अखिल भारतीय समन्वित खरपतवार प्रबंधन अनुसंधान परियोजना

All India Coordinated Research Project on Weed Management

वार्षिक प्रतिवेदन

Annual Report

2022

भाकृअनुप-खरपतवार अनुसंधान निदेशालय, जबलपुर (म.प्र.)

ICAR-Directorate of Weed Research, Jabalpur (M.P.)

गाजरघास खत्म करने दिए टिप्स

ग्वालियर। राजमाता विजयाराजे सिंधिया कृषि विश्वविद्यालय में संचालित अखिल भारतीय समन्वित खरपतवार प्रबंधन परियोजना के अंतर्गत गाजरघास जागरूकता सप्ताह पंचशील पार्क योग केन्द्र पर मनाया गया। वैज्ञानिक डॉ. वर्षा गुप्ता ने यहां रहने वाले लोगों को गाजरघास के प्रति जागरूक किया। परियोजना प्रभारी डॉ. दीप सिंह सासे ने लोगों को गाजरघास कैसे खत्म करें इस बारे में समझाया। इस कार्यक्रम में लगभग 20 महिलाएं एवं 10 पुरुष सम्मिलित थे। डॉ. चाहेक सिंह ने आभार व्यक्त किया।

गाजर घास से जमीन का बचाव करने चलाया अभियान

ग्वालियर। कृषि विश्वविद्यालय द्वारा गजरा घास जागरूकता अभियान गजपुरा गांव में चलाया गया। इस अभियान के अंतर्गत किसानों को इससे होने वाले नुकसान से बचाने के लिए जागरूकता कार्यक्रम चलाया जा रहा है। वैज्ञानिक डा. वर्षा गुप्ता ने बताया कि गाजर घास से पैदावार घटती जाती है। यहां तक पशुओं को भी नहीं बख्श पाती है। इससे 40 प्रतिशत जमीन गाजर घास से ग्रसित हो चुकी है। इसके बीज इतने हल्के होते हैं कि हवा में आसानी से उड़कर कहीं भी गिर जाते हैं और नमी पाते ही उग जाते हैं। इससे बीज घास नली में चले जाएं तो अस्थमा और हर्रार में चिपक जाएं तो व्यक्ति खुजली से ग्रसित हो जाता है। वहीं वैज्ञानिक डा.दीप सिंह सासखेड़े ने विभिन्न प्रकार के जैविक, रासायनिक व यांत्रिक तरीकों से गाजर घास उन्मूलन के प्रति

गाजर घास हटाने दिए टिप्स

ग्वालियर। राजमाता विजयाराजे सिंधिया कृषि विश्वविद्यालय के अंतर्गत संचालित अखिल भारतीय समन्वित खरपतवार प्रबंधन परियोजना में गाजरघास जागरूकता अभियान का आगाज हुआ जो कि 22 अगस्त तक विभिन्न गांवों में मनाया जाएगा। कृषि वैज्ञानिकों द्वारा ग्राम बेरडा में गाजरघास जागरूकता अभियान मनाया गया। जिसमें लगभग 30-40 पुरुष व महिला किसानों ने भाग लिया। कार्यक्रम का संचालन वैज्ञानिक डॉ. वर्षा गुप्ता ने किया। जिसमें परियोजना प्रभारी डॉ. दीप सिंह सासोड़े ने गाजरघास से होने वाली हानियों एवं रासायनिक तथा गैर रासायनिक तरीकों से बचाव के तरीकों पर प्रकाश डाला। किसानों को गाजरघास के प्रति जागरूक करते हुए गाजरघास से कम्पोस्ट बनाने के तरीके बताए गए।

दैनिक मध्यराज्य

ग्वालियर मे मनाया जायेगा 17 वां गाजर घास जागरूकता सप्ताह

मुरैना. राजमाता विजयाराजे सिंधिया कृषि विश्वविद्यालय के अंतर्गत संचालितअखिल भारतीय समन्वित खरपतवार प्रबंधन परियोजना में गाजरघास जागरूकता अभियान का आगाज हो चुका है। जो कि 16-22 अगस्त 2022 तक ग्वालियर के विभिन्न गांवों में मनाया जायेगा। आज कृषि वैज्ञानिकों द्वारा ग्वालियर के ग्राम बेरडा में गाजर घास जागरूकता अभियान मनाया गया। जिसमें लगभग 30-40 पुरुष व महिला किसान ने भाग लिया। कार्यक्रम का संचालन वैज्ञानिक डॉ. वर्षा गुप्ता ने किया। जिसमें परियोजना प्रभारी डॉ. दीप सिंह सासोड़े ने गाजरघास से होने वाली हानियों एवं रासायनिक तथा गैर रासायनिक तरीकों से बचाव के तरीकों पर प्रकाश डाला। किसानों को गाजरघास के प्रति जागरूक करते हुए गाजरघास से कम्पोस्ट बनाने के तरीके भी बताये गये।

दैनिक मध्यराज्य

पंतनगर में सर्वोच्च स्थान प्राप्त करने वाले विद्यार्थियों को पुरस्कृत किया गया • जागरण

संवृ. पंतनगर : पंत वि की खरपतवार नियंत्रण परियोजना के तहत राजकीय बालिका उच्चतर माध्यमिक विद्यालय नगला मे जागरूकता सप्ताह का समापन हो गया। विद्यार्थियों को विभिन्न जानकारियां दी गई। कार्यक्रम मे सोमवार को डा. तेज प्रताप ने गाजर घास से होने वाले नुकसान, प्रबंधन एवं उन्मूलन के बारे में जानकारी दी। डा. शैलेंद्र प्रताप सिंह ने गाजर घास के जैविक नियंत्रण के बारे में जानकारी दी। परियोजनाधिकारी, डा. वीरेंद्र प्रताप सिंह ने गाजर घास की भारत मे प्रवेश से लेकर अब तक की परिस्थितियों के बारे मे जानकारी दी। प्रतियोगिता मे चार सर्वोच्च स्थान प्राप्त करने वाले विद्यार्थी क्रमशः रिया खत्री

पार्थेनियम जागरूकता सप्ताह संपन्न

पालमपुर, 23 अगस्त(ब्यूरो): कृषि विश्वविद्यालय पालमपुर में गाजर घास उन्मूलन जागरूकता सप्ताह कार्यक्रम के अंतर्गत ग्रामीणों को जागरूक किया गया। 16 अगस्त से आरंभ हुए जागरूकता सप्ताह में पार्थेनियम को वैज्ञानिक तरीके से समाप्त किए जाने को लेकर ग्रामीणों को जानकारी दी गई। प्रधान अन्वेषक डा. एस.एस. राणा ने बताया कि भारतीय कृषि अनुसंधान परिषद खरपतवार निदेशालय जब्बलपुर मध्यप्रदेश द्वारा पार्थेनियम जागरूकता सप्ताह के अंतर्गत विश्वविद्यालय और कृषि विज्ञान केंद्रों के तहत जागरूकता कार्यक्रमों में ग्रामीणों को एकीकृत साधनों के साथ खरपतवार की देखभाल करनी की सलाह दी गई।

बच्चों ने जाने गाजरघास के नुकसान, पूछे सवाल

राजमाता विजयाराजे सिंधिया कृषि वि के जागरूकता कार्यक्रम में शामिल बच्चे। • नईदुनिया

ग्वालियर (नईदुनिया प्रतिनिधि)। राजमाता विजयाराजे सिंधिया कृषि विश्वविद्यालय में संचालित अखिल भारतीय समन्वित खरपतवार प्रबंधन परियोजना के अंतर्गत आज दिनांक 22 अगस्त 2022 को गाजरघास जागरूकता सप्ताह का समापन समारोह मनाया गया। जिसके अंतर्गत 70-75 बच्चों को गाजरघास से होने वाले हानियों व नियंत्रित करने के उपाय परियोजना प्रभारी डॉ. दीप सिंह सासोड़े व वैज्ञानिक डॉ. एकता जोशी द्वारा विस्तार से बताये गये। होने वाले नुकसान के बारे में बताया परियोजना के प्रभारी डा. दीप सिंह सासोड़े व वैज्ञानिक डा. एकता जोशी ने अखिल भारतीय समन्वित खरपतवार प्रबंधन परियोजना के अंतर्गत संचालित अखिल भारतीय समन्वित खरपतवार प्रबंधन परियोजना के परियोजना प्रभारी डॉ. दीप सिंह सासोड़े व वैज्ञानिक डा. एकता जोशी द्वारा विस्तार से बताये गये। बच्चों को गाजरघास से बचने के तरीके व नियंत्रित करने के उपाय बताये गये। जानकारी दी। इस मौके पर जोशी दीक्षित, राकेश कुमार पांडे, बाबके सिंह, वीरेंद्र एसं सुनील कुशवाह आदि मौजूद थे।

डॉ. डी.एस. सासोड़े ने छात्र-छात्राओं को बताए गाजरघास से होने वाले दुष्परिणाम

सत्त सुधार • ग्वालियर

राजमाता विजयाराजे सिंधिया कृषि विश्वविद्यालय में संचालित अखिल भारतीय समन्वित खरपतवार प्रबंधन परियोजना के अंतर्गत आज दिनांक 22 अगस्त 2022 को गाजरघास जागरूकता सप्ताह का समापन समारोह मनाया गया। जिसके अंतर्गत 70-75 बच्चों को गाजरघास से होने वाले हानियों व नियंत्रित करने के उपाय परियोजना प्रभारी डॉ. दीप सिंह सासोड़े व वैज्ञानिक डॉ. एकता जोशी द्वारा विस्तार से बताये गये। वैज्ञानिकों से गाजरघास से संबंधित अपने प्रश्न पू कार्यक्रम का संचालन श्री ओ.पी. दीक्षित, ज्योशाखाता, कक्ष्य ग्वालियर सेवा निवृत्त की अध्य में किया गया। इस कार्यक्रम में चरिष्ठ वैज्ञानिक डॉ. सिंह सासोड़े, वैज्ञानिक डॉ. एकता जोशी, श्री राके कुमार पाण्डेय, प्रधानाध्यापक शासकीय माध्यमि विद्यालय सेवा निवृत्त सहित प्रदेश विस्तार अधिक डॉ. व्याक. सिंह, सहायक श्री सौरभ शाक्य एवं सुनील कुशवाह के सहयोग व देखरेख में कार्यक्रम

गाजर घास खत्म करने की जानकारी दी

गाजर घास उन्मूलन जागरूकता सप्ताह कार्यक्रम के तहत मौजूद कृषि के छात्र।

पालमपुर : हिमाचल प्रदेश चौधरी

गया। विज्ञानियों ने गाजर घास को समाप्त करने की जानकारी दी। डा. एसएस राणा ने बताया कि खैरा, जिया, उस्तेहड़, पढ़ियारखड़, मनियाड़ा में

कलुपు మొక్కల నివారణపై అవగాహన

విజినేపల్లి: మండలంలోని పాలెం ప్రాంతీయ వ్యవసాయ పరిశోధన కేంద్రంలో గురువారం వ్యవసాయ శాస్త్రవేత్తలు వ్యవసాయ పాలిటెక్నిక్ విద్యార్థులు కలుపు మొక్కల నిర్మూలనపైఅవగాహన సదస్సు నిర్వహించారు. ఈ ఈ సందర్భంగా రాజేందర్‌నగర్‌లోని అఖిల భారత కల్పు మొక్కల పరిశోధన సంస్థ శాస్త్రవేత్త డాక్టర్ పద్మజ వయ్యారిభామ కలుపు మొక్క స్వభావం, పెరిగే నేలలు, అవి పంటలు, మనుషులకు చేసే నష్టాలు సమగ్ర యాజమాన్య పద్ధతుల గురించి వివరించారు. పాలెం ఏడిఆర్‌ఓఎర్‌ఎస్ శాస్త్రవేత్త డాక్టర్ ఎం .గోవర్ధన్ మాట్లాడుతూ ఈ కలుపు మొక్క అన్ని రకాల నేలలో అన్ని రకాల పంటలలో పెరుగుతూ పంటను ఆశించే పురుగులు తెగుళ్లకు వారధిగా ఉంటూ పంటల దిగుబడిపై దెబ్బతీస్తుందన్నారు. ఈ మొక్క నిర్మూలనపై అవగాహన పెంపొందించేందుకు ప్రతి సంవత్సరం ఆగస్టు 16 నుండి 22 వరకు అవగాహన సదస్సులు నిర్వహిస్తున్నామన్నారు. ఈ కార్యక్రమంలో వ్యవసాయ శాస్త్రవేత్తలు డాక్టర్ పుష్పావలి, ప్రోగ్రాం కోఆర్డినేటర్ డాక్టర్ జె ప్రభాకర్ రెడ్డి, డాక్టర్ అనురాధ, డాక్టర్ రామకృష్ణ బాబు వ్యవసాయ పాలిటెక్నిక్ విద్యార్థులు పాల్గొన్నారు.

TheHitavada
Raipur City Line | 2022-08-23 | Page- 4

Parthenium Hysterophorus Awareness Programme held at CARS, Mahasamund

■ Staff Reporter
RAIPUR, Aug 22

COLLEGE of Agriculture and Research Station (CARS), Kanpa in Mahasamund organised Parthenium Hysterophorus Awareness Programme Under the aegis of Indira Gandhi Agricultural University (IGAU) in campus from August 17 to 22.

Addressing the inaugural awareness programme, Dean Dr Anurag and Professor Dr G S Tomar discussed in detail about Parthenium, the problem caused by them in humans and animals, its management and method of making organic manure. Later, students cleared their doubts and were also rewarded. College campus was cleaned by staff members and students.

On the last day of Parthenium Hysterophorus Awarness Week, students of RAWE (4th year) took out an awareness

Students creating awareness on Parthenium Hysterophorus.

rally displaying posters, flexes, banners etc to educate the villagers regarding parthenium in village Gopalpur. Under a special initiative, the students also cleaned various places in the village. Dean Dr Anurag, Professor Dr G S Tomar, Dr Navneet Rana, Er K K S Mahilarg, Dr Aarti Jain, Dr Naresh, Dr Himanshu, Dr Shilpa, Dr Gangram, Dr Jyotinala, Ku Geetika and Kiran alongwith the college students, representatives and rural peoples of Gopalpur village were present on the occasion.

...రణతోనే అధిక దిగుబడి

...మంటల్లో కలుపు నివారణ చేపడితే అధిక దిగుబ...
...గోవర్ధన్ అన్నారు. మండలంలోని పాలెం ప్రాం...
...కేంద్రం ఆడిటోరియంలో పార్థీనియం కలుపు...
...గాహన కార్యక్రమం నిర్వహించారు. ఈ సంద...
...కలుపు పంటకు ఆశించిన తెగుళ్లకు వారధిగా...
...దెబ్బతీస్తుందన్నారు. కలుపు నిర్మూలనపై అవగా...
...ఏడాది ఆగస్టు 16 నుంచి 22 వరకు పార్థీని...
...అవగాహన సదస్సు నిర్వహిస్తున్నట్లు తెలిపారు. అనంతరం వయ్యా...
...కలుపు స్వభావం, పెరిగే నేలలు, పంటలకు, మనుషులకు చేసే నష్టా...
...మగ్ర యాజమాన్య పద్ధతులపై వివరించారు. కార్యక్రమంలో పద్మజ,
...ప్రభాకర్‌రెడ్డి, అనురాధ, రామకృష్ణబాబు, కేవీకే కోఆర్డినేటర్ ప్రభా
..., శాస్త్రవేత్తలు, విద్యార్థులు తదితరులు ఉన్నారు.

జాగరూకता दिवस मनाया एवं रैली निका...

जैवविविधता के लिए गाजर घास घातक

हरिभूमि न्यूज ▶▶ कांकेर

गाजर घास के तेजी से फैलने के कारण अन्य उपयोगी वनस्पतियां खत्म होने लगती है।

■ रैली में ग्राम सिंगारभाट, पत्थरी, आतुरगांव एवं व्यासकोंगेरा के किसान शरीक हुए

जैवविविधता के लिये गाजर घास एक बहुत बड़ा खतरा बनती जा रही है, इसके कारण फसलों की उत्पादकता बहुत कम हो जाती है। जिलेवासियों को जागरूक करने के लिए जागरूकता रैली आयोजित की गई। रैली में ग्राम सिंगारभाट, पत्थरी, आतुरगांव एवं व्यासकोंगेरा के किसान शरीक रहे। भारतीय

कृषि अनुसंधान परिषद नई दिल्ली द्वारा घोषित गाजर घास उन्मूलन जागरूकता सप्ताह के अंतर्गत कृषि विज्ञान केन्द्र के तत्वाधान में गाजर घास उन्मूलन जागरूकता कार्यक्रम का आयोजन सिंगारभाट में आयोजित किया गया। कृषि विज्ञान केन्द्र के कार्यक्रम सहायक दिनेश सिन्हा द्वारा गाजर घास को पहचानने के बारे में विस्तृत जानकारी दी गई। गाजर घास का पिछले कुछ वर्षों से प्रकोप सभी प्रकार की खाद्यान फसलों, सब्जियों एवं उद्यानों में भी बढ़ता जा रहा है। गाजर घास का पौधा 3 से 4 महीने में अपना जीवन चक्र पूरा कर लेता है तथा एक वर्ष में इसकी 3 से 4 पीढ़ियां पूरी होती जाती है। वैज्ञानिक डॉ. सीएल ठाकुर ने गाजर घास से होने दुष्प्रभाव के बारे में बताया कि गाजर घास के सम्पर्क में आने से मनुष्यों के त्वचा संबंधी रोग जैसे एक्जिमा, एलर्जी, बुखार एवं दमा आदि जैसी बीमारियां हो जाती है। अत्यधिक प्रभाव होने पर मनुष्य की मृत्यु तक हो जाती है। पशुओं के लिए भी यह खरपतवार अत्यधिक विषाक्त होता है। गाजर घास के तेजी से फैलने के कारण अन्य उपयोगी वनस्पतियां खत्म ▶▶ शेष पेज 10 पर

Parthenium eradication awareness programme organised at SKUAST-J

An awareness programme on Parthenium eradication is being organised at SKUAST-Jammu on Monday.

GJ REPORT

JAMMU, AUG 22: NSS, SKUAST-J, under the guidance of the Vice Chancellor SKUAST-Jammu Prof J.P.Sharma and Dean Students Welfare today organised a programme on 'Parthenium eradication'. To make aware the common human health if not managed at vegetative stage. He also told about the ill effects of weeds on cattles too as its intake poses great threat to cattles. It caused skin allergy to both human as well as in animals. In the monsoon season it grows very fast and that's why it is necessary to

ings clean. Dr Subhash C Kashyap, NSS programme Coordinator called upon the NSS students to play a role of young worrier against the this weed by disseminate the message of 'Eradication of Parthenium' and uproot the weed at vegetative stage before flowering to check its

Parthenium awareness camp organizes at Jinder Mehlu vil

EARLY TIMES REPORT

JAMMU, Aug 18: Under the leadership and guidance of Vice Chancellor, SKUAST-J, Dr. J.P. Sharma, AICRP Weed Management, Division of Agronomy, organized a Parthenium awareness camp on 18th August, 2022 at Jinder Mehlu Village of Jammu district. In this occasion Dr. B.R. Bazaya, Professor and Incharge, AICRP-Weed Management explained

skin diseases an in both humans mals. He adviser ers and public vigorous campai icate partheni pletely at villages R. Puniya Jr. AICRP Weed Ma explained about cal, chemical an cal control mea management of um. Dr. Amites SMS, KVK Jan About more than

పార్థినియం కలుపు మొక్క నిర్మూలనపై అవగాహన సదస్సు

విజినపల్లి, మేజర్ న్యూస్ మండల పరిధిలోని పాలెం ప్రాంతీయ వ్యవసాయ పరిశోధన కేంద్రం ఆధ్వర్యంలో పార్థినియం కలుపు మొక్క నిర్మూలనపై అవగాహన సదస్సును వర్షజ అఖిల భారత కలుపు మొక్కల పరిశోధన సంస్థ రాజేంద్రనగర్, హైదరాబాద్‌కే వయ్యారి భామ కలుపు స్వభావం, మనుషులు చేసే నష్టాలు సమగ్ర యాజమాన్య పద్ధతులపై ఆమె వివరించారు. అనంతరం ఏడిఆర్ శాస్త్రవేత్త గోవర్ధన్ మాట్లాడుతూ ఈ కలుపు మొక్క అన్ని రకాల నేలలో, అన్ని రకాల పంటలలో పెరుగుతూ పంటను ఆశించే పురుగులు, తెగుళ్లకు వారధిగా ఉంటూ పంటను నాశనం చేస్తున్నాయన్నారు. ప్రస్తుతం ఈ కలుపు ప్రపంచంలోని అన్ని ప్రాంతాలను విస్తరించిందన్నారు. ఈ కలుపు నిర్మూలనపై అవగాహన పెంపొందించేందుకు ప్రతి సంవత్సరం ఆగస్టు 16 నుండి 22 వరకు పార్థినియంపై అవగాహన సదస్సులు నిర్వహిస్తున్నామని అన్నారు. ఈ కార్యక్రమంలో పుంగావలి (ఏడి పాలెం) 21, ప్రభాకర్‌రెడ్డి (పీసీ, పాలెం) (ఏపిటి, ఏటీటీటీ,) అనురాధ, రామకృష్ణ బాబు (పోటీ, పాలెం) ఇతర శాస్త్రవేత్తలు, వ్యవసాయ కళాశాల, పాలిటెక్నిక్ విద్యార్థినులు పాల్గొన్నారు.

surya paper

కలుపు మొక్కల నివారణపై అవగాహన

విజినేపల్లి: మండలంలోని పాలెం ప్రాంతీయ వ్యవసాయ పరిశోధన కేంద్రంలో గురువారం వ్యవసాయ శాస్త్రవేత్తలు వ్యవసాయ పాలిటెక్నిక్ విద్యార్థులు కలుపు మొక్కల నిర్మూలనపైఅవగాహన సదస్సు నిర్వహించారు. ఈ ఈ సందర్భంగా రాజేందర్‌నగర్‌లోని అఖిల భారత కల్పు మొక్కల పరిశోధన సంస్థ శాస్త్రవేత్త డాక్టర్ పద్మజ వయ్యారిభామ కలుపు మొక్క స్వభావం, పెరిగే నేలలు, అవి పంటలు, మనుషులకు చేసే నష్టాలు సమగ్ర యాజమాన్య పద్ధతుల గురించి వివరించారు. పాలెం ఏడిఆర్‌ఓఎర్‌ఎస్ శాస్త్రవేత్త డాక్టర్ ఎం .గోవర్ధన్ మాట్లాడుతూ ఈ కలుపు మొక్క అన్ని రకాల నేలలో అన్ని రకాల పంటలలో పెరుగుతూ పంటను ఆశించే పురుగులు తెగుళ్లకు వారధిగా ఉంటూ పంటల దిగుబడిపై దెబ్బతీస్తుందన్నారు. ఈ మొక్క నిర్మూలనపై అవగాహన పెంపొందించేందుకు ప్రతి సంవత్సరం ఆగస్టు 16 నుండి 22 వరకు అవగాహన సదస్సులు నిర్వహిస్తున్నామన్నారు. ఈ కార్యక్రమంలో వ్యవసాయ శాస్త్రవేత్తలు డాక్టర్ పుష్పావలి, ప్రోగ్రాం కోఆర్డినేటర్ డాక్టర్ జె ప్రభాకర్ రెడ్డి, డాక్టర్ అనురాధ, డాక్టర్ రామకృష్ణ బాబు వ్యవసాయ పాలిటెక్నిక్ విద్యార్థులు పాల్గొన్నారు.

