbicidal activity of plants and their constituents	Dr. D.K. Pandey
4201	Optimizing *Z. bicolorata* release as an augmentative measure for the control of *Parthenium hysterophorus*.	Dr. Sushilkumar
4301	Collection, characterization and evaluation of plant pathogens for weed management (PI)	Sh. Chandrabhanu

LINKAGES AND COLLABORATION IN INDIA AND ABROAD INCLUDING EXTERNALLY FUNDED PROJECTS

Being a nodal agency for research and training in the field of weed science and a repository of information in weed science in the country, NRCWS offered research and training to the 17 research scholars and provided expertise and consultancy to the staff and students of SAUs, ICAR Institutes, NGOs, herbicide industries etc.

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

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

Externally-funded projects

Project Title & PI	Funding Agency	Duration		Budget (Rs. in lakhs)
Large scale demonstration on management of *Parthenium* through integrated approach (Net work project with 7 coperating centres) **(PI- N.T.Yaduraju)**	DBT	2004	2007	11.35
Determination of the role of weeds in epidemic and perpetuation of economically important plant viruses (In collaboration with IARI) **(PI- Chandra Bhanu)**	ICAR	2004	2007	4.50
Effect of elevated atmospheric carbon di-oxide (CO_2) on crop-weed interactions **(PI- V.S.G.R. Naidu)**	ICAR	2004	2007	19.57
Detection of weeds for precision crop management using remote sensing technique **(PI- M.B.B. Prasad Babu)**	ISRO	2004	2007	10.17
Feasibility of increasing persistence of some rice herbicide and its consequence in soil environment **(PI- K.K. Barman)**	ICAR	2005	2008	19.53
Augmentation and activity enhancement of Mexican beetle for biological control of parthenium **(PI- Sushilkumar)**	ICAR	2005	2008	14.53
Structural behavior of different sulfonylurea herbicides in sub-soil under the influence of cropping conditions - identification and quantification of potential metabolites responsible for the toxicity and their bio-accumulation in fish (In collaboration with IIBAT, Padappai and PAU, Ludhiana) **(PI- Shobha Sondhia)**	ICAR	2005	2008	9.26

IMC, SRC AND RAC MEETINGS

Institute Management Committee (IMC) Meeting

The Management Committee Meeting of the Centre was held on 28-8-2004 and 15.01.2005 under the chairmanship of Dr. N.T. Yaduraju, Director. The members present were Dr. D.L.N. Rao, IISS, Dr. V.S. Tomar, DRS, JNKVV, Jabalpur Bhopal, Dr. V.V. Singh, CIAE, Bhopal, Dr. B.T.S. Moorthy, Dr. A.K. Gogoi , Shri Balwant Rai, AAo, Shri A.K. Srivastava, AF&AO and Shri O.N. Tiwari, Secretary, IJSC from the NRCWS. The progress of development activities and infrastructure buildup was reviewed. Approval was accorded for various new items to be executed/procured during the financial year. They also visited field and laboratory experiments.

Staff Research Council (SRC)

The SRC meeting was convened on 10-11 June 2004 under the chairmanship of the Director to review the results of on-going projects and to consider new project proposals. At the outset chairman discussed the previous SRC proceeding and the recommendations of RAC and said that suggestions made by the RAC should be kept in mind while preparing the new proposals. Scientists presented their research achievements of 2003-04 and discussed on the new proposals for the coming year.

Research Advisory Committee (RAC) Meeting

A meeting of the Research Advisory Committee of the Centre comprising of Dr. J.S. Kolar (Chairman), Dr. V.M. Bhan, Dr. N.T. Yaduraju, Shri Hamid Kazi (all members) and Dr. A.K. Gogoi (Member Secretary) was held from 14-15 February 2005. The committee visited the field and laboratory experiments. They critically evaluated the research activities of the Centre and gave valuable suggestions for improvement of the programmes for the coming year.

Biosafety Committee Meeting

The Centre's biosafety committee meeting was held on 8-2-2005 under the Chairmanship of Dr. N.T. Yaduraju, Director. The members present were Dr. S.C. Deshmukh, Dr. Sharad Tiwari, Professor, Dept. of Biotechnology, JNKVV, Dr. D.K. Pandey and Dr. D. Swain. The committee reviewed the DBT project. They also visited the experiments in the net house and limited open trials in the field and expressed satisfaction at the progress made in the project.

PARTICIPATION OF SCIENTISTS IN SEMINARS, SYMPOSIA etc.