अखिल भारतीय समन्वित खरपतवार प्रबंधन अनुसंधान परियोजना
All India Coordinated Research Project on Weed Management

वार्षिक प्रतिवेदन
ANNUAL REPORT
2022

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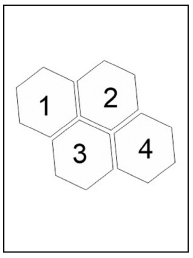


1. *In-situ* green manuring with horse gram in coconut plantation
2. Atrazine 500 g/ha as PE *fb* 2,4-D sodium salt 800 g/ha as PoE in finger millet
3. Bio-control of water hyacinth by *Neochetina* weevils
4. On-farm trial on weed management in rice

Preface

The United Nations has declared the year 2023 as the 'International Year of Millets'. India with a share of around 15% of the world total millets production, is the global leader in millets. Weeds are one of the major deterrents in successful cultivation of millets. Efforts are being made through All India Coordinated Research Project on Weed Management (AICRP-WM) to develop location-specific integrated weed management technologies to reduce crop losses due to weeds and increase the productivity of millets.

AICRP-WM has been carrying out location-specific research on weed management with its 24 cooperating centers (17 regular and 7 voluntary) for the last more than four decades. Efforts by cooperating centers have resulted in generation of location-specific technologies in the areas of sustainable weed management in diverse cropping systems, weed management in millets, management of herbicide-resistant weeds, estimation of herbicide residues in soil, water and crop produce, biological control of invasive weeds, on-farm research & demonstrations to refine and disseminate improved weed management technologies for ensuring wider adoption. In addition, new programmes on identification of Weeds of National Importance (WONI), mapping of aquatic weed infestation in the country, spread of *Phalaris minor* resistance in wheat in Punjab and Haryana, and impact assessment of weed management technologies were initiated.

The Annual Report (2022) of AICRP-WM is an inclusive document with compiled information based on 164 On-station trials, 115 OFRs and 130 FLDs across the country. The salient findings of experiments, and technologies assessed and up-scaled under on-farm/on-station situations in various production systems have been included in this report. During the period, different initiatives were taken for improving the quality of AICRP-WM work, and up scaling of doable weed management technologies in collaboration with different stakeholders. To disseminate the weed management technologies to farmers and other stakeholder's *sangosthies* and training programmes (in regional languages) were organized on various aspects of weed management. To monitor the progress, quarterly review meetings were organized virtually. A total of 40 recommendations have been included in the States Package of Practice. During the period under report, 121 research papers, 74 popular articles, 5 books and 23 book chapters were published. In addition, 72 M.Sc. (Ag.) and 49 Ph. D. thesis were submitted under AICRP-WM.

I profusely thank Dr. Trilochan Mohapatra former Secretary, DARE & Director General, ICAR and Dr Himanshu Pathak, Secretary, DARE and Director General, ICAR for their constant guidance and support in executing this project successfully. The encouragement, and guidance provided by Dr. S. K. Chaudhari, DDG (NRM), Dr. S. Bhaskar, former ADG, (A,AF&CC) and Dr. Rajbir Singh, ADG (A,AF&CC) are duly acknowledged. I wish to place on record the contributions and cooperation of the Principal Investigators & Scientists from the cooperating centers. I wish to compliment the efforts of Dr. R.P. Dubey, Principal scientist & Incharge, AICRP-WM, for coordination, monitoring and evaluation of the technical programme. I acknowledge the cooperation received from Dr. P.K. Singh, Pr. Scientist, Dr. Sushil Kumar, Pr. Scientist, Dr. Shobha Sondhia, Pr. Scientist, Dr. P.K. Mukharjee, Pr. Scientist, Dr. V.K. Choudhary, Sr. Scientist, Dr. Yogita Gharde, Sr. Scientist, Dr. Jamaludheen A, Scientist, Mr. Sandeep Dhagat, CTO and Mr. Pankaj Shukla, ACTO in bringing out this report. I hope the information contained in this report is useful to all the research institutes, agricultural universities, farmers and other stakeholders including NGOs involved in development & dissemination of weed management technologies.

(J.S. Mishra)
Director
ICAR-DWR, Jabalpur

Contents

Chapter	Particulars	Page no.
	Executive summary	v-xiv
1.	Organization and functioning	1-2
2.	Staff position and expenditure	3-4
3.	Research achievements	
	WP 1 Development of location-specific sustainable weed management practices	5-91
	WP 2 Weed biology, weed shifts and management of weeds in non-cropped areas	91-101
	WP 3 Fate of herbicide residues in different agro-ecosystems	101-108
	WP 4 Demonstration and impact assessment of weed management technologies	108-121
4.	Recommendations for package of practices	122-126
5.	Scheduled Cast Sub-plan (SCSP) programme	127-129
6.	Linkages and collaboration	130-132
7.	Publications	133-140
8.	Awards and recognitions	141
9.	Recommendations of AICRP-WM Annual Review Meeting-2022	142
10.	Status of experiments conducted	143-144
11.	Scientific staff	145-147
12.	Status of submission of annual report	148
	Acronyms	149

कार्यकारी सारांश
Executive summary

खरपतवार प्रबंधन पर अखिल भारतीय समन्वित अनुसंधान परियोजना (एआईसीआरपी-डब्ल्यूएम) विभिन्न कृषि जलवायु क्षेत्रों के तहत कृषि विश्वविद्यालयों में 17 नियमित केंद्रों और 7 स्वैच्छिक केंद्रों के माध्यम से अपने नेटवर्क अनुसंधान कार्यक्रम का समन्वय करता है। वर्ष 2022 के दौरान मुख्य उपलब्धियां नीचे दी गई हैं :

डब्ल्यूपी 1. खरपतवार प्रबंधन की स्थान-विशिष्ट पद्धतियों का विकास

- त्रिशूर में धान में *वालिसनेरिया* को 2, 4-डी 1 कि.ग्रा./हे., फ्लोरपाइरोक्सिफेन-बेंजाइल + साइहलोफोप ब्यूटाइल 0.15 किग्रा/हे. और फ्लोरपाइरोक्सिफेन-बेंजाइल 31.5 ग्रा./हे. छिड़क कर प्रभावी ढंग से प्रबंधित किया जा सकता है।
- त्रिशूर में, चावल में *लिमोनोचारिस फ्लेवा* के प्रबंधन के लिए, 2,4-डी सोडियम नमक 1 किग्रा/हे., फ्लोरपायरॉक्सिफेन बेंजाइल + साइहेलोफॉप ब्यूटाइल 150 ग्राम/हे., फ्लोरपायरॉक्सिफेन बेंजाइल 31.5 ग्राम/हे., (पेनॉक्सुलम + ब्यूटाक्लोर) 820 ग्राम/हे., (पेनोक्सुलम+पेन्डिमेथेलिन), 625 ग्राम/हे., मेट्सल्फ्यूरोन इथाइल + क्लोरीमुरोन इथाइल 0.004 किग्रा/हे., बाइस्पायरीबैक सोडियम 25 ग्राम/हे., साईहैलोफॉप ब्यूटाइल + पेनॉक्सुलम 0.15 किग्रा/एच और कारफेंट्राजोन इथाइल 0.02 किग्रा/हे. प्रभावी पाया गया।
- भुवनेश्वर में, जुताई की पारम्परिक जुताई (टीपीआर)- शून्य जुताई- शून्य जुताई प्रणाली से रबी मक्का (5.3 टन/हे.) में काफी अधिक अनाज उपज दर्ज की गई। शून्य जुताई (डीएसआर)-शून्य जुताई अवक्षेपण- शून्य जुताई प्रणाली के परिणाम स्वरूप सबसे कम मक्का अनाज की उपज हुई और रबी सीजन में पारम्परिक जुताई-पारम्परिक जुताई पद्धति की तुलना में उपज में 25% की कमी आई। खरपतवार प्रबंधन पद्धतियों में, आईडब्ल्यूएम (शाकनाशी+ मैनुअल वीडिंग) रबी मौसम में 5.82 टन/हे. की उपज के साथ एकमात्र शाकनाशी से बेहतर साबित हुआ।
- अकोला में, पूर्व उद्भव शाकनाशियों में डाइक्लोसुलम 84% डब्ल्यूडीजी 26 ग्रा/हे. या सल्फेंट्राजोन 28% क्लोमाज़ोन 30% 725 ग्रा/हे कम खरपतवार घनत्व, खरपतवार के शुष्क भार और सोयाबीन की उच्च बीज उपज के मामले में तुलनीय पाया गया।
- मूंगफली में, डाईक्लोसुलम 84% डब्ल्यूडीजी 26 ग्रा/हे. और डाईक्लोसुलम 84% डब्ल्यूडीजी 26 ग्रा/हे. अंकुरण के पूर्व के बाद प्रोपिकीजाफॉप इमेज़ेथापायर (आरएम) 125 ग्राम/हे. बुवाई

The All India Coordinated Research Project on Weed Management (AICRP-WM) coordinates its network research programme through 17 regular centres and 7 voluntary centres at SAU's under different agro-climatic zones. The salient achievements during the year 2022 are given below:

WP 1. Development of location-specific sustainable weed management practices

- *Vallisneria* in rice can be effectively managed by spraying 2, 4-D 1 kg/ha, florpyrauxifen-benzyl + cyhalofop butyl 0.15 kg/ha and florpyrauxifen-benzyl 31.5 g/ha at Thrissur.
- At Thrissur, for the management of *Limnocharis flava* in rice, post emergent application of 2, 4-D Na salt 1 kg/ha, florpyrauxifen benzyl + cyhalofop butyl 150 g/ha, florpyrauxifen benzyl 31.5 g/ha, (penoxsulam + butachlor) 820 g/ha, (penoxsulam +pendimethalin), 625 g/ha, metsulfuron ethyl + chlorimuron ethyl 0.004 kg/ha, bispyribac sodium 25 g/ha, cyhalofop butyl + penoxsulam 0.15 kg/h and carfentrazone ethyl 0.02 kg/ha were found effective.
- At Bhubaneswar, the practice of CT (TPR)-ZT-ZT system of tillage recorded significantly higher grain yield in *Rabi* maize (5.3 t/ha). Practice of ZT (DSR)-ZT+R-ZT system resulted the lowest maize grain yield and the yield reduction was in the tune of 25 % as compared to CT-CT method in the *Rabi* season. Among the weed management practices, IWM (herbicide + manual weeding) proved better than sole herbicide with yields of 5.82 t/ ha in Rabi season.
- At Akola, pre-emergence application of diclosulam 84% WDG 26 g/ha or sulfentrazone 28%+ clomazone 30% 725 g/ha was found comparable in terms of lower weed density, dry weight of weed and higher seed yield of soybean.
- In groundnut, pre-emergence application of diclosulam 84% WDG 26 g/ha alone and diclosulam 84% WDG 26 g/ha alone as PE *fb*

के 25 दिन बाद के रूप में अकोला में खरपतवार घनत्व और खरपतवार शुष्क भार को कम करने और उच्चफली उपज के लिए उपुक्त पाए गए।

- पंतनगर में तर-वतर सीधी बुवाई के चावल के प्रयोग में, पहली सिंचाई (14 DAS) के समय सबसे कम कुल खरपतवार घनत्व और शुष्क भार दर्ज किया गया और खरपतवार प्रबंधन उपचारों के बीच पेंडीमेथेलिन 678 ग्राम/हे (38.7 सीएस) अंकुरण के पूर्व उपरांत बिस्पायरीबैक सोडियम 25 ग्राम/हे + एमएसएम + सीएमई (आरएम) 4 ग्राम/हे (टैंक-मिक्स) पीओई (25-30 दिन बुवाई के बाद) ने सबसे कम कुल खरपतवार घनत्व और शुष्क भार और उच्च खरपतवार नियंत्रण दक्षता दर्ज की, जबकि अनाज और पुआल की उपज के मामले में पहली सिंचाई का समय गैर महत्वपूर्ण पाया गया। जबकि खरपतवार प्रबंधन उपचारों में पेंडीमिथालिन + पायराज़ोसल्फ्यूरोन इथाइल (आरएम) 785 ग्रा/हे अंकुरण के पूर्व एवं एक हाथ से निदाई के पश्चात् पर और खरपतवार प्रबंधन 6-2 एच डब्ल्यू 30 और 60 दिन बुवाई के बाद पर क्रमशः उच्चतम समान अनाज उपज (4.1 टन/हेक्टेयर) और लाभ लागत अनुपात प्राप्त किया।

- कोयम्बटूर में धान - धान फसल प्रणाली पर दीर्घकालिक शाकनाशी परीक्षण में, रबी 2021-22 मौसम के दौरान चावल में अंकुरण के पूर्व बेन्सल्फ़्यूरॉन-मिथाइल + प्रीटिलाक्लोर के पश्चात् अंकुरण के पश्चात् बाइस्पायरीबैक सोडियम के प्रयोग से व्यापक स्पेक्ट्रम खरपतवार नियंत्रण हुआ। जबकि, खरीफ 2022 सीजन में बेन्सल्फ्यूरोन-मिथाइल + प्रीटिलाक्लोर 660 ग्राम/हे. अंकुरण के पूर्व उपरांत बाइस्पायरीबैक-सोडियम 25 ग्राम/हे. देने से चावल में व्यापक स्पेक्ट्रम खरपतवार नियंत्रण होता है।

- कोयम्बटूर में संरक्षण कृषि की कपास-बेबीकॉर्न फसल प्रणाली में, पारम्परिक जुताई-शून्य जुताई-शून्य जुताई प्रणाली में 80.5% की उच्च खरपतवार नियंत्रण दक्षता दर्ज की गई। खरपतवार प्रबंधन प्रथाओं में उद्भव के बाद टोप्रामेज़ोन 12.5 ग्राम/हे. + ब्रशकटर 20-35 डीएएस (W2) से बेबीकॉर्न में उच्च खरपतवार नियंत्रण दक्षता (82.3%) दर्ज की गई। गौरतलब है कि पारंपरिक जुताई - पारंपरिक जुताई - शून्य जुताई के साथ 5049 कि./हे. की उच्च अनाज उपज दर्ज की गई थी। टोप्रामेज़ोन 12.5 ग्राम/हे. + ब्रशकटर ने 20-35 दिन बुवाई के बाद पर उल्लेखनीय रूप से उच्च उपज 7440 कि/हे दर्ज की।

- एट्राज़ीन 1.0 किग्रा/हेक्टेयर पैराक्वाट 600 ग्रा/हे. अंकुरण के पूर्व के बाद टेम्बोट्रियोन 120 ग्रा/हे. 20-25 बुवाई के पश्चात् शून्य जुताई, शून्य जुताई अवक्षेपण में अंकुरण के पश्चात् के रूप में और एट्राज़ीन 1.0 किग्रा/हे. पीई उपरांत टेम्बोट्रियोन 120 ग्रा/हे. 20-25 दिन बुवाई के पश्चात् अंकुरण के पश्चात्

propaquizafop + imazethapyr (RM) 125 g/ha as PoE (25 DAS) were found equivalent in reducing weed density, weed dry matter and higher pod yield at Akola.

- In *tar-vattar* DSR-experiment at Pantnagar, time of first irrigation IR1 (14 DAS) recorded lowest total weed density and dry weight and among weed management treatments pendimethalin 678 g/ha (38.7 CS) PE *fb* bispyribac sodium 25 g/ha + MSM +CME (RM) 4 g/ha (Tank-mix) PoE (25-30 DAS) recorded lowest total weed density and dry weight and higher weed control efficiency whereas in case of grain and straw yield time of first irrigation was found non-significant. While among weed management treatments pendimethalin + pyrazosulfuron ethyl (RM) 785 g/ha PE *fb* 1 HW at 30 DAS & WM6- 2 HW at 30 & 60 DAS achieved highest similar grain yield (4.1 t/ha) & benefit cost ratio, respectively.

- In long-term herbicide trial on rice-rice cropping system at Coimbatore, the application of PE bensulfuron-methyl + pretilachlor *fb* POE bispyribac sodium had broad spectrum weed control in rice during *Rabi* 2021-22 season. Whereas, in *Kharif* 2022 season application of bensulfuron-methyl + pretilachlor 660 g/ha as PE *fb* bispyribac - sodium 25g/ha as PoE had broad spectrum weed control in rice.

- In Cotton —baby corn cropping system of conservation agriculture at Coimbatore, higher weed control efficiency of 80.5% was recorded in CT- ZT- ZT system. Among weed management practices EPOE Topramezone 12.5 g/ha + brush cutter at 20-35 DAS (W2) recorded higher weed control efficiency (82.3%) in baby corn. Significantly, higher grain yield of 5049 kg/ha was recorded with conventional tillage —conventional tillage —zero tillage. EPOE topramezone 12.5 g/ha + brush cutter at 20-35 DAS significantly recorded higher yield 7440 kg/ha.

- Atrazine 1.0 kg/ha + paraquat 600 g/ha PE *fb* tembotrione 120 g/ha at 20-25 DAS as PoE in ZT, ZT+R and atrazine 1.0 kg/ha PE *fb* tembotrione 120 g/ha at 20-25 DAS as PoE in CT was found to reduce the weed growth and enhanced the maize yield at Hyderabad.

के रूप में सीटी में खरपतवार की वृद्धि को कम करने और हैदराबाद में मक्का की उपज में वृद्धि करने के लिए पाया गया।

- हैदराबाद में, नीम की खली 200 किग्रा/हे. तदोपरांत हैलोसल्फ्यूरॉन मिथाइल 67.5 ग्रा/हे. 30 डीएपी पर और नीम केक 200 किग्रा/हे. उपरांत ग्लाइफोसेट 10 और 10 ग्रा/हे. 30 डीएपी पर रोपाई करते हैं और 55 डीएपी ने नियंत्रण की तुलना में कम ओरोबेंकी संक्रमण दर्ज किया।
- बेंगलुरू में फिंगर मिलेट में पूरी फसल वृद्धि अवधि के दौरान पायराजोसल्फ्यूरान 15 ग्राम/हे. उपरांत 2, 4-डी सोडियम साल्ट 800 ग्रा/हे. के रूप में छिड़काव वाले भूखंडों में प्रभावी खरपतवार नियंत्रण पाया गया।
- जम्मू में फसल स्थापना के बीच, शून्य-जुताई वाला गेहूं पारंपरिक जुताई और एफआईआरबी की तुलना में उच्च शुद्ध रिटर्न औरबीसी अनुपात के साथ आर्थिक रूपसे उपयुक्त पाया गया। उगने से पहले के शाकनाशियों में पेंडीमिथालिन 1 किग्रा/हेक्टेयर और उसके बाद 125 ग्रा/हे फ्लूमियोक्सेजिन में सर्वाधिक शुद्ध प्रतिफल और लाभ लागत अनुपात देखा गया।
- जम्मू में, गेंदे में, एकीखरपतवार प्रबंधन पेंडिमेथालिन 1.5 किलोग्राम प्रति हेक्टेयर अंकुरण के पूर्व तदोपरांत उपरांत 1 हाथ से निंदाई के रूप में, ऑक्सीफ्लोरफेन 200 ग्राम/हेक्टेयर अंकुरण के पूर्व तदोपरांत 1 हाथ से निंदाई के रूप में और क्विजालोफोप 50 ग्राम/हेक्टेयर उपरांत 1 एचडब्ल्यू के रूप में खरपतवार प्रबंधन के लिए उपयुक्त पाया गया।
- जम्मू में, बायोएसे अध्ययन में, पिनोक्साडेन, मेसोसल्फ्यूरॉन + आयोडोसल्फ्यूरॉन और फेनोक्साप्रोप के परिणामस्वरूप अनुशंसित मात्रा पर सभी *पी. मॉइनेर* आबादी का संतोषजनक नियंत्रण हुआ। क्लोडिनाफॉप और सल्फोसल्फ्यूरॉन एक बायोटाइप में प्रतिरोध प्रदर्शित करते पाए गए।
- आनंद में, एट्राज़ीन 50% WP 1000 ग्राम / हेक्टेयर अंकुरण के पूर्व, पाइरोक्सासल्फ़ोन 85% w/w WG 127.5 ग्राम/हे. अंकुरण के पूर्व, टोप्रामेज़ोन 336 ग्राम/हे. + एट्राज़ीन 50% WP (25.2 + 500 ग्राम/हे. टैंकमिक्स) अंकुरण के पश्चात्, टेम्बोट्रियोन 34.4% एससी + एट्राज़ीन 50% डब्ल्यूपी (120+500 ग्रा/हे. टैंकमिक्स) पीओई और यांत्रिक निराई 20 और 40 दिन बुवाई के बाद में उच्च शुद्ध रिटर्न के साथ रबी मक्का की काफी अधिक अनाज और स्टोवर उपज दर्ज की गई।
- ग्वालियर में, सरसों में, एकीखरपतवार प्रबंधन के साथ, जहां ऑक्सीफ्लोरफेन 0.23 किलोग्राम/हे. को 35-40 डीएएस पर एक हाथ से निंदाई के साथ अंकुरण के पूर्व ने 45% बीज उपज में वृद्धि की और साथ ही खरपतवार के घनत्व और शुष्कभार को कम कर दिया। जुताई प्रथाओं के मामले में, फसल अवशेष प्रबंधन के साथ शून्य जुताई ने अन्य जुताई प्रथाओं

- In Hyderabad, neem cake 200 kg/ha at transplanting *fb* halosulfuron methyl 67.5 g/ ha at 30 DAP and neem cake 200 kg/ha at transplanting *fb* glyphosate at 10 and 10 g/ha at 30 DAP & 55 DAP recorded lower *Orobanche* infestation compared to control.
- In finger millet effective control of weeds was noted in the plots sprayed with pyrazosulfuron-ethyl 15 g/ha as PE *fb* 2,4-D sodium salt 800 g/ha PoE during the entire crop growth period in Bengaluru.
- Among crop establishment, zero-tillage wheat was found economically suitable with higher net returns and BC ratio than conventional tillage and FIRB. Among the pre-emergence herbicides, highest net returns and BC ratio were observed in pendimethalin 1 kg/ha followed by flumioxazin 125 g/ha in Jammu.
- At Jammu, in marigold, integrated weed management pendimethalin 1.5 kg/ha as PE *fb* 1 HW, oxyfluorfen 200 g/ha as PE *fb* 1 HW and quizalofop ethyl 50 g/ ha as POE *fb* 1 HW were found suitable for weed management.
- At Jammu, under bioassay study, pinoxaden, mesosulfuron+ iodosulfuron and fenoxaprop resulted in satisfactory control of all *P. minor* populations at recommended dose. The clodinafop and sulfosulfuron exhibit resistance in one biotype.
- At Anand, atrazine 50% WP 1000 g/ha PE, pyroxasulfone 85% w/w WG 127.5 g/ha PE, topramezone 336 g/ha + atrazine 50% WP (25.2+500 g/ha tank mix) PoE, tembotrione 34.4% SC + atrazine 50% WP (120+500 g/ha tank mix) PoE and mechanical weeding at 20 and 40 DAS recorded significantly higher grain and stover yield of *Rabi* maize with higher net returns.
- At Gwalior, in mustard, with integrated weed management where oxyfluorfen 0.23 kg/ha was applied as PE with one HW at 35-40 DAS, increased 45% seed yield as well as reduced the weed density and dry weight of weeds *fb* oxyfluorfen 0.23 kg/ha as PE. In case of tillage practices, the zero tillage with crop residue

की तुलना में 40% बीज उपज में वृद्धि की।

- ग्वालियर में, लोबिया में पेंडीमिथालिन + इमैजेथापायर 900 ग्रा/हे. के प्रयोग से उल्लेखनीय रूप से उच्चतम शुद्ध लाभ (47124/हेक्टेयर) और बीसी अनुपात (3.50) प्राप्त हुआ।

- हिसार में, खरीफ मूंग में पेंडीमेथेलिन + इमाज़ेथापियर 1000 ग्रा/हे (पूर्वमिश्रित) (प्री) उपरांत फ्लूज़िफोप-पी-ब्यूटाइल + फोमेसेफन (पूर्व मिश्रित) 250 ग्रा/हे (अंकुरण के पश्चात), पेंडीमेथालिन 1000 ग्रा/हे (प्री) उपरांत, प्रोपाक्विज़ाफॉप + इमाज़ेथापिर (पूर्व मिश्रित) 50 + 75 (अंकुरण के पश्चात) 90% से अधिक नियंत्रण दक्षता में परिणाम हुआ।

- रायपुर में, चना में उच्च बीज उपज (1.49 और 1.53 टन/हेक्टेयर) टोप्रामेज़ोन 25.28 ग्रा/हे पोस्ट (18-20 दिन बुवाई के बाद) के प्रयोग से दर्ज की गई।

- रायपुर में, गेहूं में शून्य जुताई सीधी बुवाई की धान + आर-जीरो टिलेज के तहत बिना अवशेष जुताई के जीरो टिलेज (डीएसआर)-जीरो टिलेज की तुलना में अधिक अनाज उपज (2.85 टन/हे.) प्राप्त की गई थी। एकीखरपतवार प्रबंधन ने अनुशंसित शाकनाशी के अनुप्रोग की तुलना में शुद्ध लाभ (48665 रुपये प्रति हेक्टेयर) के साथ-साथ लाभ लागत अनुपात (3.43) के मामले में अधिक लाभदायक पाया।

- रायपुर में ऑक्सीफ्लोरफेन 0.25 किलो ग्रा/हे. अंकुरण के पूर्व प्रयोग से बरसीम (*ट्राइफोलियम एलेक्साड्राइनम* एल.) चारा फसल में कसकुटा को नियंत्रित करने के लिए, उच्चतम कुल हरे चारे की उपज (54.09 टन/हे.) और बीज उपज (0.23 टन/हे.) पंजीकी गई थी।

- रायपुर में, उच्चतम शुद्धलाभ (41241 रुपये/हेक्टेयर) और बीसी अनुपात (2.43) के साथ रागी की उच्चतम अनाज उपज एट्राजीन 50% डब्ल्यूपी तदोपरांत 2,4-डी सोडियम नमक 95% के प्रयोग के तहत दर्ज की गई।

- लुधियाना में, संरक्षण खेती के तहत चावल-गेहूं प्रणाली में, निरंतर सीटी सीधी बुवाई की धान-शून्य जुताई (हैप्पीसीडर) प्रणाली के तहत गेहूं की फसल में फैलरिसमाइनर का घनत्व और बायोमास सबसे कम था। खरपतवार प्रबंधन के तहत, एकीखरपतवार प्रबंधन में संस्तुत शाकनाशी की तुलना में सभी खरपतवारों का घनत्व और बायोमास काफी कम था। पीटीआर-सीटी (रोटावेटर), सीटी (डीएसआर)-जेडटी (एचएस) और पीटीआर-एचएस ने समान गेहूं अनाज उपज प्रदान की। एकीखरपतवार प्रबंधन और संस्तुत शाकनाशी में समान गेहूं अनाज की उपज खरपतवार जांच की तुलना में काफी अधिक थी।

management increased 40% seed yield as compared to other tillage practices.

- In cowpea, the application of pendimethalin + imazethapyr 900 g/ha gave significantly highest net returns (Rs.47124/ha) and BC ratio (3.50) at Gwalior.

- At Hisar, in *Kharif* greengram, sequential application of pendimethalin + imazethapyr 1000 g/ha (RM) (PRE) *fb* fluazifop-p-butyl + fomesafen (RM) 250 g/ha (PoE), pendimethalin 1000 g/ha (PRE) *fb* propaquizafop + imazethapyr (RM) 50 + 75 (PoE), pendimethalin + imazethapyr 1000 g/ha (PRE) *fb* propaquizafop + imazethapyr (RM) 50 + 75 resulted in more than 90% weed control efficiency.

- Higher seed yield (1.49 and 1.53 t/ha) of chickpea was recorded in the topramezone 25.28 g/ha as POST (18-20 DAS) at Raipur.

- At Raipur, higher grain yield (2.85 t/ha) of wheat was obtained under ZT (DSR)+R-ZT with residue compared to ZT(DSR)-ZT without residue tillage. Integrated weed management was found more profitable in terms of net profit (Rs 48665/ha) as well as BC ratio (3.43) over recommended herbicide practice.

- To control *Cuscuta* in berseem (*Trifolium alexadrinum L.*) fodder crop, highest total green fodder yield (54.09 t/ha) and seed yield (0.23 t/ha) was registered with the application of oxyfluorfen 0.25kg/ha (PE) at Raipur.

- At Raipur, the highest grain yield of finger millet with highest net return (Rs 41241/ha) and BC ratio (2.43) was recorded under the application of atrazine 50% WP *fb* 2,4-D Sodium salt 95% post emergence.

- In Ludhiana, under rice-wheat system in CA, wheat crop under continuous CT(DSR)-ZT (happy seeder) system had the lowest density and biomass of *Phalaris minor*. Under weed management, IWM had significantly low density and biomass of all weeds than RH. PTR-CT (rotavator), CT(DSR)-ZT(HS) and PTR-HS provided similar wheat grain yield. IWM and RH had similar wheat grain yield significantly higher than weedy check.

- पाइरोक्सासल्फोन के 127.5 ग्रा/हे पर उद्भव-पूर्व प्रयोग से लुधियाना में *फैलरिस माइनर* का प्रभावी नियंत्रण प्राप्त हुआ। पाइरोक्सासल्फोन 127.5 ग्राम पेंडीमिथालिन 1000 ग्रा/हे के टैंक-मिश्रण से चौड़ी पत्ती वाले खरपतवारों के नियंत्रण में सुधार हुआ और पाइरोक्सासल्फोन की तुलना में चौड़ी पत्ती वाले खरपतवारों के घनत्व और बायोमास में काफी कमी आई।
- पालमपुर में सीधी बुआई वाले चावल में, पेनोक्सुलम + पेंडीमेथालिन 625 ग्राम /हेक्टेयर अंकुरण के बाद बिस्पायरिबेक सोडियम 25 ग्राम / हेक्टेयर 25-30 बुबाई के बाद रू. 44587/हेक्टेयर) और सीमांत लाभ लागत अनुपात 10.66 का उच्चतम शुद्ध लाभ दिया।
- ऑक्सीफ्लोरफेन 120 ग्रा/हे. (अंकुरण से पहले) तदोपरांत क्विजलोफॉप 50 ग्रा/हे. (अंकुरण के बाद) + 1 हाथ से निराई ने पालमपुर में मिश्रित खरपतवार वनस्पतियों का प्रभावी नियंत्रण प्रदान किया, जिसके परिणाम स्वरूप खरपतवार मुक्त (4 हाथ से निराई) के रूप में लहसुन की पैदावार काफी अधिक हुई और खरपतवार नियंत्रण के कारण प्रति हेक्टेयर उच्चतम सकल (रू. 3,84,433) और शुद्ध (रू. 3,71,137) लाभ अर्जित हुआ।
- जोरहाट में, 100% रासायनिक उर्वरक के साथ प्रेटीलाक्लोर 0.75 किलोग्राम/ हेक्टेयर+बिस्पायरिबेक सोडियम 25 ग्राम/ हेक्टेयर और कार्बनिक स्रोतों द्वारा प्रतिस्थापित 25% उर्वरक ने खरपतवारों को सफलतापूर्वक नियंत्रित किया है और शरद ऋतु और खरीफ चावल दोनों की अनाज उपज में व द्धि की।
- उदयपुर में डिल फसल में ऑक्साडियार्जिल 100 ग्रा/हे अंकुरण के पूर्व के उपयोग के साथ उच्चतम शुद्धलाभ (? 60256/हेक्टेयर) और लाभ लागत अनुपात (2.07) प्राप्त किया गया।
- उदयपुर में पाइरोक्सासल्फोन क्लस्टर बीन में 85% डब्ल्यूजी (अंकुरण के पूर्व) 127 ग्रा/हे के माध्यम से खरपतवारों को नियंत्रित करके उच्चतम बीज (2083 किग्रा/हेक्टेयर और स्टोवर उपज(1874 किग्रा/हेक्टेयर) प्राप्त की गई।
- उदयपुर में, ज्वार की अधिकतम अनाज उपज (2.88 टन /हेक्टेयर) 15-20 बुवाई के पश्चात् पर एट्राजीन 500+टोप्रामेज़ोन 25.2 ग्राम/हेक्टेयर (टैंक मिश्रण) के साथ दर्ज की गई, जो खरपतवार मुक्त (बुबाई के 20 और 40 दिनों पर हाथ से निदाई) के समान रही।
- कल्याणी में, बुबाई के 20 और 40 दिनों के बाद दो बार यांत्रिक निराई मसूर के खेत में चौड़ी पत्ती के खरपतवार नियंत्रण विधि के लिए सबसे प्रभावी है, इसके बाद बुबाई के 3 दिनों बाद तदोपरांत क्विजलोफोप-इथाइल 5 ईसी 50 ग्राम/ हेक्टेयर अंकुरण के बाद बुबाई के 25 दिनों बाद पर पेंडीमेथेलिन 30 ईसी 1.0 किलोग्राम/ हेक्टेयर अंकुरण के पूर्व रही।
- त्रिशूर में अदरक में प्रभावी खरपतवार नियंत्रण के लिए जल जलकुंभी, घास की कतरन, कटहल और नारियल के पत्ते जैसे

- Pre-emergence application of pyroxasulfone at 127.5 g/ha provided effective control of *Phalaris minor* at Ludhiana. Tank-mixture of pyroxasulfone 127.5 g with pendimethalin 1000 g/ha improved control of broadleaf weeds and significantly reduced broadleaf weed density and biomass than pyroxasulfone sole.
- In direct-seeded rice at Palampur, penoxulam + pendimethalin 625 g/ha fb bispyribac sodium 25 g/ha 25-30 DAS gave highest net returns over weedy check (INR 44587/ha) and marginal benefit cost ratio (MBCR) of 10.66.
- Oxyfluorfen 120 g/ha (pre-emergence) *fb* quizalofop ethyl 50 g/ha (post-emergence) + 1 HW provided effective control of mixed weed flora at Palampur, resulted in significantly higher garlic bulb yield as weed free (4 HW) and accrued highest gross (INR3,84,433) and net (INR 3,71,137) returns per hectare due to weed control.
- At Jorhat, pyrazosulfuron 25 g/ha rotated with pretilachlor 0.75 kg/ha + bispyribac sodium 25g/ha with 100% chemical fertilizer and 25% fertilizer substituted by organic sources have successfully controlled weeds and increased the grain yield of both autumn and *Kharif* rice.
- In dill crop at Udaipur, the highest net return (? 60256/ha) and BC ratio (2.07) were realized with application of oxadiargyl 100 g/ ha PE.
- In cluster bean highest seed and haulm yield (2083kg/ha and 1874 kg/ha) were obtained by controlling weeds through pyroxaslfone 85% WG (PE) 127 g/ha at Udaipur.
- In Udaipur, maximum grain yield (2.88 t/ha) of sorghum was recorded with atrazine 500+ topramezone 25.2 g/ha (Tank mix) at 15- 20 DAS which was found at par weed free (HW at 20 & 40 DAS).
- At Kalyani, twice mechanical weeding at 20 and 40 DAS was most effective for broadleaf weed control in lentil followed by pendimethalin 30 EC 1.0 kg/ha PE at 3 DAS *fb* quizalofop-ethyl 5 EC 50 g/ha PoE at 25 DAS.
- Organic mulches like water hyacinth, grass clippings, jack leaves and coconut fronds can

जैविक मल्च का उपयोग किया जा सकता है।

- भुवनेश्वर में, एफवाईएम, वर्मीकम्पोस्ट और नीमकेक + एज़ोटोबैक्टर + पीएसबी टमाटर और चावल-टमाटर-भिंडी प्रणाली में प्रत्येक के माध्यम से एन की 1/3 अनुशंसित खुराक के उपयोग से टमाटर (16 टन/ हेक्टेयर) और भिंडी (7 टन/हेक्टेयर) की अधिकतम फल उपज प्राप्त हुई।

- हैदराबाद में, टमाटर में कतारो के बीच पॉलिथीन मल्चिंग के साथ रोपाई के 30 दिन बाद पर निदाई या 5 टन/हेक्टेयर धान के पुआल मल्चिंग ने खरपतवारों को प्रभावी ढंग से दबा दिया और 40 डीएटी तक ढैंचा के साथ लाइव मल्चिंग के परिणामस्वरूप टमाटर की उच्च उपज हुई।

- पंतनगर में धान-सब्जी में खरपतवार प्रबंधन की प्रा, जैविक एवं रासायनिक खेती की तुलना के तहत मटर-स्वीटकॉर्न फसल प्रणाली में, चावल की उच्चतम अनाज उपज (3.4 टन/हेक्टेयर) रासायनिक खेती (पेनोक्सुलम + साइहेलोफॉप-ब्यूटाइल 135 ग्राम / हेक्टेयर पीओई) के बाद जैविक खेती (3.1 टन/हेक्टेयर) के बाद प्राखेती (2.6 टन/हेक्टेयर) से हासिल की गई।

- पालमपुर में, जैविक रूप से प्रबंधित मक्का-मटर फसल प्रणाली में, सघन फसल और अंतर-फसल उपचार के परिणामस्वरूप यांत्रिक जांच की तुलना में क्रमशः 70 और 40% अधिक मक्का कोब समतुल्य उपज प्राप्त हुई।

- उदयपुर में मेथी की जैविक फसल में सबसे अधिक शुद्धलाभ (91099/हेक्टेयर) प्लास्टिक मल्च के साथ स्टेलबेड तकनीक से प्राप्त किया गया जबकि अधिकतम बीसी अनुपात (2.71) इंटरकल्चर के साथ 20 बुबाई के पश्चात् उपरान्त यांत्रिक निराई 40 बुबाई के पश्चात् पर दर्ज किया गया।

- उदयपुर में बेबीकॉर्न में, उच्चतम शुद्धलाभ (71760/ हेक्टेयर) और बीसी अनुपात (3.30) मिट्टी के सौरकरण उपरांत सेसबानिया 30 दिनों के बाद मल्च के रूप उपरांत 1 निदाई 40 बुबाई के पश्चात् पर के साथ प्राप्त किया गया।

डब्ल्यूपी 2. गैर-फसली और जलीय क्षेत्रों में खरपतवारों का प्रबंधन

- बेंगलुरु में, *ए. फिलोक्सरोइड्स* पौधों में एलेलोकेमिकल्स विभिन्न हिस्सों जैसे, जड़, तने से और पूरे पौधे के जलीय अर्क 5, 10, 20 और 40 ग्राम/एल 1 सांद्रता पर *आइकोर्निया क्रैसिप्स* पर विकास प्रमोटर के रूप में काम किया, जहां नियंत्रण (अनुपचारित) की तुलना में वृद्धि देखी गई। हालांकि, 80 ग्राम/एल सांद्रता पर जड़, तने और पूरे पौधे का जलीय अर्क एक विकास अवरोधक के रूप में कार्य करता है।

be used for effective weed control in ginger at Thrissur.

- At Bhubaneswar, application of 1/3 recommended dose of N each through FYM, vermicompost and neem cake + *Azotobacter* + PSB to tomato and lady's finger in rice-tomato-lady's finger system resulted in the maximum fruit yield of tomato (16 t/ha) and lady's finger (7 t/ha).

- At Hyderabad, inter row polythene mulching with HW at 30 DAT or paddy straw mulching 5 t/ha suppressed the weeds effectively and resulted in higher tomato fruit yield followed by live mulching with *dhaincha* up to 40 DAT.

- Under comparison of natural, organic and chemical farming of weed management in rice-veg. pea- sweet corn cropping system, the highest grain yield of rice (3.4 t/ha) was achieved with chemical farming (Penoxsulam + cyhalofop- butyl 135 g/ha PoE) followed by organic farming (3.1 t/ha) followed by natural farming (2.6 t/ha) at Pantnagar.

- At Palampur, in the organically managed maize —peas cropping system, intensive cropping and intercropping treatments resulted in 70 and 40% higher maize cob equivalent yield over the mechanical check, respectively.

- At Udaipur, in organic fenugreek crop, the highest net return (Rs 91099 /ha) was obtained with stale seed bed technique with plastic mulch whereas maximum BC ratio (2.71) was recorded with Inter culture at 20 DAS *fb* mechanical weeding at 40 DAS.

- In baby corn, the highest net return (Rs 71760 /ha) and BC ratio (3.30) was obtained with soil solarization *fbSesbania* as smothering crop in between rows and used same as mulch after 30 days fb 1 HW at 40 DAS at Udaipur.

WP 2. Management of weeds in non-cropped and aquatic areas

- At Bengaluru, allelo-chemicals in different plant parts viz., root, stem and whole plant aqueous extracts of *A. philoxeroides* at 5, 10, 20 and 40 gm L^{-1} concentrations on *Eichhornia crassipes* acted as a growth promoter, where an increase in growth was observed compared to control (untreated). However, at 80 gm L^{-1} concentrations the aqueous extract of root, stem and whole plant act as a growth inhibitor.

- त्रिशूर में, (मेटसल्फ्यूरॉन-मिथाइल + क्लोरिमुरोन-इथाइल), 10.0 या 12.5 ग्राम /हेक्टेयर, और मेटसल्फ्यूरॉन-मिथाइल, 10 ग्राम/ हेक्टेयर के तैयार मिश्रण संयोजन उत्पाद का छिड़काव करने से खरपतवार सिंगापुर डेज़ी (स्फाग्नेटिकोला/वेडेलिया) का कुशल नियंत्रण मिल सकता है। यह गैर-फसल वाले क्षेत्रों और व क्षारोपण में भी अनुशंसित किया जा सकता है जहां इसने एक समस्या परक खरपतवार की स्थिति प्राप्त कर ली है।
- तमिलनाडु कृषि विश्वविद्यालय वेटलैंड फार्म के पास कृष्णमपथी झील में नए उभरे जलकुंभी के पैच में नियोकेटिना घुन को एकत्र किया गया और छोड़ा गया और अन्य झीलों जैसे सेल्वमपथी और कुमारसामी झीलों में जल जलकुंभी का कोई संक्रमण नहीं है।
- त्रिशूर में, जलमग्न जलीय खरपतवार भारतीय स्टारपौधा (*हाइड्रिला वेर्टसिलाटा*) के प्रबंधन के लिए, पानी के पीएच को तटस्थता तक बढ़ाने के लिए त्वरित चूने या हाइड्रेटेड चूने के रूप में उपयोग बहुत प्रभावी है।
- लुधियाना केंद्र ने पंजाब रिमोट सेंसिंग सेंटर के सहयोग से जलकुंभी की स्थानिक अस्थायी गतिशीलता का नक्शा तैयार करना शुरू किया है। जलकुंभी का वर्णक्रमीय प्रोफाइल मल्टीस्पेक्ट्रल इमेजरी का उपयोग करके प्राप्त किया गया था। भू-टैग किए गए जमीनी सत्य डेटा के साथ वर्गीपिक्सेल की तुलना करके किए गए विकसित वर्णक्रमीय प्रोफ़ाइल की सटीकता बहुत कम थी और इसमें और सुधार की आवश्यकता है।
- जलकुंभी के खतरे को कम करने के लिए, पंजाब कृषि विश्वविद्यालय ने एक नया 'भाई बाबूसिंह बरार सर्वोदय छापर पुरस्कार' शुरू किया है और इसे गांव रानी सिंह कलां (मोगा) को प्रदान किया गया।
- लुधियाना जिले के मंसूरन गांव को 2016 से ग्रामीणों और अखिल भारतीय समन्वयक अनुसन्धान खरपतवार प्रबंधन परियोजना के लुधियाना केंद्र के समर्थन से *पार्थेनियम* मुक्त गांव के रूप में बनाए रखा गया है।

डब्ल्यूपी 3. विभिन्न कृषि पारिस्थितिक तंत्रों में शाकनाशी अवशेष की स्थिति

- हैदराबाद में, शाकनाशी प्रयोग के 4 घंटे के बाद, मिट्टी के नमूनों में एट्राजीन के प्रारंभिक अवशेष 0.403 से 0.412 µg/ग्राम तक पाए गए। एट्राजीन अवशेष सभी मिट्टी के नमूनों में 0.05 µg/ग्राम की पहचान सीमा से नीचे थे।
- हैदराबाद में, फसल के समय मिट्टी और गोभी के नमूनों और मिट्टी में ऑक्सीफ्लोरफेन के अवशेष 0.05 मिलीग्राम/ किलोग्राम की पहचान सीमा से नीचे थे।

- In Thrissur, spraying ready mix combination product of (metsulfuron-methyl + chlorimuron-ethyl), 10.0 or 12.5 g/ha or metsulfuron-methyl 10 g/ha can give efficient control of the weed Singapore daisy (*Sphagnetticola/ Wedelia*). This can be recommended in non-cropped areas and in plantations also where it has attained the status of a problem weed.
- *Neochetina* weevils were collected and released in the newly emerged water hyacinth patches at Krishnampathy lake near Wetland farm of TNAU. And there is no infestation of water hyacinth in other lakes viz., Selvampathy and Kumarasamy lakes.
- For management of submerged aquatic weed Indian star wort *(Hydrilla vertcillata),* lime application either as quick lime or hydrated lime to increase the pH of water to neutrality is very effective at Thrissur.
- Ludhiana centre has initiated to map spatial temporal dynamics of water hyacinth in collaboration with Punjab remote sensing centre. Spectral profile of water hyacinth was derived using multispectral imageries.
- In a drive to reduce the menace of water hyacinth, PAU has initiated a new 'Bhai Babu Singh Brar Sarvotam Chappar award" and it was awarded to village Ranisinh Kalan (Moga).
- The village Mansuran in district Ludhiana continued to be maintained as *Parthenium*-free village with support of villagers and AICRP-WM, PAU centre, since 2016.

WP 3. Fate of herbicide residues in different agro-ecosystems

- At Hyderabad, after 4 hours of herbicide application, initial residues of atrazine varied from 0.403 to 0.412 µg/g in the soil samples. In the final soil sample, and maize grain/ plant samples collected at the time of harvest, the atrazine residues were below the detection limit of 0.05 µg/g in all the soil samples.
- Residues of oxyfluorfen in soil and cabbage samples and soil at the time of harvest were below the detection limit of 0.05 mg/kg at Hyderabad.