Participants	Conference / Symposium	Venue & Date
V.S.G.R. Naidu	National Symposium on Resource Conservation and Agriculture Productivity	PAU, Ludhiana Nov 22-25 2004
Siddarth Nayak	92nd Session of Indian Science Congress	Ahmedebad, Gujarat Jan 3-7 2005
Seema Paroha	Winter School Training on Photosynthesis and Bio-productivity	IARI, New Delhi 2-22 Dec 2004
A.K. Gogoi and Dr. Anil Dixit	International Symposium on "Rainfed Rice Ecosystems: Perspective and Potential	IGAU, Raipur 11-13 October 2004
A.K. Gogoi and Dr. Anil Dixit	National Seminar cum Workshop on "Challenges for Enhancing Rice Production in Fragile Environments	JNKVV, Jabalpur 19-21 October 2004
V.P. Singh. P.K. Singh, J.S. Mishra, R.P. Dubey and VSGR Naidu	National Symposium on Resource Conservation and Agricultural Productivity	PAU, Ludhiana 22-25 November
Anil Dixit	34th Annual Soybean Workshop	GBPUAT, Pantnagar 8-10 April 2004
A.K. Gogoi	39th Annual Rice Group Meeting	IARI, New Delhi 12-14 April 2004
	XIIIth Group Meeting of All India Network Project on Pesticide Residues,	IARI, New Delhi 5-6 May 2004
	NATP-CGP (IPM Projects) Review Meeting	UAS, Dharwad 24 June 2004
N.T. Yaduraju, A.K. Gogoi, J.S. Mishra, Sushilkumar, R.P. Dubey, D. Swain, V.S.G.R. Naidu, Chandra Bhanu, Sri Sandeep Dhagat and Sri. O.N. Tiwari	Biennial Workshop of AICRP-WC	UAS, Bangalore 26-28 May 2004
Sushilkumar and Chandra Bhanu	Biennial Workshop on Biological control	PDBC, Bangalore 21-22 May 2004
K.K. Barman, M.B.B. Prasad Babu and P.J. Khankhane	International Conference on 'Soil, Water and Environmental Quality Issues and Strategies	IARI, New Delhi Jan 28 Feb 1, 2005
R.P. Dubey, J.S. Mishra, P.K. Singh, M.B.B. Prasad Babu, D. Swain, Anil Dixit, Sushilkumar, Monika Singh, S. Rahuvanshi, V.P. Singh	International Conference on Sustainable Crop Production in Stress Environments: Management and Genetic Options	JNKVV, Jabalpur Feb 9-12, 2005

WORKSHOPS SEMINARS, TRAINING PROGRAMMES ORGANIZED

Biennial Workshop of AICRP-Weed Control

The sixteenth biennial workshop of All India Coordinated Research Programme on Weed Control was held from 26-28 May 2004 at the University of Agricultural Sciences, Bangalore. All the scientists working in 22 AICRP-WC Centres, scientists from other ICAR institutes and representatives from pesticide industries participated in the workshop. Dr. Gurbachan Singh, ADG (Agro), ICAR, New Delhi and Chief Guest of the function mentioned that there is need to have weed management practices in organic farming system. According to him investigations on herbicide residue is very important and there is a need to monitor herbicide residues in soil, water and food chain. Dr. N.T. Yaduraju, Director, NRCWS, Jabalpur presented the research highlights of AICRP-WC 2003-2004. Several publications *viz.*, Integrated weed management in rice under different ecologies, Herbicide Manual, Annual Report of AICRP-WC 2003-04, Twenty five years PG research and Research publications under AICRP-WC and a CD on *Orobanche* were also released on the occasion.

National *Parthenium* Awareness Day

With a view to make people aware of the problem of *Parthenium* in the country which has devastating effects on health, agriculture and environment and how to manage/utilize this weed, a special programme on Awareness and Management of *Parthenium* was organized by the Centre on 4th September 2004 throughout the country. All the AICRP-WC centres located in different State Agricultural Universities, NGO's and some ICAR institutions and other Government Organizations took part in the programme. From the feedback received, it was known that the campaign was a grand success. There was overwhelming response and participation of Universities and State Departments of Agriculture, Municipal/local administration, Schools and school children, NGO's and general public. The activities included lectures by experts, demonstration of available technology for *Parthenium* management, release of publications related to *Parthenium*, release of Mexican beetle, etc.