- लुधियाना में मिट्टी में मेट्रिबुज़िन के प्रारंभिक अवशेष 0.047 से 0.116 µg/ग्राम तक थे जो फसल की कटाई पर मिट्टी और गेहूं के अनाज में पता लगाने योग्य सीमा (<0.01 µg/ग्राम) से नीचे थे। संस्तुत शाकनाशी और एकीखरपतवार प्रबंधन उपचारों के तहत फसल के समय मिट्टी और गेहूं के अनाज में क्लोडिनाफॉप-प्रोपार्जिल के अवशेष पता लगाने योग्य सीमा (<05 µg/ग्राम) से नीचे थे।
- लुधियाना, मोगा, कपूरथला, फाजिल्का और संगरूर जिलों के किसानों के खेतों से फसल कटाई के समय लुधियाना में एकत्र की गई मिट्टी, पानी और फसल उत्पादन के नमूनों में सल्फो सल्फ्यूरॉन, मेटसल्फ्यूरॉन-मिथाइल, पिनोक्साडेन, पाइरोक्सासल्फोन, पेंडीमेथेलिन, मेसोसल्फ्यूरॉन मिथाइल, आयोडोसल्फ्यूरॉन मिथाइल, क्लोडिनाफॉप, मेट्रिबुज़िन, प्रिटिलाक्लोर, ब्यूटाक्लोर, अनिलोफोस, बिस्पायरिबेक सोडियम, पेनोक्सुलम, सैहलोफोप-पाईराजोसुल्फुरान के अवशेष <0.01-0.05 µg/ग्राम) पाए गए। फसल कटाई के समय प्रछेत अनुसन्धान कार्यक्रम और अग्रिम पंक्ति के प्रदर्शन परीक्षणों से एकत्र किए गए मिट्टी, पानी और फसल उपज के नमूनों में पाइरोक्स सल्फोन, पेंडीमेथेलिन, क्लोडिनाफॉप + मेट्रिबुज़िन और पेनोक्ससुलम के अवशेष पता लगाने योग्य सीमा (<0.01 µg/ग्राम) से नीचे थे।
- कोयम्बटूर में, 2, 4-डी, टेम्बोट्रियोन और टोप्रामेज़ोन के प्रयोग से खरपतवार नियंत्रण के लिए अपनाई जाने वाली जुताई प्रबंधन पद्धतियों के बावजूद मिट्टी, बेबीकॉर्नकॉब और पुआल में कोई अवशेष नहीं छोड़े गए। एट्राज़ीन का प्रयोग 0.5 किग्रा/हेक्टेयर पर 0.011 से 0.018 मिलीग्राम/किग्रा दर्ज किया गया और 1.0 किग्रा/हेक्टेयर पर 0.030 से 0.041 मिलीग्राम/किग्रा के अवशेषों के साथ मिट्टी में, कटाई के समय दर्ज किया गया।

डब्ल्यूपी 4. खरपतवार प्रबंधन प्रौद्योगिकियों और एससीएसपी का प्रदर्शन और प्रभाव मूल्यांकन

- भुवनेश्वर केंद्र द्वारा पुरी जिले के देलंगा के सिंहबेरहामपुर में रबी 2021-22 के दौरान मूंग और मूंगफली पर किए गए प्रक्षेत अनुसन्धान कार्यक्रम परीक्षणों से पता चला कि पेंडीमेथालिन 750 ग्रा/हे के उपयोग से मूंग में 1.0 टन/हेक्टेयर और मूँगफली में 1.6 टन/हेक्टेयर की अधिकतम उपज हुई है। उपचारित भूखंडों में मूंग में 6500 रुपये प्रति हेक्टेयर और मूंगफली में 10,000 रुपये प्रति हेक्टेयर की शुद्ध बचत प्राप्त की गई।
- बेंगलुरु में, चामराजनगर जिले में अनुसूचित जाति उपयोजना कार्यक्रम के अंतर्गत पांच गांवों अर्थात् अर्धनारीपुरा, हुन्सेपाल्या, बायनुरू, अरयापाल्या और लोकेनाहल्ली के 79 किसानो को तथा कोलार जिले के वेमागल तालुक के चोक्कापुरा गांव में 40 किसान लाभान्वित हुए उन्हें साइकिल वीडर, स्प्रेयर, स्पेड,

- The initial residues of metribuzin in soil ranged from 0.047 to 0.116 µg/g which were below the detectable limit (<0.01 µg/g) in soil and wheat grain at crop harvest. The residues of clodinafop-propargyl in soil and wheat grain at harvest under RH and IWM treatments were below detectable limit (<0.05 µg/g) at Ludhiana.
- In soil, water and crop produce samples, collected in Ludhiana at harvest from farmers' fields from districts Ludhiana, Moga, Kapurthala, Fazilka and Sangrur, the residues of sulfosulfuron, metsulfuron-methyl, pinoxaden, metribuzin, pyroxasulfone, pendimethalin, mesosulfuron methyl, iodosulfuron methyl sodium, clodinafop, metribuzin, pretilachlor, butachlor, anilofos, bispyribac sodium, penoxsulam, cyhalofop butyl, pyrazosulfuron were below detectable limits (<0.01-0.05 µg/g). The residues pyroxasulfone, pendimethalin, clodinafop + metribuzin and penoxsulam in samples of soil, water and crop produce collected from OFR and FLD trials at harvest were below detectable limit (<0.01 µg/g).
- At Coimbatore, application of 2,4-D, tembotrione and topramezone did not leave any residues in soil, baby corn cob and straw irrespective of the tillage management practices followed for weed control. Application of atrazine at 0.5 kg/ha recorded residues of 0.011 to 0.018 mg/kg and at 1.0 kg/ha with residues of 0.030 to 0.041 mg/kg at harvest in soil.

WP 4. Demonstration and impact assessment of weed management technologies

- On-farm trials conducted on greengram and ground nut during *Rabi* 2021- 22 at Singh berhampore, Delanga of Puri district revealed maximum yield of 1.0 t/ha in greengram and 1.6 t/ha in ground nut in the plot applied with pendimethalin 750 g/ha. A net saving of Rs. 6500/ha in greengram and Rs. 10,000/ha in groundnut were obtained in the plots treated with herbicides.
- Under Scheduled Caste Sub Plan Programme weeding tools were distributed to 79 farmers at Chamrajnagar district covering five villages viz., Ardhanaripura, Hunsepalya, Bynuru, Arayapalya and lokenahalli, in Chokkapura

सिकल, और विभिन्न क्षमता वाले स्प्रेयर और नोजल, कुदाल, सिकल वितरित किए गए।

- जम्मू में, 8 एफएलडी में, नए शाकनाशी का क्लोडिनेफॉप - प्रोपरगेल + मेटसल्फ्यूरॉन 60 + 4 ग्राम/हेक्टेयर और 30-35 डीएएस पर सल्फो सल्फ्यूरॉन + कार्फेनट्राज़ोन 25 + 20 ग्राम/हेक्टेयर बुबाई के 30-35 दिनों पर शून्य-जुताई गेहूं में खरपतवार नियंत्रण के लिए उपयुक्त पाया गया।
- जम्मू में, मुख्य परिसर शेर-ए-कश्मीर कृषि विज्ञान एवं प्रौद्योगिकी विश्वविद्यालय, चठा में शाकनाशी के प्रयोगो की तकनीकों पर प्रशिक्षण आयोजित किया गया और गांव अपरचकरोई के 100 किसानों को नैप्सैक स्प्रेयर वितरित किया गया।
- रायपुर में 25 क्षेत्र प्रदर्शन आयोजित किए गए, सीधी बुआई वाले चावल में 20 ग्रा/हे पायराजो सल्फ्यूरॉन का 20 ग्रा/हे 20 डीएएस उपरांत बिसपैरिबैक 20 ग्रा/हे बुबाई के 20 दिनों पर, किसान की प्रथा बिस्पायरिबेक 25 ग्रा/हे से बेहतर पाया गया और 5.61 और 5.57 टन/हेक्टेयर औसत उपज प्राप्त हुई जबकि किसानों की प्रथा में 4.6 टन/हेक्टेयर पाई गई। किसानों की प्रथा पर अनुशंसित अभ्यास के तहत प्रतिशत वृद्धि क्रमशः 21.66 और 21.18% थी।
- ऑक्सीफ्लोरफेन 150 ग्राम/हेक्टेयर + हाथ से निराई सबसे प्रभावी खरपतवार प्रबंधन उपचार था, जिसने पालमपुर में दो बार हाथ से निराई करने की किसानों की प्रथा की तुलना में 25 हजार से अधिक शुद्ध लाभ दिया।
- पंतनगर में ओएफआर के तहत सोयाबीन में, सोडियम एसेफ्लोरफेन + क्लोडिनाफॉप प्रोपरगिल 165 + 80 ग्रा/हे (पीओई) केरेडी-मिक्स संयोजन से 1.7 टन/हे. की उच्चअनाज उपज दर्ज की गई, जिसके बाद फ्लुज़ीफॉप-पी-ब्यूटाइल + फोमेसेफन 250 ग्राम/हे. किसान की तकनीक पर उच्च उपज प्राप्त की गई। मक्का के मामले में, एट्राज़िन 500 ग्राम + टोप्रामेज़ोन 25.2 ग्रा/हे अंकुरण के पश्चात् के टैंक-मिक्स अनुप्रयोग से उच्च उपज दर्ज की गई, जिसके बाद एट्राज़ीन 500 ग्राम + टेम्बोट्रियोन 120 ग्राम/हे अंकुरण के पश्चात् का पालन किया गया, जिसने किसान की तकनीक से बेहतर प्रदर्शन किया।
- मूंगफली में खरपतवार प्रबंधन पर कोयंबटूर केंद्र द्वारा पांच ऑनफार्म अनुसंधान परीक्षण और प्याज में पांच प्रथम पंक्ति प्रदर्शन किए गए। सभी पांच स्थानों में इमेजेथापायर + क्विज़ालोफॉप-इथाइल (50+50 ग्राम/हेक्टेयर) उपरान्त 30-35 दिन बाद हाथ से निदाई के उपयोग से कुल खरपतवार घनत्व और खरपतवार शुष्क भार काफी कम था। इमेजैथापायर + क्विज़ालोफॉप-इथाइल (50+50 ग्राम/हेक्टेयर) उपरान्त 30-35

village of Vemagal taluk and 40 farmers in Kolar district of Karnataka.

- At Jammu, in 8 frontline demonstrations, the new herbicidal interventions i.e. clodinafop - propargyl + metsulfuron 60 +4 g/ha at 30-35 DAS and sulfosulfuron + carfentrazone 25 + 20 g/ha at 30-35 DAS were found suitable for weed control in zero-tillage wheat.
- Training on herbicide application techniques was conducted in main campus SKUAST-Jammu, Chatha and distributed knapsack sprayer to 100 farmers of village Upper Chakroi.
- At Raipur, 25 field demonstrations were conducted, in direct-seeded rice pre-emergence application of pyrazosulfuron 20 g/ha at 0-7 DAS *fb* bispyribac- Na g/ha at 20 DAS was found superior over farmer's practice of bispyribac-Na 25g/ha at 20 DAS. The yield increased to 5.61 and 5.57 t/ha over farmers' practice of 4.6 t/ha. The per cent increase under recommended practice over farmers practice was 21.66 and 21.18%.
- Oxyfluorfen 150 g/ha + hand weeding was most effective weed management treatment in rajmash, gave 25 thousand more net returns over the farmers practice of hand weeding twice in Palampur.
- In soybean under OFR, ready-mix combination of sodium acefluorfen + clodinafop propargyl 165 + 80 g/ha (PoE) recorded higher grain yield 1.7 t/ha which was closely followed by fluazifop-p-butyl + fomesafen 250 g/ha which were attained higher yield over farmer's technology. In case of Maize, tank-mix application of atrazine 500 g + topramezone 25.2 g/ha (PoE) recorded higher yield which was closely followed by atrazine 500g +tembotrione 120 g/ha (PoE) which performed better than farmer's technology at Pantnagar.
- Five On Farm Research trials conducted by Coimbatore centre on weed management in ground nut and five FLDs in onion were carried out. Total weed density and weed dry weight were considerably lower with application of EPOE imazethapyr + quizalofop-ethyl (50+50 g/ha) *fb* hand weeding 30 - 35 DAP in all five locations. Higher percentage of yield increase

दिनों के पश्चात् हाथ से निराई के तहत उपज वृद्धि का उच्च प्रतिशत भी दर्ज किया गया। शीघ्र अंकुरण पश्चात् इमेजेथापायर + क्विज़ालोफॉप-इथाइल (50+50 ग्राम/हेक्टेयर) उपरान्त हैंडवीडिंग 30-35 दिन बुवाई के बाद के उपयोग से मूंगफली में व्यापक स्पेक्ट्रम खरपतवार नियंत्रण, उच्च बीज उपज और आर्थिक लाभ दर्ज किया गया।

- खरपतवार प्रबंधन तकनीक अपनाने से प्याज में 25-30 दिन बुवाई के बाद पर अंकुरण से पूर्व ऑक्सीफ्लोरफेन 200 ग्रा/हे + हाथ से निराई करने से फसल की प्रारंभिक अवस्था के दौरान खरपतवारों को प्रभावी ढंग से नियंत्रित किया जा सकता है और बाद में हाथ से निराई के लिए कम श्रम की आवश्यकता लगी।

was also recorded under the EPOE imazethapyr + quizalofop-ethyl (50+50 g/ha) fb hand weeding 30 - 35 DAP.

- The adoption of weed management technology PE oxyfluorfen 200g/ha + hand weeding on 25-30 DAP in onion efficiently controlled the weeds during the early stage of the crop and required less labour for subsequent hand weeding.

1. ORGANIZATION AND FUNCTIONING

1.1 Introduction

The All India Coordinated Research Project on Weed Management was launched in April, 1978 by the ICAR in collaboration with the United States Department of Agriculture (USDA) at six locations, Punjab Agricultural University, Ludhiana (Punjab); University of Agricultural Sciences, Bengaluru (Karnataka); Indian Institute of Technology, Kharagpur (West Bengal); Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.); Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (U.P.); and Himachal Pradesh Krishi Vishwa Vidyalaya, Palampur (H.P.). The initial financial outlay of the project was Rs. 42.97 lakhs for five years. The tenure of the project was, however, extended for one more year till March, 1984 with the savings. Further work was continued at these centres with the AP Cess fund of ICAR till the implementation of VII Plan in April, 1986.

The activities of the project were extended covering 7 more cooperating centres, Assam Agricultural University, Jorhat (Assam); Marathwada Agricultural University, Parbhani (Maharashtra); Gujarat Agricultural University, Anand (Gujarat); Narendra Dev University of Agriculture and Technology, Faizabad (U.P.); Indian Institute of Horticultural Research, Bengaluru (Karnataka); Indian Grassland and Fodder Research Institute, Jhansi (U.P.) and Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu) through a fresh negotiation between ICAR and FERRO, USDA with a sanctioned outlay of Rs 58.10 lakhs for five years. The work at these centres was effectively implemented from 1982-83 to 1986-87.

In the third phase, 9 more centres, Birsa Agricultural University, Ranchi (Bihar); Haryana Agricultural University, Hisar (Haryana); Vishwa Bharati, Sriniketan (W.B.); Rajendra Agricultural University, Pusa (Bihar); Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.); Kerala Agricultural University, Thrissur (Kerala); Orissa University of Agriculture and Technology, Bhubaneswar (Orissa); Acharya N.G. Ranga Agricultural University, Hyderabad (Andhra Pradesh) and ICAR Research Complex, Barapani (Meghalaya) were initiated at total outlay of Rs. 63.85 lakhs for four years (1985-86 to 1989-90) with the assistance of USDA under USIF funds. In the VIII Plan, 4 new centres, Rajasthan Agricultural University, Bikaner; Indira Gandhi Krishi Vishva Vidyalaya, Raipur; Konkan Krishi Vidhya Peeth, Dapoli and University of Agricultural Sciences, Dharwad were initiated with total outlay of 16.41 lakhs. Seventy five percent of the total budget required by each centre was provided by the ICAR and the remaining 25% was met from the state department of agriculture as a state share. There was however, 100% funding by the ICAR to Visva Bharati, Sriniketan.

During IX Plan (1997-2002), X Plan (2002-2007), XI plan (2007-2012) and XII plan (2012-17) the total expenditure incurred under AICRP-WM was Rs. 823.79, 1696.57, 3548.78 lakhs and 4007.26 lakhs, respectively. During XII Plan (2012-17), four AICRP on Weed Management centres, University of Agricultural Sciences, Dharwad; Chandra Shekhar Azad University of Agriculture & Technology, Kanpur; Swami Keshwanand Rajasthan Agricultural University, Bikaner, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani and Visva-Bharati, Sriniketan were closed and new centers at Maharana Pratap University of Agriculture and Technology, Udaipur; University of Agricultural Sciences, Raichur; Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola; Bidhan

Chandra Krishi Viswavidyalaya, Kalyani; Sher-eKashmir University of Agricultural Sciences and Technology, Jammu and Central Agricultural University, Pasighat by redeployment of existing manpower were opened. As per the approval of SFC (2017-20), another six coordinating centres (NDUAT, Faizabad; CAU, Pasighat; RAU, Pusa; BAU, Ranchi; DBSKKV, Dapoli and UAS, Raichur) were closed w.e.f. 1.4.2018.

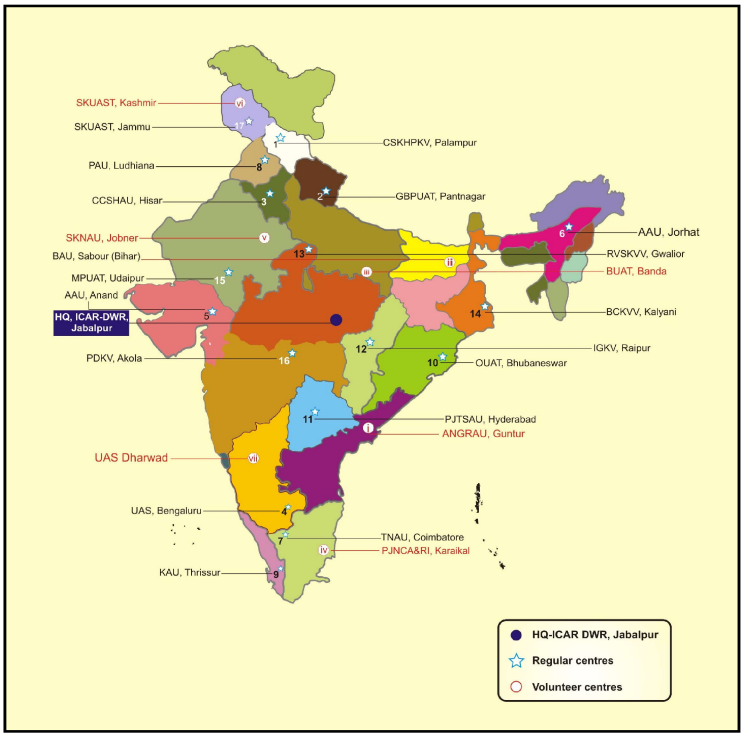
The coordinating unit of the project was located initially at Central Rice Research Institute, Cuttack, and shifted to National Research Centre for Weed Science in 1989. Later in 2009, NRC for Weed Science was upgraded to Directorate of Weed Science Research. During XII Plan (2012-17), it has been renamed as "Directorate of Weed Research" and "AICRP on Weed Control" was renamed as "AICRP on Weed Management"

1.2 Mandate

- To conduct location-specific research for developing appropriate weeds management technologies.
- To demonstrate the weed management technologies through on-farm adaptive trials.

1.3 Objectives

- To work out effective and economic weed management modules for field and horticultural crops, in non-crop and aquatic situations
- To study long-term residual and cumulative effect of herbicides, if any.
- To evaluate new herbicides and working out the residual effect on non-targeted organisms
- To study biology and control of problem weeds including aquatic and parasitic weeds
- To analyze herbicide residues in soil, water and food chain
- To test available tools/ implements for weed management under various agro-ecosystems
- To transfer weed management technologies on farmers' fields through OFT and FLDs their impact assessment and training.



	AICRP Regular Centres
01	CSKHPKV, Palampur
02	GBPUAT, Pantnagar
03	CCSHAU, Hisar
04	UAS, Bengaluru
05	AAU, Anand
06	AAU, Jorhat
07	TNAU, Coimbatore
08	PAU, Ludhiana
09	KAU, Thrissur
10	OUAT, Bhubaneswar
11	PJTSAU, Hyderabad
12	IGKV, Raipur
13	RVSKVV, Gwalior
14	BCKVV, Kalyani
15	MPUAT, Udaipur
16	PDKV, Akola
17	SKUAST, Jammu
	Volunteer Centres
I	ANGRAU, Guntur
II	BAU, Sabour
III	BUAT, Banda
IV	PJNCA&RI, Karaikal
V	SKNAU, Jobner
VI	SKUAST, Kashmir
VII	UAS, Dharwad

2. STAFF POSITION AND EXPENDITURE

AICRP on Weed Management is presently under operation in 17 State Agricultural Universities in 17 different states of the country and represent diverse agro-ecological regions. A total of 34 scientists positions under Agronomy, Residue Chemistry and Taxonomy are sanctioned. Besides 17 main centres, 7 volunteer centres are also in operation. The details of staff position and funds allocated in the financial year 2022-23 are given below:

Staff position at different coordinating centres during 2022-23

Centre	Scientific		Technical		Driver	
	Sanctioned	Filled	Sanctioned	Filled	Sanctioned	Filled
PAU, Ludhiana	2	2	1	1	-	-
UAS, Bengaluru	2	2	1	1	1	1
RVSKVV, Gwalior	2	2	1	1	-	-
GBPUAT, Pantnagar	2	2	1	1	-	-
CSKHPKV, Palampur	2	1	1	1	1	1
AAU, Jorhat	2	2	1	1	1	1
AAU, Anand	2	1	1	1	1	1
TNAU, Coimbatore	2	2	1	1	1	1
KAU, Thrissur	2	2	1	1	1	1
OUAT, Bhubaneshwar	2	2	1	1	1	1
PJTSAU, Hyderabad	2	2	1	-	1	-
CCSHAU, Hisar	2	2	1	-	-	-
IGKVV, Raipur	2	2	1	1	-	-
PDKV, Akola	2	1	1	1	-	-
MPUAT, Udaipur	2	2	1	-	-	-
SKUAST, Jammu	2	2	1	1	-	-
BCKV, Kalyani	2	2	1	1	-	-
Total	**34**	**31**	**17**	**14**	**08**	**07**

Funds released to different coordinating centres during the financial year 2022-23

(Rs. in lakh)

Sl. No.	Centre Name	Capital	SCSP (Capital)	Salary	TA	Research Expenses	Operational Expenses	SCSP (General)	Total
1	PAU, Ludhiana	-	0.20	24.26	-	1.10	0.75	0.30	**26.61**
2	UAS, Bengaluru	-	0.20	41.14	-	1.10	0.75	0.30	**43.49**
3	RVSKVV, Gwalior	-	0.20	27.38	-	1.10	0.75	0.30	**29.73**
4	GBPUAT, Pantnagar	-	0.20	63.67	-	1.10	0.75	0.30	**66.02**
5	CSKHPKV, Palampur	-	0.20	44.78	0.32	1.45	1.50	0.30	**48.55**
6	AAU, Jorhat	-	-	129.44	-	1.10	0.75	-	**131.29**
7	AAU, Anand	-	-	17.24	-	1.10	0.75	-	**19.09**
8	TNAU, Coimbatore	-	0.20	27.27	-	3.10	0.75	0.30	**31.62**
9	KAU, Thrissur	-	0.20	66.22	0.40	2.26	1.50	0.30	**70.88**
10	OUAT, Bhubaneshwar	-	0.20	62.43	-	2.78	0.75	0.30	**66.46**
11	PJTSAU, Hyderabad	1.45	-	28.80	0.11	2.56	1.78	-	**34.70**
12	CCSHAU, Hisar	2.48	0.20	17.71	-	1.10	0.75	0.30	**22.54**
13	IGKV, Raipur	2.87	-	52.19	0.25	2.62	2.04	-	**59.97**
14	PDKV, Akola	4.55	-	18.53	0.26	2.40	2.68	-	**28.42**
15	BCKV, Kalyani	1.90	0.20	17.56	0.28	2.38	3.00	0.30	**25.62**
16	MPUAT, Udaipur	1.70	0.20	51.85	0.20	2.39	2.06	0.30	**58.70**
17	SKUAST, Jammu	3.75	0.20	29.53	0.13	1.43	1.58	0.30	**36.92**
	PC, Unit, Jabalpur	1.69	-	-	-	2.87	-	-	**4.56**
	Total	**20.39**	**2.40**	**720.00**	**1.95**	**33.94**	**22.89**	**3.60**	**805.17**

3. Research Achievements

WP-1 Development of location-specific sustainable weed management practices

WP-1.1 Weed management in major crops and cropping systems

WP-1.1.1. Weed management in *tar-vattar* direct-seeded rice (DSR)

Cooperating centres: CCSHAU, Hisar, GBPUAT, Pantnagar, SKUAST, Jammu

Objectives:

- To study the interaction between timing of first irrigation and weed management on weed dynamics and productivity of *tar- vattar* DSR
- To determine bio-efficacy of herbicide combinations for managing weeds in *tar-vattar* DSR

Treatments:

Main plot: Timing of first irrigation

IR 1: 7 days after sowing (DAS)

IR 2: 14 DAS (At Pantnagar and Jammu)

IR 3: 21 DAS (At Pantnagar and Jammu)

Sub-plot: Weed management

WM 1-Pendimethalin + pyrazosulfuron-ethyl (Ready mix/RM) 785 g/ha as PE *fb* 1 HW at 30 DAS

WM 2-Penoxsulam + pendimethalin (RM) 625 g/ha as PE *fb* bispyribac –sodium 25 g/ha as PoE (25-30 DAS)

WM 3-Penoxsulam + pendimethalin (RM) 625 g/ha as PE *fb* fenoxaprop ethyl 67g/ha + ethoxysulfuron 18 g/ha as PoE (25-30 DAS)

WM 4-Pendimethalin 678 g/ha (38.7 CS) as PE *fb* bispyribac-sodium 25 g/ha + [(metsulfuron methyl + chlorimuron ethyl) (RM)] 4 g/ha (Tank mix) as PoE (25-30 DAS)

WM 5-Pendimethalin 678 g/ha (38.7 CS) as PE *fb* penoxsulam + cyhalofop-butyl (RM) 135 g/ha as PoE (25-30 DAS)

WM 6-2 HW at 30 and 60 DAS

WM 7- Partially weedy check (Weeds will be removed at 60 DAS after taking observation on weeds)

Design: Split-plot and replication: 3

Results

At **Hisar** *Echinochloa crus-galli* followed by *Dactyloctenium aegyptium* and *Leptochloa chinensis* were the major weed flora. Density and dry weight of *E. crus-galli* were reduced significantly with the delay in first irrigation *i.e.* 21 DAS to the tune of 90%. Among weed management practices, higher reduction of *E. crus-galli* dry weight was recorded with the application of pendimethalin 678 g/ha (38.7 CS) followed by penoxsulam + pendimethalin 625 g/ha as compared to pendimethalin + pyrazosulfuron-ethyl (RM) 785 g/ha. Poor germination was recorded in the treatments due to abnormal rise of temperature after irrigation applied at 14 and 21 DAS. Application of pendimethalin as PE *fb* penoxsulam + cyhalofop butyl (RM) (25-30 DAS) recorded the highest grain yield of 2.01 t/ha whereas, among the timing of first irrigation, application of first irrigation at 7 DAS registered the grain yield of 3.05 t/ha.

At **Pantnagar** *Echinochloa colona, Leptochloa chinensis* and *Eleusine indica* among the grasses, *Alternanthera sessilis* and *Cyanotis axillaris* among the broadleaf weeds and the sedges *Cyperus iria, Fibmbristylis miliacea* and *Cyperus roundus* were the major weeds. Application of first irrigation at 14 DAS recorded lower total weed dry weight and higher weed control efficiency as compared to 21 DAS. Complete control of all the weeds were recorded with

pendimethalin + pyrazosulfuron-ethyl (Ready mix/RM) 785 g/ha as PE *fb* 1 HW at 30 DAS) closely followed by the treatment penoxsulam + pendimethalin (RM) 625 g/ha as PE *fb* fenoxaprop ethyl 67g/ha + ethoxysulfuron 18 g/ha as PoE (25-30 DAS). Application of first irrigation at 21 DAS has been found effective in terms of higher grain yield, net returns and B:C. The highest grain yield of 4.1 t/ha was recorded by the treatment penoxsulam + pendimethalin (RM) 625 g/ha PE *fb* fenoxaprop ethyl 67g/ha + ethoxysulfuron 18 g/ha PoE (25-30 DAS).

At **Jammu**, The experimental field was dominated by *Echinochloa* spp., and *Digitaria sanguinalis* amongst grassy weeds; *Caesulia axillaris* and *Physalis minima* amongst broadleaf weeds and *Cyperus* spp. Other weeds like and *Commelina benghalensis*, *Alternanthera philoxeroides*, *Phyllanthus niruri* and *Dactyloctenium aegyptium* were recorded. Different timings of first irrigation did not record any significant effect on yield parameters, grain yield and straw yield. However, first irrigation at 21 days after sowing recorded higher yield parameters, grain yield and straw yield than first irrigation at 14 days after sowing. The highest number of panicles/m^2, number of grains/panicle, grain yield and straw yield were recorded in two hand weeding at 30 and 60 DAS, which was significantly higher than penoxsulam + pendiemthalin (RM) 625 g/ha as PE *fb* bispyribac–sodium 25 g/ha as PoE (25-30 DAS) and weedy check and at par with other treatments. The highest net returns and B:C were recorded in pendimethalin 1000 g/ha as PE *fb* bispyribac-sodium 25 g/ha + metsulfuron methyl + chlorimuron ethyl 4 g/ha as PoE (25-30 DAS) followed by pendimethalin 1000 g/ha (30 EC) as PE *fb* penoxsulam + cyhalofop-butyl 135 g/ha as PoE (25-30 DAS).

WP-1.1.2. Weed management in dry direct-seeded rice (DSR)

Cooperating centres: IGKV, Raipur, CSKHPKV, Palampur, OUAT, Bhubaneswar, UAS, Bengaluru, BAUT, Banda, PAJNCOA & RI, Puducherry, BAU, Sabour, BCKV, Kalyani

Objectives:

- To study the weed dynamics and productivity of rice influenced by weed management practices in dry DSR
- To determine bio-efficacy of herbicide combinations for managing diverse weed flora in dry DSR

Results

At **Raipur**, the major weed flora of experiment was *Alternanthera sessilis, Cyanotis axillaris, Echinochloa colona* and *Cyperus iria.* Application of pendimethalin 1000 g/ha (30 EC) as PE *fb* bispyribac sodium 25 g/ha + (metsulfuron methyl + chlorimuron ethyl) (RM) 4 g/ha tank-mix PoE (25- 30 DAS) has been found effective to control the weeds as this treatment recorded minimum weed density and weed biomass. Significantly the highest number of effective tillers, grain yield (6.56 t/ha), net returns (Rs.105190/ha) and B:C (3.67) were recorded under the same treatment **(Table 1.1.3)**. Sequential application of pendimethalin 1000 g/ha (30 EC) as PE *fb* bispyribac sodium 25 g/ha + (metsulfuron methyl + chlorimuron ethyl) (RM) 4 g/ha tank-mix PoE (25- 30 DAS) has emerged as a promising weed management treatment for controlling weeds, obtaining highest grain yield and maximum economic returns in DSR.

Table 1.1.3: Effects of weed management treatments on weed control efficiency, grain yield and economics.

Treatment	WCE (%) at 40 DAS	Grain yield (t/ha)	Net returns (Rs/ha)	B:C
Pendimethalin + pyrazosulfuron-ethyl (RM) 785 g/ha (PE) *fb* 1HW at 30 DAS	84.9	5.82	87693	2.82
Penoxsulam + pendimethalin (RM) 625 g/ha as PE *fb*bispyribac sodium 25 g/ha as PoE (25-30 DAS)	81.2	5.62	86222	3.04
Penoxsulam + pendimethalin (RM) 625 g/ha as PE *fb* fenoxaprop ethyl 67 g/ha +ethoxysulfuron 18g/ha as PoE (25-30 DAS)	85.2	6.02	93329	3.17
Pendimethalin 1000 g/ha (30EC) as PE *fb*bispyribac sodium 25 g/ha + (metsulfuron methyl + chlorimuron ethyl) (RM) 4 g/ha tank-mix PoE (25-30 DAS)	90.6	6.56	105190	3.67
Pendimethalin 1000g/ha (30EC) PE *fb* penoxsulam + cyhalofop butyl (RM)135 g/ha PoE (25-30 DAS)	87.0	6.25	97724	3.27
2HW at 30 & 60 DAS	89.0	6.12	91416	2.73
Partially weedy check (1HW at 60 DAS)	0.00	2.50	19233	0.61
SEm (±)		0.22		
LSD (P=0.05)		0.68		

At **Palampur,** weed flora in the experimental field was *Cyperus* spp. (30%), *Ageratum* spp. (29%), *Polygonum alatum* (19%), *Commelina* spp. (15%), *Digitaria sanguinalis* (4%), *Echinochloa colona* (3%), *Galinsoga parviflora* and *Ipomoea* 1% each and *Aeschynomene indica*. At later stage the population of *Ageratum* spp. (40%) was increased, whereas populations of other weeds were decreased. However, towards maturity *Ageratum* spp. constituted 93% of the total weed flora in the experimental field. Application of pendimethalin 1000 g/ha (30 EC) as PE *fb* bispyribac sodium 25 g/ha + (metsulfuron methyl + chlorimuron ehyl) 4 g/ha tank-mix as PoE (25-30 DAS) effectively reduced the total weed count and weed biomass; however, penoxsulam + pendimethalin (RM) 625 g/ha as PE *fb* bispyribac sodium 25 g/ha as PoE at 25-30 DAS recorded maximum grain yield of 2.97 t/ha and highest net returns over weedy check (Rs 44587/ha) and marginal benefit cost ratio (MBCR) of 10.66. Sequential application of penoxsulam + pendimethalin (RM) 625 g/ha as PE *fb* bispyribac sodium 25 g/ha as PoE at 25-30 DAS has been recorded as an effective weed management treatment in DSR.

At **Bhubaneswar,** the floristic composition of the experimental site was dominated with grasses like *Digitaria ciliaris, Cynodon dactylon, Echinochloa colona* and broadleaf weeds like *Ageratum conyzoides, Cleome viscosa, Celosia argentea Oldenlandia corymbosa, Ludwigia parviflora, Physalis minima and Amaranthus viridis.* The dominant sedges were *Cyperus rotundus and Cyperus iria.* Application of penoxsulam + pendimethalin (RM) 625 g/ha as PE *fb* fenoxaprop ethyl 67g/ha + ethoxysulfuron 18 g/ha as PoE (25 DAS) recorded lowest weed index of 3.35 %, highest grain yield of 3.32 t/ha, highest net returns of Rs.18900/ha and B:C of 2.78. Sequential

application of penoxsulam + pendimethalin (RM) 625 g/ha as PE *fb* fenoxaprop ethyl 67g/ha + ethoxysulfuron 18 g/ha as PoE (25 DAS) has been recorded as a promising weed management treatment in DSR.

At **Bengaluru,** the weed flora observed in the experimental plots were sedge *Cyperus rotundus, grasses Eleusine indica*, *Digitaria marginata* and *Cynodon dactylon*. In broadleaf weeds, *Borreria hispida, Ageratum conyzoides*, *Commelina benghalensis, Acanthospermum hispidum, Celosia argentea, Cleome viscose* and *Argemone mexicana,* were the dominant weed species. Among the total weed density, broadleaf weeds *Borreria hispida, Ageratum conyzoides* and *Commelina benghalensis* recorded the highest value followed by grasses and sedges.

Application of pendimethalin + pyrazosulfuron-ethyl (Ready-mix/RM) 785 g/ha as PE *fb* 1 HW at 30 DAS recorded the highest weed control efficiency of 65.83 % at 20 DAS. At 40 and 60 DAS, pendimethalin 1000 g/ha (30 EC) as PE *fb* bispyribac-sodium 25 g/ha + [(metsulfuron methyl + chlorimuron ethyl) (RM)] 4 g/ha (Tank-mix) as PoE (25-30 DAS) recorded the highest weed control efficiency of 71.4 and 70.6%, respectively, higher grain yield of 1.32 t/ha and highest net returns of Rs. 39,670/ha and B:C of 2.06. Among the weed management treatments pendimethalin 1000 g/ha (30 EC) as PE *fb* bispyribac-sodium 25 g/ha + [(metsulfuron methyl + chlorimuron ethyl) (RM)] 4 g/ha (Tank-mix) as PoE (25 DAS) was recorded as a superior treatment for controlling diverse weed flora effectively in DSR especially during continuous rain.

At **Banda,** the experimental field of rice was infested with several grassy weeds, broadleaf weeds and sedges. The major weeds species were *Echinochloa crusgalli, Brachiaria reptans, Digera arvensis, Centella asiatica, Phyllanthus niruri, Cyperus rotundus.* Pendimethalin 1000 g/ha (30 EC) PE *fb* penoxsulam + cyhalofop-butyl (RM) 135 g/ha as PoE (25-30 DAS) significantly reduced the weed dry weight at all the growth stages and also recorded maximum weed control efficiency. Highest rice grain yield (4.2 t/ha) and B:C (3.1) were recorded in the treatment pendimethalin 1000 g/ha (30 EC) PE *fb* penoxsulam + cyhalofop-butyl (RM) 135g/ha as PoE and the value was closely followed by pendimethalin 1000 g/ha (30 EC) PE *fb* bispyribac-sodium 25 g/ha + [(metsulfuron methyl + chlorimuron ethyl) (RM)] 4 g/ha (Tank-mix) as PoE (25-30 DAS).

At **Puducherry,** the experimental field was dominated by sedges (67.7%), broadleaf weeds (3.6%) and grasses (28.7%). Predominant weeds of the experimental field were *Echinochloa colona* Link. *Digitaria marginata* Stapf, *Panicum repens* L., *Dactyloctenium aegyptium* (L.) Willd. *Cyperus difformis* L., *Eclipta alba* (L.) Hassk, *Corchorus tridens* L., *Phyllanthus niruri* L. and *Aeschynomene indica* L. at 60 DAS. Sequential application of penoxsulam + pendimethalin 625 g/ha as PE *fb* fenoxaprop ethyl 67 g/ha + ethoxysulfuron 18 g/ha as PoE (25-30 DAS) recorded lower total weed density (5.2 no./m^2) and higher grain yield (3.39 t/ha).

At **Sabour,** the major weeds observed in the experimental plots were *Echinochloa colona, Echinochloa crusgalli, Eleusine indica, Cynodon dactylon, Digitaria sanguinalis* among the grasses, *Cyperus rotundus, Cyperus iria, Cyperus difformis, Fimbristylis miliaceae* among the sedges and *Alternanthera sessilis, Caesulia axillaris, Ludwigia parviflora, Eclipta alba, Phyllanthus niruri, Amaranthus viridis, Physalis minima, Commelina benghalensis* among broadleaf weeds. Among the different weed management treatments, pendimethalin + pyrazosulfuron-ethyl (Ready-mix/RM) 785 g/ha as PE *fb* 1 HW at 30 DAS recorded lowest weed density (6.33/m^2), and weed dry weight (7.61g/m^2), highest weed control efficiency (97%) at 60 DAS, maximum grain yield (5.12 t/ha), maximum net returns (Rs. 78670/ha) and desirable B:C (1.94) **(Table 1.1.4)**.

Table 1.1.4. Effects of weed management treatments on weed control efficiency, grain yield and economics.

Treatment	WCE (%) at 60 DAS	Grain yield (t/ha)	Net returns (Rs/ha)	B:C
Pendimethalin + pyrazosulfuron-ethyl (Ready mix/RM) 785 g/ha as PE fb 1 HW at 30 DAS	97	5.12	78670	1.94
Penoxsulam + pendiemthalin (RM) 625 g/ha as PE fb bispyribac –sodium 25 g/ha as PoE (25-30 DAS)	92	4.41	64270	1.68
Penoxsulam + pendimethalin (RM) 625 g/ha as PE fb fenoxaprop ethyl 67g/ha + ethoxysulfuron 18 g/ha as PoE (25-30 DAS)	92	4.51	65501	1.62
Pendimethalin 1000 g/ha (30 EC) or 678 g/ha (38.7 CS) as PE fb bispyribac-sodium 25 g/ha + [(metsulfuron methyl + chlorimuron ethyl) (RM)] 4 g/ha (Tank mix) as PoE (25-30 DAS)	93	4.92	77888	2.12
Pendimethalin 1000 g/ha (30 EC) or 678 g/ha (38.7 CS) as PE fb penoxsulam + cyhalofop-butyl (RM) 135 g/ha as PoE (25-30 DAS)	91	4.72	73388	1.99
2 HW at 30 and 60 DAS	97	5.61	84756	1.83
Partially weedy check (1HW at 60 DAS)	0	3.84	50338	1.27
SEm (±)	-	0.32	-	-
LSD (P=0.05)	-	0.94	-	-

BCKV, Kalyani

The experiment has not been conducted because of germination failure due to frequent rainfall immediately after sowing.

Weed management in transplanted rice-chickpea cropping system (*Rabi* 2021-22)

IGKV, Raipur

The experimental field was dominated by *Medicago denticulata,* which accounted for 50% of the total weed population during entire crop growth. Other major weeds were *Chenopodium album* and *Cichorium intybus*. *Echinochloa colona* and *Cynodon dactylon* were the other weeds recorded in the field during *Rabi* 2021-22.

Among the different weed amangement treatments, topramezone 25.28 g/ha as PoE (18-20 DAS) has performed as a best treatment as it recorded significantly lowest weed biomass and highest weed control efficiency of 82.9 and 81.1% at 60 DAS and at harvest, respectively. While, next in order, flauzifop-p-butyl + fomesafen 250 g/ha PoE also appreciably reduced the weed dry weight recorded higher weed control efficiency **(Table 1.1.5)**.

Significantly higher seed yield (1.49 and 1.53 t/ha) was recorded in the topramezone 25.28 g/ha as PoE (18-20 DAS) over the other weed control treatments except oxyfluorfen 140 g/ha as PE (1.29 and 1.34 t/ha), flauzifop-p-butyl + fomesafen 250 g/ha POST (1.28 and 1.32 t/ha) and flauzifop-p-butyl + fomesafen 125 g/ha POST (1.28 t/ha). Topramezone also recorded the highest net returns (Rs. 53,290 and 54630/ha) and B:C (3.35 and 3.33).

Table 1.1.5: Effect of treatments on weed control efficiency, seed yield and economics in chickpea in transplanted rice-chickpea cropping system *Rabi* 2021-22.

Treatments	Weed control efficiency (%)		Seed yield (t/ha)		B:C	
	60 DAS	At harvest	2020-21	2021-22	2020-21	2021-22
Pendimethalin 678 g/ha PE	49.3	50.0	1.12	1.15	2.75	2.74
Pendimethalin+imazethapyr 1000 g/ha as PE	53.9	53.5	1.13	1.23	2.78	2.93
Oxyfluorfen 140 g/ha as PE	65.8	63.9	1.29	1.34	3.18	3.19
Topramezone 25.28g/haas POST (18-20 DAS)	83.5	83.8	1.49	1.53	3.35	3.33
Pendimethalin 678 g/ha PE fb quizalofop 50 g/ha POST	59.4	59.3	1.18	1.22	2.70	2.72
Pendimethalin 678 g/ha PE fb propaquizofop 50 g/ha POST	56.4	55.8	1.17	1.19	2.75	2.71
Flauzifop-p-butyl + fomesafen125 g/ha POST	72.6	70.5	1.24	1.28	2.04	3.05
Flauzifop-p-butyl+fomesafen 250 g/ha POST	76.6	75.2	1.28	1.32	3.06	3.05
Propaquizafop + imazethapyr 125g/ha POST	42.1	43.7	1.11	1.13	2.74	2.69
Mechanical weeding at 20 fb 40 DAS	82.4	74.3	1.31	1.40	3.15	3.26
Hand weeding at 30 DAS/ Farmers practice	89.0	81.7	1.39	1.43	2.71	2.71
Weedy check	0.0	0.0	0.53	0.56	1.49	1.51
SEm (±)			0.10	0.03	-	-
LSD (P= 0.05)			0.30	0.11	-	-

Effect of green manures and herbicides on weed dynamics and yield of transplanted rice-wheat cropping system (2021-22)

SKUAST, Jammu

The weed flora included *Phalaris minor* among the grassy weeds, *Rumex* spp., *Anagallis arvesnsis*, *Medicago* spp., *Vicia* spp., and *Melilotus* spp. among broadleaf weeds were observed in wheat.

Different nutrient levels and herbicides had significant effect on grassy (*P. minor*), broadleaf weeds (except *Medicago* spp.) and total weed density and weed biomass at 60 DAS and at harvest. Among the nutrient levels, lowest total weed density as well as weed biomass was observed in 125% RDF, which was significantly lower than 100% RDF and 75% RDF. Among the herbicidal treatments, significantly lowest *P. minor* density was recorded in clodinafop propargyl + metribuzin 54+120 g/ha at 30-35 DAS than other herbicides at 60 DAS. However, different herbicidal treatments had non-significant effect on *P. minor* density at harvest. At 60 DAS, lowest total biomass of weeds was recorded with clodinafop propargyl + metsulfuron- methyl 60+4 g/ha at 30-35 DAS, which was

significantly lower than mesoulfuron-methyl + iodosulfuron- methyl sodium 14.4 g/ha at 30-35 DAS.

The highest grain and straw yields were observed in 125% RDF, which was at par with 100% RDF and significantly higher than 75% RDF. Also 125% RDF recorded the highest gross, net returns and B:C. The highest grain and straw yields were recorded with clodinafop propargyl + metsulfuron- methyl 60+4 g/ha at 30-35 DAS, however, highest net returns and B:C were recorded in clodinafop propargyl + metribuzin 54+120 g/ha at 30-35 DAS followed by clodinafop- propargyl + metsulfuron-methyl 60+4 g/ha at 30-35 DAS **(Table 1.1.6)**. Application of 125% RDF resulted in highest grain yield (4.71 t/ha), net returns (Rs. 83744/ha) and B:C (2.99). Among the herbicidal treatments, clodinafop propargyl + metsulfuron- methyl 60+4 g/ha as PoE and Clodinafop propargyl + metribuzin 54+120 g/ha as PoE have been found effective for controlling weeds in wheat.

Table 1.1.6: Effect of nutrient levels and herbicides on yields and economics of wheat (*Rabi* 2021-22).

Treatments	Grain yield (t/ha)	Straw yield (t/ha)	Net returns (Rs./ha)	B:C
75% RDF	3.82	4.83	65959	2.59
100% RDF	4.48	5.38	79601	2.98
125% RDF	4.71	5.66	83744	2.99
SEm ±	0.09	0.13	-	-
LSD (p=0.05)	0.34	0.50	-	-
Sulfosulfuron + carfentrazone-ethyl 25+20 g/ha at 30-35 DAS	4.36	5.24	77070	2.89
Clodinafop propargyl + metsulfuron methyl 60+4 g/ha	4.38	5.37	77408	2.86
Clodinafop propargyl + metribuzin 54+120 g/ha	4.35	5.34	77487	2.95
Mesoulfuron-methyl + iodosulfuron methyl sodium 14.4 g/ha	4.24	5.21	73773	2.71
SEm (±)	0.09	0.10	-	-
LSD (P=0.05)	NS	NS	-	-
Interaction	NS	NS	-	-

Effect of green manures and herbicides on weed dynamics and yield of direct seeded rice-wheat cropping system (2021-22)

SKUAST, Jammu

The weed flora included *Phalaris minor*, *Ranunculus arvensis*, *Rumex* spp., *Anagallis arvensis* and *Medicago* spp., as major weeds and other weeds like *Vicia* spp., and *Melilotus* spp. were also observed in wheat. Among the wheat establishment, significantly lowest weed density of *P. minor* and *A. arvensis* was observed in zero-tillage wheat than the conventional tillage and FIRB method but significantly highest density of *Medicago* spp., other weeds and total weed were observed in zero-tillage as compared to the conventional tillage and FIRB method. Different wheat establishment had non-significant effect on total weed biomass at 60 DAS. However, significantly lowest *P. minor* biomass was observed in zero-tillage wheat at 60 DAS than conventional tillage and FIRB system.