15th Foundation Day of the Centre

The Centre celebrated its 15th foundation day on April 22, 2004. On this occasion, Dr. V.M. Bhan, founder Director of the Centre inaugurated the main gate and approach road. While addressing the gathering of the scientists and other staff members, Dr. S.P Gautam, Vice Chancellor, Rani Durgavati University, Jabalpur and Chief Guest of the function opined that weeds should be removed from crops as well as from life to increase the

crop productivity and energy in life, respectively. Dr. D.P. Singh, Vice Chancellor, JNKVV, Jabalpur appreciated the efforts being made by the Centre in generating successful technologies for weed management. Dr. N.T. Yaduraju, Director of the Centre highlighted the various research activities being taken up by the Centre. Two technical bulletins *viz., Tillage and Weed Management* and *Soil Solarization - a novel technique of weed management* and *NRCWS profile* were released on the occasion. On this occasion some staff members were honoured for successful completion of 25 years of their services in ICAR.

Workshop-cum-demo on Aquatic Weeds

The Centre organized a fields Workshop cum demo on aquatic weeds at Ranital, Jabalpur on 5-11-2004 under National Environment Awareness Campaign sponsored by Environmental Planning and Co-ordination Organization (EPCO), Bhopal. The main aim of this programme was to make people aware about the importance of water and how to keep it clean and minimize the losses through various means. Addressing the gathering, Er. H.S. Bisen, Principal Scientist and Chief Guest of the function told the historical background of the Ranital in the Jabalpur and the importance of clean water in day to day life. Dr. Sushilkumar, Coordinator of the programme informed that aquatic weeds cause 5-12 times more loss of water through evapo-transpiration. Water hyacinth, the major aquatic weed, could effectively be controlled by a bioagent *Neochetina* spp. A poster exhibition was also organized by the Centre to provide understanding and knowledge about aquatic weeds to the residents.

Inauguration of Centre's Recreation Club

Dr. N.T. Yaduraju, Director, NRCWS, inaugurated the Recreation Club of the Centre on 01-01-2005. The Club has a gymnasium and also facilities for indoor sports like carrom, chess, table tennis etc.

TRAINING TO STUDENTS

The following students from different Universities/Colleges were trained during the year.

Sl.	Name	Supervisors
1	Maheshwara Krishnam, Bharathi Dakan University, Puddukottai, Tamil Nadu	Dr. V.S.G.R. Naidu
2	Amrita Sagdeo, Home Science College, Jabalpur	
3	Neha Saxena, Home Science College, Jabalpur	
4	Jaidev Rathore, RDVV, Jabalpur	Dr. D.K. Pandey
5	Neha Jain, Home Science College, Jabalpur	Dr. Chandra Bhanu
6	Sachi Dubey, Home Science College, Jabalpur	Dr. Chandra Bhanu
7	Parveen G. Ansari, RDVV, Jabalpur	Dr. K.K. Barman
8	Ch. Srinivasa Rao, Bharathi Dakan University, Puddukottai, Tamil Nadu	Dr. D. Swain
9	Pallavi Jha, APS University, Rewa	Dr. Chandra Bhanu
10	Sonal Kharya, Home Science College, Jabalpur	Dr. J.S. Mishra
11	Ravi Shanker Pandey APS University, Rewa	Dr. D.K. Pandey
12	Neetu Mishra, APS University, Rewa	Dr. D. Swain
13	G.K. Boudh, APS University, Rewa	Dr. K.K. Barman
14	Saroj Kushwaha, APS University, Rewa	Dr. Sushilkumar
15	A. Rajnikumari, Nagarjuna University, Guntur, Andhra Pradesh	Dr. D.K. Pandey
16	B.N. Sravanthi, Nagarjuna University, Guntur, Andhra Pradesh	Dr. D. Swain
17	Venkataswara Rao, Bharathi Dakan University, Puddukottai, Tamil Nadu	Dr. Sushilkumar

Lectures

Dr. VSGR Naidu delivered a lecture on 20th Nov 2004 during the training programme on Propagation and Management Practices of Medicinal Plants during Nov 17th to Nov 30th 2004 at JNKVV Jabalpur Madhya Pradesh.

Dr. Anil Dixit delivered lectures on "Weed management in oilseed crops" on 30-10-2004 and "Weeds of rice and their control" on 4-12-2004 at Farmers Training Centre, Jabalpur.

Dr. J.S. Mishra delivered a lecture on "Significance of objectionable weed seeds in the management of seed programmes" in a training programme "Management of Seed Industry" on 26th August 2004 at JNKVV, Jabalpur.

Dr. Anil Dixit delivered a lecture on "Weeds in *Kharif* crops and their management" on 28th August 2004 at Farmers' Training Centre, Jabalpur.

Dr. Anil Dixit delivered a lecture on "Weed Management in North-East Region" in a training programme on "Advances in Weed Management" on 8 April 2004 at GBPUAT, Pantnagar

Dr. J.S. Mishra spoke on "Weed management in rapeseed-mustard based cropping system" at the winter school on "Advances in rapeseed-mustard research technology for sustainable production of oilseeds" on 03-01-2005 at NRCRM, Bharatpur.