All the per-emergence herbicidal treatments recorded statistically *at par* values on total weed density and biomass but these are significantly lower than weedy check. However, lowest weed density and biomass was observed in pendimethalin 1 kg/ha as PE. Among the wheat establishment, highest grain and straw yields were observed in conventional tillage followed by FIRB. However, highest B:C was recorded in zero-tillage than conventional tillage and FIRB. Highest net returns and B:C were recorded in pendimethalin 1 kg/ha as PE followed by flumioxazin 125 g/ha as PE **(Table 1.1.7)**.

Significantly the lowest *P. minor* biomass was recorded in zero-tillage wheat at 60 DAS than conventional tillage and FIRB system. Highest grain yield (4.51 t/ha) was recorded in conventional tillage followed by FIRB (4.43 t/ha). However, highest B:C (3.13) was observed in zero-tillage than conventional tillage and FIRB. Highest net returns (Rs. 82887/ha) and B:C (3.47) were recorded in pendimethalin 1 kg/ha as PE.

Table 1.1.7: Effect of wheat establishment and pre-emergence herbicides on yields and economics of wheat (*Rabi* 2021-22).

Treatments	Grain yield (t/ha)	Straw yield (t/ha)	Net returns (Rs./ha)	B:C
Conventional tillage	4.51	6.04	78052	2.87
Zero tillage	4.19	5.61	74349	3.13
FIRB	4.43	5.88	74490	2.59
SEm ±	0.06	0.12	-	-
LSD (P=0.05)	NS	NS	-	-
Pendimethalin 1 kg/ha as PE	4.57	6.19	82887	3.47
Flumioxazin 125 g/ha as PE	4.56	6.22	82566	3.39
Pyroxasulfone 127.5 g/ha as PE	4.57	6.23	78529	2.75
Weed free	5.03	6.61	82412	2.35
Weedy check	3.16	3.98	51758	2.36
SEm (±)	0.12	0.11	-	-
LSD (P=0.05)	0.35	0.33	-	-
Interaction	S	S	-	-

WP-1.1.3. Weed management in sorghum

Cooperating centres: RVSKVV, Gwalior; ANGRAU, Guntur; MPUAT, Udaipur

At **Gwalior**, the major weeds were *Setaria glauca, Echinochloa colona, Acrachne racemosa, Brachiaria reptans*, and *Cynodon dactylon* as narrow leaved weeds, *Commelina benghalensis, Bryophyllum pinnatum, Phyllanthus niruri* and *Digera arvensis* as broadleaf weeds and *Cyperus rotundus* as sedge. Of these, the relative density of *Cyperus rotundus* (45.29%) and *Echinochloa colona* (11.10%) was higher at 20 DAS; however, after 40 and 60 DAS only one weed *Cyperus rotundus* (76.61% and 85.37%, respectively) was a dominant weed. In case of IVI value, *Cyperus rotundus* (89.59) and *Echinochloa colona* (22.11) were found dominant weeds at 20 DAS; however, at 40 and 60 DAS the IVI value of *Cyperus rotundus* was 96.56 and 57.19, respectively.

At 20 and 40 DAS the minimum density and biomass of weeds were recorded in the treatment atrazine 500 g/ha as PE *fb* mechanical weeding at 30 DAS. Whereas at 60 DAS, the minimum weed population and biomass of total weeds were recorded in bentazone 960 g/ha as PoE (20 DAS). Among the different weed management treatments, after 20 DAS, the maximum weed control efficiency (73%)

was recorded with the treatment atrazine 500 g/ha as PE *fb* mechanical weeding at 30 DAS. This treatment was followed by the tank-mix combination of atrazine 500 g/ha + topramezone 25.2 g/ha (61%) as EPoE (15 DAS), whereas after 40 DAS, the maximum weed control efficiency (82%) was recorded in atrazine 500 g/ha as PE *fb* mechanical weeding at 30 DAS and it was followed by bentazone 960 g/ha as PoE at 20 DAS (54%). However, at 60 DAS the maximum weed control efficiency (60%) was recorded with bentazone 960 g/ha as PoE at 20 DAS **(Table 1.1.8)**.

Maximum grain (2.61 t/ha) and stover yields (15.64 t/ha) were recorded in the treatment atrazine + mesotrione (RM) 656 g/ha as PoE at 20 DAS and the values were *at par* with the treatment of 2 HW (20 & 40 DAS) (Grain and stover yields of 2.58 t/ha and 15.49 t/ha, respectively). Maximum net returns (Rs.89260/ha) and B:C (4.51) were obtained with the treatment atrazine + mesotrione (RM) 656 g/ha as PoE at 20 DAS.

Table 1.1.8: Effect of different treatments on yields and economics of sorghum crop.

Treatments	Dose	Grain yield (t/ha)	Stover yield (t/ha)	Net Returns (Rs./ha)	B:C
Atrazine *fb* 2,4-D Ethyl ester	750 g/ha *fb* 500 g/ha	2.31	13.83	76269	4.03
Atrazine *fb* 2,4-D dimethylamine salt	750 g/ha *fb* 750 g/ha	2.16	12.93	69802	3.79
Atrazine + Mesotrione (RM)	438 g/ha	2.51	15.04	84916	4.35
Atrazine + Mesotrione (RM)	656 g/ha	2.61	15.64	89260	4.51
Atrazine + Toprame zone (Tank-mix)	(500+18.9) g/ha	2.36	14.14	78641	4.14
Atrazine + Toprame zone (Tank -mi x)	(500+25.2) g/ha	2.38	14.29	79330	4.12
Atrazine *fb* Mechanical weeding at 30 DAS	500 g/ha	2.33	13.98	76025	3.87
Bentazone	960 g/ha	2.23	13.38	72214	3.78
Weed free (HW at 20 & 40 DAS)		2.58	15.49	86532	4.20
Weedy check		1.48	8.87	43078	2.95
SEm (±)		0.142	0.849	6200.5	0.2
LSD (P=0.05)		0.414	2.486	18151.4	0.7

At **Guntur**, atrazine 0.75 kg/ha PE *fb* 2,4-D dimethyl amine salt 0.750 kg/ha PoE at 20 DAS controlled the weeds effectively with higher values of weed control efficiency without having any phytotoxic effect on sorghum plants. This treatment also recorded highest grain yield and B:C **(Table 1.1.9)**.

Table 1.1.9: Effect of treatments on weed control efficiency, grain yield and B:C of late *Kharif* sorghum during 2022-23.

Treatment	Weed Control Efficiency (%)			Grain yield (kg/ha)	B:C
	20 DAS	40 DAS	Harvest		
Atrazine 0.75 kg/ha PE *fb* 2,4-D ethyl ester 0.50 kg/ha PoE at 20 DAS	75.54	49.75	49.62	3476	3.06
Atrazine 0.75 kg/ha PE *fb* 2,4-D dimethyl amine salt 0.750 kg/ha PoE at 20 DAS	76.86	54.58	52.70	3683	3.24
Atrazine + Mesotrione ready-mix 438 g/ha PoE at 20 DAS	10.41	58.6	57.48	2376	2.10
Atrazine + Mesotrione ready-mix 656 g/ha PoE at 20 DAS	0.96	69.21	68.64	2214	1.96
Tank-mix application of atrazine 0.5 kg/ha + topramezone 18.9 g/ha PoE at 15 DAS	10.47	71.86	70.33	2291	2.02
Tank-mix application of atrazine 0.5 kg/ha + topramezone 25.2 g/ha PoE at 15 DAS	10.01	78.52	77.87	2053	1.81
Atrazine 0.50 kg/ha PE *fb* inter cultivation at 30 DAS	74.9	73.05	72.56	3420	3.01
Bentazone 0.960 kg/ha PoE at 20 DAS	2.89	29.75	29.54	3091	2.73
Weed free (hand weeding at 20 & 40 DAS)	11.93	86.8	86.11	3904	3.44
Weedy check				2897	2.56
SEm (+)				88.5	-
LSD (P=0.05)				262	-

At **Udaipur,** the dominant weed species were *Echinochloa colona* (49.23%), *Echinochloa crusgalli* (5.90%), *Elusine indica* (29.54%), *Digera arvensis* (2.95%), *Commelina benghalensis* (6.90%), *Setaria glauca* (2.95%) and *Physalis minima* (2.49%).At 40 DAS, atrazine 500 g/ha + topramezone 18.9 g/ha (Tank-mix) as EPoE (15 DAS), atrazine 500 g/ha + topramezone 18.9 g/ha (Tank-mix) as EPoE (15 DAS), atrazine 500 g/ha *fb* mechanical weeding at 30 DAS and HW at 20 & 40 DAS resulted in zero total weed density, and dry matter and 100% weed control efficiency**(Table 1.1.10)**. Maximum seed yield (2.88 t/ha) of sorghum was recorded with atrazine + topramezone (Tank-mix) (500 +25.2) g/ha EPoE (15 DAS), which was *at par* with atrazine 500 g/ha as PE *fb* 2,4-D Ethyl ester 750 g/ha as PoE (20 DAS) (2.43 t/ha) and HW at 20 & 40 DAS (2.61 t/ha).

Economical evaluation of different weed management treatments showed that apart from weed free, the highest net returns (Rs. 48782/ha) was realized with atrazine 500 g/ha PE *fb* mechanical weeding at 30 DAS, while the maximum B:C (2.39) was found with atrazine 750 g/ha PE *fb* 2,4-D ethyl ester 500 g/h PoE (20 DAS). Atrazine 500 g/ha PE *fb* mechanical weeding at 30 DAS has emerged as a promising weed management treatment resulted in highest grain yield and economic returns in sorghum.

Table 1.1.10: Effect of treatments on weed control efficiency, grain yield and economics in sorghum.

Treatment	Dose (g/ha)	Time of application	WCE (%) at 40 DAS	Grain yield (t/ha)	Net returns (Rs/ha)	B:C
Atrazine *fb* 2,4-D Ethyl ester	750 g/ha *fb* 500 g/ha	PE *fb* PoE (20 DAS)	73.73	2.33	44478	2.39
Atrazine *fb* 2,4-D dimethylamine salt	750 g/ha *fb* 750 g/ha	PE *fb* PoE (20 DAS)	65.01	2.22	40232	2.17
Atrazine + Mesotrione (RM)	438 g/ha	PoE (20 DAS)	51.07	2.04	34312	1.70
Atrazine + Mesotrione (RM)	656 g/ha	PoE (20 DAS)	57.99	2.14	34203	1.60
Atrazine + Topramezone (Tank-mix)	(500 +18.9) g/ha	EPoE (15 DAS)	100.00	2.31	40951	2.12
Atrazine + Topramezone (Tank-mix)	(500 +25.2) g/ha	EPoE (15 DAS)	100.00	2.18	38238	1.86
Atrazine *fb* Mechanical weeding at 30 DAS	500 g/ha	PE	100.00	2.77	48782	2.13
Bentazone	960 g/ha	PoE (20 DAS)	41.82	2.15	37752	1.98
Weed free (HW at 20 & 40 DAS)			100.00	2.91	48833	1.83
Weedy check			0.00	1.11	8049	0.48
SEm (±)				0.10	2732	0.13
LSD (P = 0.05)				0.31	8119	0.40

WP-1.1.4. Weed management in direct seeded/ drill sown finger millet

Cooperating centres: IGKV, Raipur; PAJNCOA & RI Puducherry; UAS, Bengaluru

IGKV, Raipur

The experimental field was infested with *Echinochloa colona, Alternanthera sessilis, Celosia argentia, Cyperus iria, Physalis minima, Cyanotis axillaris* and *Dinebra retroflexa.*

Atrazine 500 g/ha as PE *fb* 2, 4-D sodium salt 800 g/ha as PoE recorded the lowest weed biomass and achieved highest weed control efficiency (37.07, 50.27 and 43.53% at 20, 40 and 60 DAS, respectively) and highest grain yield (1.96 t/ha), net returns and B:C over the other weed management practices. Atrazine 500 g/ha as PE *fb* metsulfuron-methyl + chlorimuron-ethyl 4 g/ha PoE has also found to be comparable in terms of producing grain yield and net returns **(Table 1.1.11)**.

Table 1.1.11: Effect of the treatments on weed control efficiency, grain yield and economics of direct drill sown finger millet (2022).

Treatment	WCE (%)			Grain yield (t/ha)	Net returns (Rs/ ha)	B:C
	20 DAS	40 DAS	60 DAS			
Pyrazosulfuron-ethyl 15 g/ha as PE	7.35	10.64	26.82	1.68	32574	2.18
Atrazine 500 g/ha as PE				1.75	35069	2.27
Pyrazosulfuron-ethyl 15g/ha as PE *fb* 2, 4-D sodium salt 800 g/ha as PoE	21.11	15.23	28.64	1.78	34811	2.21
Atrazine 500 g/ha as PE *fb* 2, 4-D sodium salt 800 g/ha as PoE				1.96	41241	2.43
Pyrazosulfuron-ethyl 15g/ha as PE *fb* metsulfuron methyl + chlorimuron-ethyl 4g/ha PoE	23.54	21.11	29.93	1.78	34784	2.20
Atrazine 500 g/ha as PE *fb* metsulfuron-methyl + chlorimuron-ethyl 4 g/ha PoE				1.95	40857	2.41
2 HW at 20 & 40 DAS	37.07	50.27	43.53	1.93	29079	1.73
Weedy check				0.75	259	1.01
SEm (±)				0.15	-	-
LSD (P=0.05)				0.45	-	-

PAJNCOA & RI, Puducherry

Hand weeding twice significantly reduced the weed density (113.3 no./m^2), resulted in higher weed control efficiency (88.9%) and grain yield (1011.7 kg/ha). Weedy check treatment accounted for 80.7% finger millet yield loss. All the herbicidal treatments were found lees effective in controlling weeds **(Table 1.1.12)**.

Table 1.1.12: Effect of weed management treatments on weed dry weight, weed biomass, weed control efficiency, grain yield and weed index of direct seeded finger millet during *Kharif* 2022.

Treatment	Total weed density (no./ m^2)	Total weed dry weight (g/m^2)	WCE (%)	Grain yield (kg/ha)	Weed Index (%)
Pyrazosulfuron-ethyl 15g/ha as PE	13.0(169.3)	12.8(164.5)	38.8	690.0	31.8
Atrazine 500 g/ha as PE	16.4(270.0)	14.2(206.9)	23.0	448.3	55.7
Pyrazosulfuron-ethyl 15 g/ha as PE *fb* 2, 4-D sodium salt 800 g/ha as PoE	13.1(170.7)	14.2(213.5)	20.5	655.0	35.3
Atrazine 500 g/ha as PE *fb* 2, 4-D sodium salt 800 g/ha as PoE	17.4(305.3)	15.7(246.9)	8.1	436.7	56.8
Pyrazosulfuron-ethyl 15g/ha as PE *fb* metsulfuron-methyl + chlorimuron-ethyl 4 g/ha PoE	11.8(139.3)	12.3(182.7)	32.0	568.3	43.8
Atrazine 500 g/ha as PE *fb* metsulfuron-methyl + chlorimuron-ethyl 4 g/ha PoE	18.5(343.3)	16.0(260.6)	3.0	226.7	77.6
2 HW at 20 & 40 DAS	10.6(113.3)	5.5(29.8)	88.9	1011.7	0.0
Weedy check	19.7(386.7)	16.4(268.7)	-	195.0	80.7
LSD (P=0.05)	2.81	5.52		156.6	-

*Original figures in parenthesis were subjected to square root transformation ("x+0.5) before statistical analysis.

UAS, Bengaluru

Major weed flora found in the experimental plots were sedges *Cyperus rotundus*, grasses *Eleusine indica, Digitaria marginata and Cynodon dactylon*. Among broadleaf weeds, *Borreria hispida, Ageratum conyzoides, Commelina benghalensis, Celosia argentia, Oledenlandia corymbosa, Achyranthus aspera* and *Alternanthera sessilis* were recorded. Broadleaf weeds dominated the weed flora followed by grasses and sedges.

At 20 DAS, atrazine 500 g/ha as PE *fb* metsulfuron methyl + chlorimuron ethyl 4 g/ha as PoE and atrazine 500 g/ha as PE treatment recorded the highest weed control efficiency of 78.34 and 70.05%, respectively, whereas even at 40 DAS, atrazine 500 g/ha as PE *fb* metsulfuron methyl + chlorimuron ethyl 4 g/ha as PoE recorded the highest weed control efficiency of 67.84% followed by 2HW at 20 and 40 DAS (67.41%), while at later stages 2HW (53.13%) and atrazine 500 g/ha as PE *fb* 2,4-D sodium salt 800 g/ha as PoE (47.43%) recorded the highest weed control efficiency compared to other treatments.

The 2 HW at 20 and 40 DAS significantly recorded the highest grain yield of 1.85 t/ha. Atrazine 500 g/ha as PE *fb* metsulfuron methyl + chlorimuron ethyl 4 g/ha as PoE (1.78 t/ha) was *on par* with the above treatment.

The highest net returns was obtained in atrazine 500 g/ha as PE *fb* metsulfuron methyl + chlorimuron ethyl 4 g/ha (Rs. 36,960 Rs/ha) followed by atrazine 500 g/ha as PE *fb* 2,4-D sodium salt 800 g/ha as PoE (Rs 35,562/ha) and 2 HW at 20 and 40 DAS (Rs. 34,792/ha). The B:C was highest in atrazine 500 g/ha as PE *fb* metsulfuron methyl + chlorimuron ethyl 4 g/ha (2.45) followed by atrazine 500 g/ha as PE *fb* 2,4-D sodium salt 800 g/ha as PoE (2.38). Atrazine 500 g/ha as PE *fb* metsulfuron methyl + chlorimuron ethyl 4 g/ha as PoE recorded the lowest weed index (0.53%) indicating that these treatments were effective in controlling weeds and produced on a par yield of hand weeding treatment.

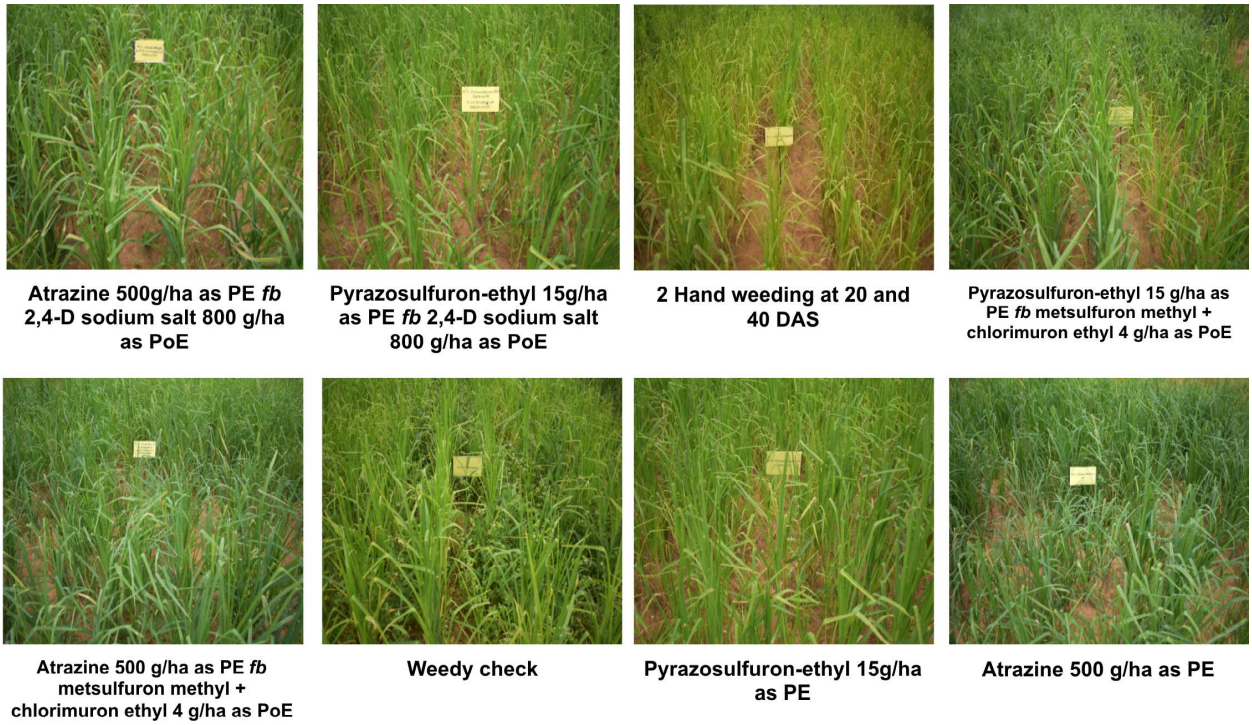


Plate 1: Direct seeded/ drill sown finger millet at 30 DAS with different treatments

WP-1.1.5. Weed management in soybean

Cooperating centres: CSKHPKV, Palampur; BCKV, Kalyani; MPUAT, Udaipur; UAS, Dharwad

CSKHPKV, Palampur

The weed flora of the experimental field was composed of *Cyperus* spp. (31%), *Polygonum alatum* (15%), *Digitaria sanguinalis* (10%), *Ageratum* spp. (11%) and *Commelina* spp. (8%). The other weeds constituted 25% of the total weed flora.

Fluazifop-p-butyl + fomesafen (RM), sulfentrazone + clomazone, bentazone and sodium acifluorfen + clodinafop propargyl effectively reduced the count of *Polygonum alatum* and *Ageratum* spp. Sulfentrazone + clomazone and HW twice were *at par* with each other resulted in significant lower count of *Polygonum alatum* over the weedy check. Fluazifop-p-butyl + fomesafen (RM), sulfentrazone + clomazone, bentazone and sodium acifluorfen + clodinafop propargyl effectively reduced the population of *Polygonum alatum* and *Ageratum* spp. Sulfentrazone + clomazone and HW twice were at par with pendimethalin + imazethapyr resulted in significantly lower total weed count over rest of the treatments. Fluazifop-p-butyl + fomesafen (RM) gave 11.8% higher yield, 62.5% higher net returns due to weed control and more than 9.7 times higher MBCR over the hand weeding twice. Pendimethalin + imazethapyr (RM) and sodium acifluorfen + clodinafop propargyl were the other better treatments gave higher net returns and MBCR over 2 HW treatment.

Fluazifop-p-butyl + fomesafen (RM) 250 g/ha as PoE, sodium acifluorfen + clodinafop propargyl 245 g/ha as PoE (20 DAS) and pendimethalin + imazethapyr (RM) 800 g/ha as PE have emerged as promising weed management treatments in soybean.

MPUAT, Udaipur

The dominant weed species were *Echinochloa colona* (30.39%), *Dinebra retroflexa* (9.79%), *Eleusine indica* (8.82%), *Digera arvensis* (6.85%), *Commelina benghalensis* (17.65%), *Physalis minima* (20.15%) and *Amaranthus viridis* (19.62%).

The maximum weed control efficiency at 40 DAS of total weed flora (95.94 %) was recorded with sulfentrazone + clomazone 725 g/ha PE followed by 2HW at 20 and 40 DAS (94.20%). Maximum seed yield of soybean was recorded with diclosulam + pendimethalin (TM) (1620 kg/ha), which was *at par* with sulfentrazone + clomazone (1593 kg/ha) and imazethapyr + propaquizafop (RM) (1574 kg/ha). The highest net returns (Rs. 80088/ha) was obtained with diclosulam + pendimethalin (TM), which was followed by imazethapyr + propaquizafop (RM) (Rs. 78253/ha) **(Table 1.1.13)**. While the maximum B:C (3.42) was recorded with imazethapyr + propaquizafop (RM), which was followed by diclosulam + pendimethalin (TM) (3.34). Observations were made in terms of leaf necrosis and wilting on as visual scale and it was observed that 3 to 4 scale of phytotoxicity at 10 to 20 days after herbicide application when Fluazifop-p-butyl + Fomesafen (RM) 250 g/ha PoE (20 DAS) was applied and it didn't recover after some day.

Diclosulam + pendimethalin (TM) 25.2+750 g/ha as PE and imazethapyr + propaquizafop (RM) 125 g/ha PoE (20 DAS) have been found as effective treatments for controlling weeds in soybean without having any phytotoxicity on soybean plants.

Table 1.1.13: Effect of the treatments on weed control efficiency, seed yield and economics of soybean.

Treatment	Dose	Time of application	WCE (%) at 40 DAS	Seed yield (kg/ha)	Net Returns (Rs/ha)	B:C
Diclosulam	26 g/ha	PE	67.20	1389	67301	3.09
Pendimethalin + imazethapyr (RM)	800 g/ha	PE	60.33	1296	60768	2.71
Sulfentrazone + clomazone	725 g/ha	PE	95.94	1593	76039	2.92
Diclosulam + pendimethalin (TM)	25.2+750 g/ha	PE	76.91	1620	80088	3.34
Fluazifop-p-butyl + Fomesafen (RM)	250 g/ha	PoE (20 DAS)	89.62	824	30604	1.38
Bentazone	960 g/ha	PoE (20 DAS)	77.20	444	6471	0.29
Sodium acifluorfen + clodinafop propargyl	245 g/ha	PoE (20 DAS)	67.11	1389	66419	2.96
Imazethapyr + propaquizafop (RM)	125 g/ha	PoE (20 DAS)	77.16	1574	78253	3.42
2HW at 20 and 40 DAS			94.20	1204	56282	2.66
Weedy check			0.00	65	9097	0.46
SEm (±)				52		
LSD (P = 0.05)				154		

PDKV, Akola

Density of dicot weeds (67%) was much higher than that of monocot weeds (29%) throughout the crop growing season. Among the dicot weeds, density values of *Euphorbia* sp. *Parthenium hysterophorus*, *Phyllanthus niruri* were higher than the monocot weeds *Commelina benghalensis, Cynodon dactylon, Dinebra retroflexus*, *Dactyloctenium aegyptium*, *Digitaria sanguinalis*, *Rottboelia cochinchinensis*, *Elusine indica* and *Cyperus rotundus* among sedges (4%). These weeds were predominant in the experimental plots.

Application of sulfentrazone 28% + clomazone 30% WP as pre-emergence herbicide recorded higher weed control efficiency over rest of the treatments and was closely followed by 2 HW. Among post-emergence herbicides, application of imazethapyr + propaquizafop reported higher weed control efficiency over remaining post-emergence herbicides. Application of sulfentrazone+clomazone as PE recorded minimum weed index, followed by pendimethalin + diclosulam and diclosulam alone. Sulfentrazone 28% + clomazone 30% WP, pendimethalin 30% EC + diclosulam 84% WDG and diclosulam 84% WDG alone recorded higher seed yield over rest of the treatments. However, among post-emergence herbicides, application of imazethapyr 3.75% + propaquizafop 2.50% and fluazifop-p-butyl 11.1%+ fomesafen 11.1% recorded highest seed yield. However, among post-emergence herbicides, application of sodium acifluorfen 16.5% + clodinafop 8% also was not safe for soybean as it has expressed phytotoxicity on soybean plants. Among various weed management treatments, the highest net returns and B:C were recorded with the treatment sulfentrazone + clomazone (Rs. 31314/ha and 1.84, respectively), which was closely followed by treatment pendimethalin+diclosulam (Rs. 28875/ha and 1.76, respectively) **(Table 1.1.14)**.

Among the different weed management treatments, sulfentrazone 28%+ clomazone 30% WP (RM) 725 g/ha as PE and pendimethalin 30% EC + diclosulam 84% WDG 25.2+750 g/

ha (Tank-mix) as PE have appeared as effective weed management treatments without having any phytotoxicity on soybean plants.

Table 1.1.14: Effect of the treatments on weed control efficiency, weed index, seed yield and economics of soybean.

Treatment	Dose	Time of application	WCE (%) at 60 DAS	Weed index (%)	Seed yield (t/ha)	Net returns (Rs/ha)	B:C
Diclosulam	26 g/ha	PE	61.4	8.00	1.47	27266	1.76
Pendimethalin + imazethapyr (RM)	800 g/ha	PE	48.4	12.97	1.39	23745	1.66
Sulfentrazone + clomazone	725 g/ha	PE	76.7	0.0	1.60	31314	1.84
Diclosulam + pendimethalin (TM)	25.2+750 g/ha	PE	73.3	3.13	1.55	28875	1.76
Fluazifop-p-butyl + Fomesafen (RM)	250 g/ha	PoE (20 DAS)	64.8	18.59	1.30	20675	1.59
Bentazone	960 g/ha	PoE (20 DAS)	31.2	23.18	1.06	9891	1.28
Sodium acifluorfen + clodinafop propargyl	245 g/ha	PoE (20 DAS)	59.2	19.92	1.15	13957	1.39
Imazethapyr + propaquizafop (RM)	125 g/ha	PoE (20 DAS)	70.5	17.31	1.32	20889	1.58
2HW at 20 and 40 DAS			74.2	30.27	1.42	18508	1.43
Weedy check			0.00	44.65	0.89	5678	1.17
SEm (±)			-	--	0.04	-	--
LSD (P = 0.05)			-	--	0.13	-	--

UAS, Bengaluru

Weed flora observed in the experimental plots were *Cyperus rotundus, Cynodon dactylon, Eleusine indica, Digitaria marginata, Borreria hispida, Ageratum conyzoides, Commelina benghalensis, Celosia argentea, Oldenlandia corymbosa, Achyranthes aspera, Acanthospermum hispidum, Lonaidium sufruiticesam.*

The highest weed control efficiency was observed with 2 HW at 20 and 40 DAS. The weed control efficiency of sulfentrazone 28% + clomazone 30% WP (RM) 725 g/ha at all the stages of observations was higher among pre-emergence herbicides, and among post-emergence fluazifop -p- butyl 11.1 % + fomesafen 11.1 % SL 250 g/ ha had shown higher weed control efficiency. Among the pre-emergence herbicides, application of sulfentrazone 28%+ clomazone 30% WP (RM) 725 g/ha significantly recorded higher seed yield (1.91 t/ha) followed by diclosulam 84% WDG + pendimethalin 38.7% CS (TM) (25.2 + 750 g/ha). While in PoE herbicides, application of fluazifop-p-butyl 11.1 % + fomesafen 11.1 % SL 250 g/ha and sodium acifluorfen 16.5% + clodinafop propargyl 8% EC 245 g/ha and imazethapyr 3.75% + propaquizafop 2.5% ME (RM) 125 g/ha recorded higher seed yield of 1.90, 1.87 and 1.86 t/ha, respectively, which were on par among each other. Among the pre-emergence herbicides, application of sulfentrazone 28%+ clomazone 30% WP (RM) 725 g/ha recorded higher net returns (Rs. 56595/ha) followed by diclosulam 84% WDG + pendimethalin 38.7% CS (TM) (25.2 + 750 g/ha) (Rs. 53467/ha). Among the post-emergence herbicides, net returns were higher in the case of fluazifop -p- butyl 11.1% +fomesafen 11.1% SL 250 g/ha (Rs. 57356/ha) followed by sodium acifluorfen 16.5% + clodinafop propargyl 8% EC 245 g/

ha (Rs. 56671/ha).

UAS, Dharwad

The lowest weed density and weed dry matter was recorded with sodium acifluorfen + clodinafop propargyl 245 g/ha as PoE at 20; 40 and 60 DAS (4.77; 4.03 &4.76 /m^2 and 0.36; 6.59 & 2.21g/m^2, respectively), followed by sulfentrazone + clomazone 725 g/ha as PE at all the three intervals (5.72; 4.76 & 9.61/m^2 and 0.42; 1.32 & 4.59 g/m^2, respectively). However, among the herbicidal treatments, bentazone 960 g/ha as PoE did not reduce the weed parameters (22.50; 8.81 & 44.93/m^2 and 4.46; 11.11 & 19.45 g/m^2, respectively).

The highest soybean yields were recorded with the treatment sulfentrazone + clomazone as PE 725 g/ha (1244.44 kg/ha), followed by fluazifop-p-butyl + fomesafen (RM) 250 g/ha as PoE and sodium acifluorfen + clodinafop propargyl 245 g/ha as PoE (1235.19 and 1198.20 kg/ha, respectively).

Sulfentrazone + clomazone as PE 725 g/ha and fluazifop-p-butyl + fomesafen (RM) 250 g/ha as PoE have been found as promising weed management treatments in soybean.

BCKV, Kalyani

Trial has not been conducted

WP-1.1.7. Weed management in maize-chickpea cropping system

Cooperating centres: MPUAT, Udaipur; RVSKVV, Gwalior; UAS, Dharwad

MPUAT, Udaipur

The experimental plot was infested with grassy, broadleaf weeds and sedges. The dominant weed species were *Echinochloa colona* (43.31%), *Elusine indica* (6.04%), *Dinebra retroflexa* (3.83%), *Digera arvensis* (9.86%), *Commelina benghalensis* (7.68%), *Trianthema portulacastrum* (4.39%) and *Physalis minima* (3.83%).

Among herbicidal treatments, the maximum weed control efficiency at 40 DAS of total weed flora (100 %) was recorded with application of atrazine + tembotrione (Tank-mix) (750 +120) g/ha as EPoE (15 DAS), atrazine + topramezone (Tank-mix) (750 + 25.2) g/ha as EPoE (15 DAS) **(Table 1.1.15)**. Among the herbicidal treatments, maximum grain yield (3.65 t/ha), highest net returns (Rs. 52399/ha) and B:C (2.55) were recorded by the treatment atrazine + topramezone (Tank-mix) (750 + 25.2) g/ha as EPoE (15 DAS).

Table 1.1.15: Effect of the treatments on weed control efficiency, grain yield and economics of maize.

Treatment	WCE (%) at 40 DAS	Grain yield (t/ha)	Net Returns (Rs/ha)	B:C
Atrazine + Tembotrione (Tank-mix) (750 +120) g/ha as EPoE (15 DAS)	100.00	3.48	49285	2.42
Atrazine + Topramezone (Tank-mix) (750 + 25.2) g/ha as EPoE (15 DAS)	100.00	3.65	52399	2.55
Atrazine + Mesotrione (RM) 875 g/ha as PoE (20 DAS)	97.14	3.38	47480	2.36
2 HW at 20 and 40 DAS	86.55	3.66	45922	1.69
Partially weedy (Weeds will be removed at 60 DAS after taking weed observations)	0.00	2.56	34490	2.06
SEm (±)		0.17		
LSD (P = 0.05)		0.55		

Atrazine + topramezone (tank mix) (750 + 25.2) g/ha as EPoE (15 DAS) has emerged as best weed management treatment for controlling diverse weed flora and also obtaining higher grain yield, and highest economic returns in maize.

RVSKVV, Gwalior

The weeds observed in the experimental site were *Echinochloa colona, Setaria glauca, Acrachne racemosa, Brachiaria reptans,* and *Cynodon dactylon* as narrowleaf weeds, *Digera arvensis, Commelina benghalensis and Phyllanthus niruri* as broadleaf weeds and *Cyperus rotundus* as sedges. Out of 9 above species recorded in maize only one major weed *Cyperus rotundus* was dominant during entire period of growth in maize with (81%, 66% and 92% dominancy at 20, 40 and 60 DAS respectively. In case of IVI value, *Cyperus rotundus* (95) and *Commelina benghalensis* (26) were found dominant weeds at 20 DAS, *Cyperus rotundus* (81.52) *Echinochloa colona* (25.39) and *Setaria glauca* (21.50) at 40 DAS; however, at 60 DAS the IVI value of *Cyperus rotundus* was 107.

The minimum values of density and biomass of weeds were recorded in the treatment atrazine + topramezone (Tank-mix) (750 + 25.2) g/ha as EPoE at 15 DAS. Whereas at 60 DAS, the minimum weed population and biomass of total weeds were recorded in the treatment atrazine + tembotrione (Tank-mix) (750 +120) g/ha as EPoE at15 DAS. Among the different herbicidal treatments, the maximum weed control efficiency (82 and 83% at 20 and 40 DAS, respectively) was recorded in the treatment atrazine + topramezone (Tank-mix) (750 + 25.2) g/ha as EPoE (15 DAS). Whereas at 60 DAS, the maximum weed control efficiency (87%) was registered with the treatment atrazine + tembotrione (Tank-mix) (750 +120) g/ha as EPoE (15 DAS). Among the herbicidal treatments, atrazine + topramezone (Tank-mix) (750 + 25.2) g/ha as EPoE (15 DAS) resulted in highest grain yield (3.25 t/ha), which was *at par* with the treatment atrazine + mesotrione (RM) 875 g/ha as PoE (20 DAS) and also recorded maximum net returns (Rs. 58175/ha) with B:C of 2.97.

Atrazine + topramezone (Tank-mix) (750 + 25.2) g/ha as EPoE (15 DAS) has emerged as best weed management treatment for controlling diverse weed flora and obtaining highest grain yield, and maximum economic returns in maize.

UAS, Dharwad

Atrazine + tembotrione (Tank-mix) (750 +120) g/ha as EPoE (15 DAS) reduced the weed density as well as weed dry matter at 20, 40 and 60 DAS (7.50; 4.60 & 6.04 /m^{-2} and 4.17; 4.56 & 1.57 g/m^{-2}, respectively), followed by the treatment atrazine + mesotrione (RM) 875 g/ha as PoE (20 DAS) (9.14; 5.47 & 7.33 /m^{-2} and 4.11; 6.06 & 6.97 g/m^{-2}, respectively). The treatment atrazine + tembotrione (Tank-mix) registered highest grain yield of 12.3 t/ha.

The treatment atrazine + tembotrione (Tank-mix) (750 +120) g/ha as EPoE (15 DAS) has appeared as an effective weed management treatment for minimizing weed problems and obtaining higher grain yield of maize.

Atrazine + Tembotrione (Tank-mix) (750 +120) g/ha as EPoE (15 DAS)

Effect of herbicides on weed dynamics and yield of maize-chickpea cropping system (2020-21)

SKUAST, Jammu

The lowest weed density was recorded in propaquizafop + imazethapyr 50 + 75 g/ha as PoE at 20-25 DAS, which was statistically *at par* with imazethapyr + pendimethalin (RM) 1000 g/ha as PE and topramezone 25.2 g/ha as PoE at 20-25 DAS. The significantly lowest

total weed biomass was recorded with propaquizafop + imazethapyr 50 + 75 g/ha as PoE at 20-25 DAS than other herbicidal treatments. The imazethapyr + pendimethalin (RM) 1000 g/ha as PE and topramezone 25.2 g/ha as PoE at 20-25 DAS had statistically similar response with respect to weed biomass at 60 DAS. Highest weed control efficiency was observed in propaquizafop + imazethapyr 50 + 75 g/ha as PoE at 20-25 DAS followed by topramezone 25.2 g/ha as PoE at 20-25 DAS and imazethapyr + pendimethalin (RM) 1000 g/ha as PE. The highest seed yield was observed in mechanical weeding at 20 and 40 DAS, which was statistically *at par* with imazethapyr + pendimethalin (RM) 1000 g/ha as PE and topramezone 25.2 g/ha as PoE at 20-25 DAS and significantly higher than other treatments. The propaquizafop + imazethapyr 50 + 75 g/ha as PoE (20-25 DAS) and fluazifop-p-butyl + fomesafen 250 g/ha PoE showed phytotoxicity to chickpea. Highest net returns and B:C were observed and imazethapyr + pendimethalin (RM) 1000 g/ha as PE followed by topramezone 25.2 g/ha as PoE at 20-25 DAS **(Table 1.1.16)**.

Imazethapyr + pendimethalin (RM) 1000 g/ha as PE and topramezone 25.2 g/ha as PoE at 20-25 DAS have been found as effective weed management treatments for controlling weeds, providing higher seed yield and better economic benefits of chickpea.

Table 1.1.16: Effect of the treatments on weed control efficiency, seed yield and economics of chickpea.

Treatments	WCE (%) at 60 DAS	Seed yield (kg/ha)	Net returns (Rs/ha)	B:C
Pendimethalin 678 g/ha as PE	65.12	689	18027	0.91
Oxyfluorfen 140 g/ha as PE	55.24	561	10805	0.54
Imazethapyr + pendimethalin (RM) 1000 g/ha as PE	86.77	764	21502	1.05
Pendimethalin 1000 g/ha *fb* quizalofop ethyl 50 g/ha as PoE at 20-25 DAS	79.68	704	16778	0.76
Pendimethalin 1000 g/ha *fb* propaquizafop 50 g/ha as PoE at 20-25 DAS	76.84	678	16315	0.78
Topramezone 25.2 g/ha as PoE at 20-25 DAS	89.40	769	19383	0.85
Propaquizafop + imazethapyr 50 + 75 g/ha as PoE at 20-25 DAS	96.39	438	3933	0.19
Fluazifop-p-butyl + fomesafen 125 g/ha as PoE at 20-25 DAS	38.70	455	5906	0.31
Fluazifop-p-butyl + fomesafen 250 g/ha as PoE at 20-25 DAS	54.17	475	6014	0.30
Mechanical weeding at 20 and 40 DAS	95.39	792	18010	0.70
Weedy	0.00	295	-1275	-0.07
SEm (±)		27	-	-
L.S.D (P=0.05)		79	-	-

Station trials

ST 1.1.1. Long-term herbicide trial in transplanted low land rice-blackgram cropping system

TNAU, Coimbatore

Among the treatments, higher grain yield of 7572 kg/ha was recorded with bensulfuron-methyl + pretilachlor 660 g/ha as PE *fb* bispyribac - sodium 25g/ha as PoE followed by with pyrazosulfuron- ethyl 20 g/ha as PE *fb* penoxsulam + cyhalofop butyl 135 g/ha as

PoE (7398 kg/ha). Higher net returns of Rs. 51351/ha and benefit cost ratio (2.02) was recorded with bensulfuron-methyl + pretilachlor 660 g/ha as PE *fb* bispyribac - sodium 25g/ha as PoE.

ST 1.1.2a. Management of blood grass (*Isachne miliacea)* in transplanted rice

KAU, Thrissur

Application of fenoxaprop-p-ethyl 120 g/ha at 25-30 DAT can be recommended as an effective management practice of *Isachne miliacea* in transplanted rice. It is important to note that as the herbicide is applied at a higher dose, a delayed application at 25-30 DAT only is recommended in order to avoid phytotoxicity to the crop plants and also to have sufficient spread of weed for the effective foliar action of the herbicide.

ST 1.1.2b. Soil residue analysis of cyhalofop butyl, penoxsulam, pendimethalin and butachlor in wetland rice fields

KAU, Thrissur

Two hours after herbicide spray (0 DAS), penoxsulam and butachlor in pre-mix penoxsulam + butachlor treated soil sample were detected in treated plots. As the sampling interval increased to 10 days and beyond, herbicide degradation occurred. This was clearly visible in case of butachlor, which showed a sharp decline from 4.35 ppm (O DAS) to 0.036 ppm (30 DAS). In case of pre-mix penoxsulam + pendimethalin, only pendimethalin was observed above detectable level after 2 hours and 10 days of spraying at 0.086 and 0.06 ppm, respectively. Residue levels of pre-mix penoxsulam + cyhalofop butyl were below quantification levels at all the sampling intervals. Residues of butachlor persisted upto 30 days (0.036 ppm), which was longer than all the other herbicides.

ST 1.1.3. Management of alien weed *Syngonium podophyllum* in the rubber plantation

KAU, Thrissur

The formulations of 2, 4 – D (Na salt and amine) 1000 g/ha was found to be effective in controlling the weed for a short period of up to 4- 6 months. As the vines are very hard, the regrowth could be observed and hence, integrated strategy of herbicide spray followed by removal and disposing in pits only can help in long term control. The other herbicidal treatments were not effective against this hardy weed. Mechanical removal is not a viable option as the milky sap causes itching and fragmentation results rapid vegetative spread of the weed. Making people aware of this problematic weed and ensuring community participation in eradication programmes through the integration of physical and chemical means can be recommended for its management.

ST 1.1.4. Weed management in rajmash

CSKHPKV, Palampur

Oxyfluorfen 150 g/ha + HW was *at par* with imazethapyr + HW resulted in significantly higher yield of rajmash. Oxyfluorfen 150 g/ha + HW was recorded as most effective weed management treatment in rajmash.

ST 1.1.5. Weed management in pea

CSKHPKV, Palampur

Pre-emergence application of imazethapyr 75 g/ha *fb* propaquizafop 50 g/ha as PoE resulted in 37.7% higher seed yield and 86.1% higher net returns due to weed control over the farmers' practice of hand weeding twice.

ST 1.1.6. Weed management in cluster bean

SKNAU, Jobner

Minimum weeds and maximum weed control efficiency were recorded in 2 HW, which was found *at par* with propaquizafop 2.5% + imazethapyr 3.75% w/w (RM) 125 g/ha at 2-3 leaf stage of weed. Seed and straw yields were recorded maximum in 2 HW, which was found *at par* with diclosulam 84% WDG (PE) 24 g/ha. Sulfentrazone 28% + clomozone 30

% WP (PE) 725g/ha showed phytotoxicity on clusterbean.

MPUAT, Udaipur

The maximum seed and haulm yields (2083 and 1874 kg/ha, respectively) of clusterbean was recorded with pyroxasulfone 85% WG (PE) 127 g/ha, which was *at par* with propaquizafop 2.5% + Imazethapyr 3.75% w/w (RM) 125 g/ha at 2-3 leaf stage of weed (1931 and 1738 kg/ha, respectively). Maximum net returns (Rs. 104061/ha) and B:C (3.92) were obtained with the application of pyroxasulfone 85% WG (PE) 127 g/ha. Application of fluazifop-p-butyl 13.4% + fomesafen 11.1 % EC (RM) 230 g/ha at 2-3 leaf stage of weed, sulfentrazone 28% + clomazone 30 % WP (PE) 25 g/ha, fomesafen 12% + quizalofop ethyl 3% SC (RM) 230 g/ha at 2-3 leaf stage of weed and diclosulam 84% WDG (PE) 24 g/ha followed by fomesafen 12% + quizalofop ethyl 3% SC (RM) 230 g/ha at 20- 25 DAS showed phyto-toxicity symptoms on crop plants and they didn't recover after some days.

ST 1.1.7. Weed management in Sesame

UAS, Bengaluru

Higher weed control efficiency (73.37% at 30 DAS) & lower weed index (24.00 %) was observed in pre-emergence application of pendimethalin 30 EC 750 g/ha over weedy check, which recorded 80.97% of weed index. Hence, pendimethalin 30 EC 750 g/ha as PE can be used for weed management in sesame. All the pre-emergence application of herbicides except pendimethalin 30 EC 750 g/ha and alachlor 50 EC 1000 g/ha and all the early post-emergence application of herbicides showed phyto-toxicity on crop plants.