Dr. Anil Dixit delivered a talk on "Weed management in oilseed crops" on 05-03-2005 and 28-03-2005 at Farmers Training Centre, Jabalpur.

Guest Lectures

Dr. P.K. Sen, Professor, IIT, Delhi delivered a lecture on "Water distillation by multiple effects using biomass based fuels for rural drinking water" on 27-8-2004.

Dr. (Mrs.) Padma V. Sen, Professor, IIT, Delhi delivered a lecture on Phytoremediation of waste-water using seed beds" on 27-8-2004.

Staff Seminars

The following staff seminars were delivered during the year.

Speaker	Topic	Date
Dr. Seema Paroha	Your health, Your choice	24-4-2004
Mrs. Monika Bedi	Biological control of weeds using deleterious *Rhizobacteria*	24-4-2004
Dr. Shobha Sondhia	Pesticide residues and risk assessment	26-6-2004
Dr M.S. Raghuvanshi	Global warming	30-7-2004
Mr. Roby Mathew	WTO and Indian agriculture	30-7-2004
Mr. Chandra Bhanu	Bio-terrorism and threat of weeds to Indian agriculture and biodiversity	24-9-2004
Mrs. Archana Trivedi	Common medicinal weeds of central India	24-9-2004
Mr. Sanjay Jain	Transgenics in agriculture	24-9-2004

DISTINGUISHED VISITORS

Shri Kantilal Bhuria, Hon'ble Minister of State for Agriculture, Govt. of India visited the Centre on 5-10-2004. He evinced keen interest in various activities of the Centre. Dr. N.T. Yaduraju, Director briefed the minister about the various activities being taken up by the Centre. The Hon'ble minister also visited different research laboratories and library of the Centre.

Dr. S.M. Paul Khurana, Vice Chancellor, RDVV, Jabalpur on 7-12-2004

Dr. S.M.P. Khurana being welcommed by the Director

Dr. B.L. Jalali, Ex Director of Research, CCS HAU, Hisar on 02-12-2004

Dr. D.V. Singh, Head, Division of Mycology and Plant Pathology, IARI, New Delhi on 02-12-2004

Dr. J.S.P. Yadav, Former Chairman, ASRB, New Delhi on 26-6-2004

Dr. G.S. Khush, Adjunct Professor, University of California, USA, on 11-02-2005

Dr. G.S. Khush visiting the net house experiments on transgenic mustard

Dr. P.N. Jha, Former Vice Chancellor, RAU, Pusa on 11-02-2005

Dr. P. Das, DDG (Ext.), ICAR, New Delhi on 19-02-2005

Dr. P. Das DDG (Ext.) is being briefed by the Director regarding biocontrol of Parthenium.

PERSONALIA (as on 31.03.2005)

Director
Dr. N.T. Yaduraju

Scientific

Dr. B.T.S. Moorthy	Pr. Scientist (Agro.)
Er. H.S. Bisen	Pr. Scientist (Ag. Engg.)
Dr. A.K. Gogoi	Pr. Scientist (Agro.)
Dr. D.K. Pandey	Sr. Scientist (Pl. Physiol.)
Dr. K.K. Barman	Sr. Scientist (Soil Sci.)
Dr. V.P. Singh	Sr. Scientist (Agro.)
Dr. Sushilkumar	Sr. Scientist (Entomo.)
Dr. R.P. Dubey	Sr. Scientist (Agro.)
Dr. J.S. Mishra	Sr. Scientist (Agro.)
Dr. Anil Dixit	Sr. Scientist (Agro.)
Dr. D. Swain	Sr. Scientist (Econ. Botany)
Dr. P.K. Singh	Sr. Scientist (Agril. Extn.)
Dr. M.B.B.Prasad Babu	Scientist (SS) (Soil Sci.)
Dr. P.J. Khankhane	Scientist (SS) (Soil Sci.)
Dr. Shobha Sondhia	Scientist (Residue Chem.)
Dr. V.S.G.R. Naidu	Scientist (Economic Botany)
Sh. Chandra Bhanu	Scientist (Pl. Pathology)

Administration, Finance and Accounts

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

Technical

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

Supporting

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

केन्द्र में हिन्दी के बढ़ते कदम

राष्ट्रीय खरपतवार विज्ञान अनुसंधान केन्द्र में वर्षभर में राजभाषा कार्यान्वयन समिति की चार बैठकों का आयोजन किया गया । एवं केन्द्र में हिन्दी दिवस और हिन्दी पखवाड़े का आयोजन किया गया । जिसमें सात प्रतियोगिताओं का आयोजन किया गया । केन्द्र के दो लिपिक वर्गीय कर्मचारियों को छः माह के लिए हिन्दी टंकण प्रशिक्षण हेतु हिन्दी शिक्षण योजना भेजा गया । और केन्द्र के प्रशासनिक वर्ग के अधिकारियों/कर्मचारियों की झिझक दूर करने एवं राजभाषा हिन्दी के कार्यान्वयन एवं प्रचार प्रसार हेतु दो दिवसीय हिन्दी कार्यशाला का आयोजन किया गया । निरीक्षण दल के सुझावनुसार केन्द्र के पाँच अनुभागों को अपना संपूर्ण कार्य हिन्दी करने हेतु नामित किया गया । राजभाषा कार्यान्वयन समिति कि हिन्दी वार्षिक पत्रिका **''तृण संदेश''** का प्रकाशन किया गया । जिसमें केन्द्र के सभी वैज्ञानिक अधिकारियों के शोध लेख एवं कर्मचारियों के लेख, कविताएं, लोक गीत और कहानियां आदि प्रकाशित कि गई ।

हिन्दी कार्यशाला

केन्द्र में प्रशासनिक वर्ग के कर्मचारियों को अधिक से अधिक हिन्दी में कार्य करने के लिए राजभाषा कार्यान्वयन समिति के तत्वाधान में 24 से 25 अगस्त, 2004 तक दो दिवसीय हिन्दी कार्यशाला का आयोजन किया गया । जिसमें केन्द्र के प्रशासनिक वर्ग के सभी अधिकारियों/कर्मचारियों ने भाग लिया । इस कार्यशाला में हिन्दी राजभाषा की उत्पत्ति, विकास एवं संवैधानिक स्थिति, राजभाषा कार्यान्वयन में परिषद के विभिन्न संस्थाओं में किये जा रहे प्रयास, हिन्दी की प्रमाणिक वर्तनी एवं राजभाषा में संगणक (कम्प्यूटर) का ज्ञान, आदि विषयों पर श्री जी. आर. डोंगरे, डॉ. व्ही. पी. सिंह, एवं श्री संदीप धगट द्वारा प्रतिभागियों को जानकारी दी गयी ।

राजभाषा पखवाड़ा

केन्द्र की राजभाषा कार्यान्वयन समिति के तत्वावधान में 14 सितम्बर से 30 सितम्बर 2004 तक राजभाषा पखवाड़ा मनाया गया । इस कार्यक्रम में सभी वैज्ञानिकों/अधिकारियों एवं कर्मचारियों को हिन्दी में अधिकाधिक कार्य करने हेतु प्रेरित किया गया । इसके अंतर्गत विभिन्न प्रतियोगिताओं जैसे निबंध, शुद्धलेखन, टंकण, वाद-विवाद आदि का आयोजन किया गया जिसमें केन्द्र के सभी वर्गो के कर्मचारियों ने भाग लिया तथा विजेताओं को पारितोषिक वितरण किया गया । इस कार्यक्रम के दौरान रामदेव जी महाराज की तपोसाधना से फलित 'योगासन एवं प्राणायाम रहस्य' की वीडियो सी डी भी प्रदर्शित की गई ।

Annexure-I

Meteorological data during 2004-05

Months	Temperature (°C)		Relative humidity (%)		Wind velocity (km/hr)	Sunshine (hrs)	Rainfall (mm)	Rainy days	Evapo-ration (mm)
	Maxi.	Mini.	I	II					
April, 04	39.6	23.4	40	14	6.0	9.0	1.2	0	9.1
May	40.7	27.0	46	20	6.8	9.1	5.0	1	10.4
June	36.3	26.6	67	46	7.5	5.7	205.1	6	7.1
July	31.9	24.8	86	68	5.4	4.0	326.2	15	3.5
August	27.9	23.6	92	80	6.1	2.2	487.3	17	2.1
September	32.2	24.0	87	58	3.2	6.4	87.8	6	3.3
October	30.2	17.7	89	45	2.0	8.3	34.4	3	2.8
November	28.8	12.1	90	33	1.2	8.2	17.6	1	2.3
December	25.3	8.4	94	36	1.5	7.8	0	0	1.8
January, 05	23.8	10.0	93	46	2.5	6.7	81.0	5	2.1
February	27.0	12.4	85	37	3.0	8.5	4.5	1	3.1
March	33.2	17.0	72	27	3.5	8.3	31.1	2	4.7
Total							**1281.2**		