ST 1.1.8. Weed management in groundnut

PDKV, Akola

For effective management of weeds and obtaining higher pod yield and economics, application of diclosulam as PE *fb* propaquizafop + imazethapyr 0.125 kg/ha as EPoE at 15 DAS has appeared as promising weed management treatment in groundnut.

ST 1.1.9. Integrated weed management in cotton based inter cropping system

PJTSAU, Hyderabad

The seed cotton yield obtained in sole cotton was significantly superior to that obtained in intercropping. It was significantly reduced in cotton+sesame intercropping. While the reduction was only 19.0% in cotton+dhaincha and 23% in cotton+soybean. Among the weed management treatments, highest seed cotton yield was obtained with IWM (PE herbicide *fb* intercultivation at 30 & 45 DAS). Herbicides and HW/MW were inferior and were *at par* with each other. The germination and growth of the sesame was less due to heavy rains. Hence, lower yield levels were noticed. Similarly, soybean also suffered due to heavy and continuous rains. Hence, the yield levels were low. Relatively higher yield of soybean was recorded in herbicides treatment.

PAJANCOA&RI, Puducherry

Field study revealed that cotton+ greengram intercropping system or sole cotton with herbicidal management of weeds (pendimethalin 38.7 CS 640 g/ha as PE *fb* quizalofop ethyl 10 EC 45 g/ha as PoE at 25 DAS) resulted in higher seed cotton yield in coastal deltaic region of Karaikal, Puducherry UT.

ST 1.1.10. Integrated weed management in *Kharif* groundnut

AAU, Anand

Maximum net returns was recorded under application of pendimethalin 30 EC 750 g/ha *fb* IC + HW at 40 DAS (Rs. 71422/ha) along with higher benefit cost ratio of 1.79.

ST 1.1.11. Efficacy of herbicides against diverse weed flora of barley

SKNAU, Jobner

Maximum grain yield, and straw yield

and minimum weeds were recorded in weed free treatment, which were found *at par* with post-emergence tank-mix application of pyroxasulfone + metsulfuron 127.5 + 4 g/ha and post-emergence application of pyroxasulfone 127.5 g/ha in barley.

ST 1.1.12. Efficacy of herbicide against diverse weed flora in mustard

SKNAU, Jobner

Maximum seed & stover yields and minimum weeds were recorded in weed free treatment, which were found *at par* with pre-emergence application of pendimethalin 750 g/ha *fb* 1HW and pre-emergence application of pendimethalin 750 g/ha in mustard.

ST 1.1.13. Efficacy of new herbicides in managing broad spectrum weed flora in groundnut

SKNAU, Jobner

Seed and straw yields were recorded maximum in 2 HW, which were found *at par* with diclosulam 84% WDG as PE 24 g/ha. Sulfentrazone 28% + clomazone 30 % WP as PE 725 g/ha showed phytotoxicity on groundnut crop.

ST 1.1.14. Weed management in greengram

CCSHAU, Hisar

Sequential application of pendimethalin + imazethapyr 1000 g/ha (RM) as PE *fb* propaquizafop + imazethapyr (RM) 50 + 75 g/ha as PoE or pendimethalin + imazethapyr 1000 g/ha (RM) as PE *fb* fluazifop-p-butyl + fomesafen (RM) 250 g/ha as PoE have higher weed control efficiency than alone application of either as pre-emergence or post-emergence in greengram.

ST 1.1.15. Evaluation of pre-and post-emergence herbicides in prosomillet and kodo millet

ANGRAU, Guntur

The treatment comprising hand weeding twice at 20 and 40 DAS recorded highest grain yield of 910 kg/ha with highest B:C (1.36). These (Grain yield of 875 kg/ha and B:C of 1.31) were closely followed by the herbicidal treatment atrazine 0.75 kg/ha as PE in prosomillet. In case of kodomillet highest grain yield of 1592 kg/ha and B:C of 2.23 were obtained in 2 HW at 20 and 40 DAS and the values (Grain yield of 1505 kg/ha and B:C of 2.11) were closely followed by the treatment bispyribac sodium 25 g/ha as PoE at 20 DAS.

ST 1.1.16. Competitive ability of *Parthenium* against direct sown rice

PAJNCOA&RI, Puducherry

The study indicated that *Parthenium* was found to reduce the plant height of rice at 60 DAS. Likewise, the rice was found to reduce the plant height of *Parthenium* to 2:2 and *Parthenium* was found to reduce the plant height of rice to 1:3 and 3:1 at 90 DAS and also at harvest. The study also indicated that *Parthenium* was found to reduce the length of roots in rice at harvest. *Parthenium* root was higher in 1:3 since no competition for *Parthenium*. However, the length of the roots got reduced in 2:2 since competition among *Parthenium* as well rice and 4:0 since competition among *Parthenium*. In 3:1, the root length of *Parthenium* was higher than all other *Parthenium* and the root length of rice was reduced compared to all other rice plants.

Station trials (2021-22)

Long-term herbicide trial in transplanted lowland rice-rice cropping system

TNAU, Coimbatore

Among the weed management treatments, bensulfuron-methyl + pretilachlor 660 g/ha as PE *fb* bispyribac sodium (10% EC) 25 g/ha as PoE has emerged as an effective weed management treatment in transplanted rice-rice cropping system during *Rabi* season.

CSKHPKV, Palampur

Integrated weed management in blackgram under high hills wet temperate zone of Himachal Pradesh

The treatments constituting of oxyfluorfen 150 g/ha were toxic to blackgram. Pendimethalin 1000 g/ha + imazethapyr 75 g/ha (PE) resulted in highest seed yield, net returns and MBCR followed by imazethapyr 75 g/ha as PE *fb* HW 30 DAS and pendimethalin 1000 g/ha as PE *fb* HW 30 DAS.

Evaluation of herbicide combinations for the management of complex weed flora in direct-seeded rice (*Oryza sativa* L.)

Pretilachlor *fb* bispyribac-sodium, bispyribac-sodium *fb* HW at 45 DAS, penoxsulam + cyhalofop-butyl (Pre-mix) *fb* HW at 45 DAS, triafamone+ethoxysulfuron (Pre-mix) *fb* mechanical weeding at 45 DAS and pretilachlor + pyrazosulfuron-ethyl (Pre-mix) *fb* HW at 30 DAS reduced the weed pressure effectively in DSR.

PAU, Ludhiana

Dissipation mesosulfuron and iodosulfuron in soil and *Phalaris minor*

The concentration of mesosulfuron methyl and iodosulfuron methyl sodium in both Resistant and Sensitive populations peaked at 24 hour (1 day) after treatment and decreased slowly over successive days. The initial residues (24 hours after spray) of mesosulfuron methyl in resistant biotypes varied from 2.366 ± 3.24 to 4.878 ± 2.35 µg/g while for sensitive biotypes residues varied from 3.121 ± 4.21 to 4.223 ± 2.65 µg/g. However, for iodosulfuron methyl sodium initial residues varied from 0.177 ± 3.77 to 2.767 ± 3.22 µg/g in resistant biotypes and 1.433 ± 2.32 to 3.345 ± 2.333 µg/g in sensitive biotypes. The concentration of mesosulfuron methyl and iodosulfuron methyl sodium in the R biotypes decreased sharply and was lower than in the S populations at all sampling intervals. Mesosulfuron methyl and iodosulfuron methyl sodium could not degrade completely and residues were still present in S biotypes at 45 DAA while the residues were below detectable limit in R biotypes at 45 DAA.

Degradation of safener mefenpyr diethyl in soil

Mefenpyr (metabolite of mefenpyr diethyl) appeared at 3 day and persisted up to 15 days at lower application rate of herbicides *i.e.*, 14.4 and 28.8 g/ha while it persisted up to 21 days at higher application rates of herbicides i.e., 43.2 and 57.6 g/ha.

PDKV, Akola

Weed management in groundnut

For effective management of weeds and obtaining higher pod yield and economics, application of diclosulam as PE *fb* propaquizafop + imazethapyr 0.125 kg/ha as EPoE at 15 DAS has appeared as promising weed management treatment in groundnut.

MPUAT, Udaipur

Integrated weed management in groundnut-wheat cropping system

The maximum net returns (Rs. 85661 / ha) and B:C (2.78) were recorded in the treatment carfentrazone-ethyl+sulfosulfuron 50 g/ha as PoE at 35 DAS in wheat.

Studies on weed management in Dil (*Trigonella foenum-graecum* L.)

Amongst the treatments, maximum seed yield (1188 kg/ha) was obtained by controlling weeds through IC *fb* HW at 20 & 40 DAS, which was *at par* with oxadiargyl 75 g/ha as PE *fb* HW at 40 DAS (1,161 kg/ha) and oxadiargyl 100 g/ha as PE (1,138 kg/ha). The highest net returns (Rs. 60256/ha) and B:C (2.07) were realized with application of oxadiargyl 100 g/ha as PE.

UAS, Bengaluru

Evaluation of herbicides against weed complex of Field bean (*Rabi)*

From the preliminary screening of the pre-emergence herbicides diclosulam 84 % WDG at 26 g/ha and pendimethalin 38.7 CS 1000 g/ha and among the early post-emergence herbicides imazethapyr 10 SL + surfactant 75

g /ha can be recommended for controlling weeds effectively in field bean. Though fluazifop–p-butyl 11.1% + fomesafen 11.1SL 250 g/ha was found effective in controlling weeds; however, due to phyto-toxicity these herbicides cannot be recommended. From the preliminary screening of the pre-emergence herbicides diclosulum 84% WDG at 26 g/ha and pendimethalin 38.7 CS 1000 g/ha were found to be effective both in turns of controlling weeds and yield. Among post-emergence herbicides Imazethapyr 10 SL + surfactant -EPOE 75g/ ha was found to be effective in controlling weeds. These herbicides can be recommended for controlling weeds effectively in field bean.

PDKV, Akola

Effect of pre and post-emergence herbicides on onion

Among the weed control treatments, pre-emergence application of pendimethalin+ oxyfluorfen 0.541+0.092 kg/ha recorded significantly higher bulb yield excepting application of oxadirgyl 0.090 kg/ha and pendimethalin 0.677 kg/ha before transplanting due to better control of weeds. For effective weed management, bulb yield and higher monetary returns in onion pre-emergence application of pendimethalin + oxyfluorfen 0.541 + 0.092 kg/ha at (0-5 DAT) has been found effective.

OUAT, Bhubaneswar

Weed management with new generation herbicides in maize (sweet corn) in maize – blackgram cropping system *Rabi* 2021-22

The highest seed yield (866 kg/ha) was recorded in fluazifop-p-butyl + fomesafen (RM) 125 g/ha treatment, which remained *at par* with pendimethalin 1.0 kg/ha as PE *fb* quazalofop-ethyl 50 g/ha as PoE (835 kg/ha) and pendimethalin 1.0 kg/ha as PE *fb* propaquizafop 50 g/ha as PoE (840 kg/ha). These three treatments were found significantly superior to rest of the treatments in blackgram.

Weed management in greengram with new generation herbicides

Among different weed management treatments, application of fluazifop-p-butyl + fomesafen (RM) 125g/ha as PoE recorded minimum total weed count and maximum seed yield (866 kg/ha) with highest B:C (2.46). The highest net returns (Rs. 40702/ha) was obtained with application of fluazifop-p-butyl + fomesafen (RM) 125 g/ha as PoE. Hence, one single application of fluazifop-p-butyl + fomesafen (RM) 125 g/ha as PoE can be recommended for the control of complex weed flora and thereby realizing the highest yield of greengram.

Weed management and fertility levels on growth, yield and soil health in okra – groundnut cropping system

Among fertility levels, application of 50% RDF along with 50% N through FYM significantly reduced the weed population and dry matter accumulation in comparison to other treatments. Addition of nutrients through chemical means invited the weed population significantly. Application of pendimethalin as PE 0.75 kg/ha significantly increased the pod yield and economics in comparison to other treatments.

CCSHAU, Hisar

Weed management in onion

Application of oxyfluorfen (150 g/ha) *fb* clodinafop + oxyfluorfen (Tank-mix) (60 +120 g/ha) resulted in 68.5% higher bulb yield as compared to weedy check treatment.

Management of problematic weed *Cuscuta campestris* and *Coronopus didymus* in berseem (*Trifolium alexandrinum* L.) and residual behaviour of herbicides on succeeding crop

Among herbicides, the forage yield was maximum (522 q/ha) with the use of imazethapyr 70 g/ha at 15 DAS and *fb* after 2nd cutting, which was at par with imazethapyr

70 g/ha at 15 DAS and *fb* after 3rd cutting followed by imazethapyr 70 g/ha at 30 DAS and *fb* after 2nd cutting.

AAU, Anand

Chemical and non-chemical approach for weed management in turmeric

Among the herbicidal treatments, application of atrazine 50 WP 500 g/ha + pendimethalin 30 EC 500 g/ha (Tank-mix) as PE *fb* paddy straw mulch 5 t/ha (0-3 DAP) *fb* HW at 75 DAP recorded significantly higher rhizome yield (22.6 t/ha) but it was *at par* with application of metribuzin 70% WP 750 g/ha PE *fb* paddy straw mulch 5 t/ha (0-3 DAP) *fb* HW at 75 DAP which recorded 22.1 t/ha rhizome yield.

Integrated weed management in *Rabi* maize

Grain yield of maize was recorded significantly higher (8.58 t/ha) under mechanical weeding carried out at 20 and 40 DAS and it was closely followed by the treatment topramezone 336 g/l w/v SC 25.2 g/ha as PoE (8.51 t/ha). Maximum net returns of Rs. 93173/ha and benefit cost ratio of 2.12 were recorded under topramezone 336 g/l w/v SC 25.2 g/ha as PoE.

Weed management in onion nursery

Pendimethalin 38.7 CS as PPI and pendimethalin 30 EC as PE showed wilting symptoms at 7 DAHA but at 14 DAHA it recovered. Whereas, oxyfluorfen 23.5 EC as PE and EPoE showed leaf injury and necrosis symptoms on onion seedlings up to 14 DAHA. Further, application of oxyfluorfen 23.5 EC 80 g/ha as EPoE and propaquizafop 5% + oxyfluorfen 12% w/w EC (Ready-mix) 43.75 + 105 g/ha as EPoE showed slight toxicity up to 7 DAHP and later on the seedlings were recovered from the toxicity. Maximum net returns of Rs. 2,24,230/ha and benefit cost ratio of 12.4 were recorded under propaquizafop 5% + oxyfluorfen 12% w/w EC (PM) 43.75 + 105 g/ha as EPoE. On the basis of two years of experimentation, it can be concluded that for obtaining healthy transplantable onion seedlings, effective management of weeds and net returns, application of propaquizafop 5% + oxyfluorfen 12% w/w EC (PM) 43.75 + 105 g/ha as EPoE, oxyfluorfen 23.5% EC 80 g/ha as EPoE, pendimethalin 30% EC 300 g/ha as PE and twice hand weeding at 15 and 30 DAS were found very much effective.

Weed management in onion

On the basis of two years of experimentation, it can be concluded that for obtaining higher onion bulb yield, effective management of weeds and net returns, application of pendimethalin 38.7 CS 580.5 g/ha as PPI, propaquizafop 5% + oxyfluorfen 12% w/w EC (Ready-mix) 43.75 +105 g/ha as PoE, pendimethalin 38.7 CS 580.5 g/ha as PPI *fb* oxyfluorfen 23.5% EC 120 g/ha as PoE, oxyfluorfen 23.5% EC 120 g/ha as PE *fb* propaquizafop 5% + oxyfluorfen 12% w/w EC (PM) 43.75 +105 g/ha as PoE and 2HW at 20 and 40 DAT were found effective.

Weed management in dry direct-seeded rice under irrigated condition (Collaboration with RRS)

It can be concluded that 2HW at 20 and 40 DAS, application of pretilachlor 30% + pyrazosulfuron-ethyl 0.75% WG 600+15 g/ha as PE (Ready-mix) *fb* HW at 30 DAS, triafamone 20% + ethoxysulfuron 10% WG 44.0+22.5 g/ha as PoE (PM) *fb* HW at 30 DAS and penoxsulam 1.02% + cyhalofop-butyl 5.1% OD 120 g/ha as EPoE (PM) *fb* HW at 30 DAS were found effective for the management of complex weed flora in dry direct-seeded rice under middle Gujarat condition with higher net returns and B:C.

BCKV, Kalyani

Identification of suitable weed management strategy in lentil under rainfed situation

Among all the treatments mechanical weeding by hand grubber at 20 DAS and 40

DAS recorded highest seed yield (1762 kg/ha). However, net returns was highest in the herbicidal treatment pendimethalin 30 EC 1000 g/ha as PE at 3 DAS *fb* quizalofop-ethyl 5 EC 50 g/ha as PoE at 25 DAS (Rs. 59544/ha).

Study on weed dynamics and weed management strategies in rice-wheat-green manure cropping system under new alluvial soils

Among the herbicidal treatments, highest grain yield of wheat (48.5 q/ha) was recorded with pendimethalin 1000 g/ha as PE *fb* metribuzin 200 g/ha as PoE at 25 DAS.

SKUAST, Jammu

Effect of different weed management practices in marigold

(Collaboration with Division of Vegetable & Floriculture, SKUAST-Jammu)

The highest flower yield of marigold (13.22 t/ha) was recorded in mechanical weeding at 20 & 40 DAS, which was statistically *at par* with pendimethalin 1.5 kg/ha as PE *fb* 1HW (13.00 t/ha), oxyfluorfen 200 g/ha as PE *fb* 1HW and quizalofop ethyl 50 g/ ha as PoE *fb* 1HW. The highest net returns (Rs. 167940/ ha) and B: C (1.74) were obtained in mechanical weeding at 20 & 40 DAS followed by pendimethalin 1.5 kg/ha as PE *fb* 1HW (Net returns of Rs. 161415/ha and B:C of 1.64).

Study of weed flora and their management through herbicides in rice grown under different establishment methods.

Irrespective of crop establishment, weed density and weed dry weight were significantly reduced at 60 DAS/DAT with penoxsulam (22.5 g/ha), metsulfuron-methyl 10%+chlorimuron-ethyl 10% + 0.2% surfactant (4 g/ha) and bis-pyribac sodium used as PoE (25 DAS/DAT), resulted in 89% weed control efficiency. Significantly higher grain yield was recorded with all the PoE herbicides i.e. penoxsulam (22.5 g/ha), metsulfuron-methyl 10%+ chlorimuron-ethyl 10% + 0.2% surfactant (4 g/ha) and bis-pyribac sodium, which also recorded lowest WI (3.8 to 5.7%).

SKUAST, Kashmir

Bio-efficacy of post-emergence herbicides for weed management in wheat under temperate condition of Kashmir valley

Application of clodinafop 60 g/ha at 140 DAS *fb* metsulfuron 4 g/ha at 160 DAS or 2,4-D 500 g/ha at 160 DAS or 3 HW at 35, 140 and 160 DAS were at par to weed free treatment with respect to wheat grain yield and weed dry matter.

Weed management practices in vegetable peas under temperate conditions of Kashmir

Pendimethalin 1000 g/ha as PE *fb* imazethapyr 75, 100 & 125 g/ha as PoE were *at par* to weed free treatment with respect to pod yield of vegetable pea.

Response of maize to weed management practices under temperate Kashmir condition.

The application of herbicides as PE (pendimethalin or atrazine) *fb* tembotrione (120 g/ha at 25 DAS) as PoE recorded maximum value of weed control efficiency (86 - 87%) next to weed free plots (96%) and minimum weed index value (Less than 10%).

UAS, Dharwad

Development of herbicide tolerant Mycorrhizal and Plant growth promoting phylloplane bacteria biofertlizers:

Among the 58 native AM fungal isolates, three native AM fungal isolates *viz.*, AMFHT-17, AMFHT-23 and AMFHT-54 were tolerant to all the five herbicides screened *viz.*, glyphosate 71% EC (PoE); pendimethalin 30% EC (PE); diclosulum 84% WDG (PE); imazethapyr 10% SL (PoE) and haloxyfop-R-methyl 10.5% EC (PoE) at recommended (x) as well as higher the dosage of herbicide (2x) with a spore germination percentage ranging from 90.0 to 95 per cent. Among the 80 isolates screened, PPFM-1, PPFM-27, PPFM-31, and

PPFM-59 were tolerant to all the ten herbicides *viz.*, glyphosate 71%EC (POE), tembotrione 42%SC (POE), 2,4D 80%EC (POE), topramezone 33.6% SC (EPOE), atarzine 50%WP (PE), pendimethalin 30% EC (PE), imazethapyr 10% SL (POE), diclosulam 84% WDG (PE), haloxyfop-R-methyl 9.3% EC (POE) and fenoxyprop-P-ethyl 9.3% EC (PoE) at both recommended (x) as well as higher concentrations (2x).

BAUT, Banda

Studies on herbicidal effect of imazethapyr and its ready-mix with imazamox and pendimethalin against weeds in blackgram and their residual effect on succeeding mustard crop

(Residual effect on succeeding mustard crop)

Significantly lower seed yield of mustard was obtained when imazethapyr applied alone or in combination with imazamox as pre or post-emergence application in blackgram. Seed yield of mustard obtained from treatment imazethypyr + pendimethalin (Ready-mix) 1000 g/ha PE applied in blackgram was comparatively higher than other herbicidal treatments.

WP 1.2 Weed management under conservation tillage- based systems

WP 1.2.1 Weed management in rice-wheat-legume cropping system under conservation tillage

Objectives

- To monitor weed dynamics, crop productivity, resource use efficiency and herbicide residues under long-term tillage and residue management practices
- To study C-sequestration and changes in physico-chemical and biological properties of soil

Cooperating centers:

SKUAST; Jammu; CCSHAU, Hisar; GBPUAT, Pantnagar; PAU, Ludhiana; IGKVV, Raipur; BCKV, Kalyani; OUAT, Bhubaneswar and CSKHPKV, Palampur

Treatment	Rice (DSR)	Wheat	Greengram/green manure
Mainplot	**Tillage**		
	CT	CT	CT
	CT+R	CT+R	CT+R
	ZT	ZT	ZT
	ZT+R	ZT+R	ZT+R
Subplot	**Weed management**		
Herbicide rotation	1st year: Pendimethalin 678 g/ha (2 DAS) *fb* bispyribac sodium 25 g/ha (20 DAS) 2nd year: Pretilachlor + pyrazosulfuron 615 g/ha (2 DAS) *fb* cyhalofop+ penoxsulam 135 g/ha (20 DAS) 3rd year: Pendimethalin+pyrazosulfuron 920 g/ha (2 DAS) *fb* triafamone+ethoxysulfuron 67.5 g/ha (20 DAS)	1st year: Clodinafop + metsulfuron 64 g/ha (30 DAS) 2nd year: Mesosulfuron + iodosulfuron 14.4 g/ha (30 DAS) 3rd year: Pinoxaden + carfentrazone 40 + 20 g/ha or Sulfosulfuron + metsulfuron 32 g/ha (30 DAS)	1st year: Pendimethalin + imazethapyr 1.0 kg/ha (2 DAS) 2nd year: Imazethapyr 100 g/ha (20 DAS) 3rd year: Pendimethalin 678 g/ha (2 DAS)
IWM	Pendimethalin 678 g/ha (2 DAS) *fb* bispyribac sodium 25 g/ha (20 DAS) *fb* hand weeding (40 DAS) *fb* weed seed harvest	Clodinafop+ metsulfuron 64 g/ha (30 DAS) *fb* HW (45 DAS)	Pendimethalin 678 g/ha (2 DAS) *fb* hand weeding (30 DAS)
Unweeded check	Partially weedy (weeds removed after critical period)	Partially weedy (weeds removed after critical period)	Partially weedy (weeds removed after critical period)

DSR: direct-seeded rice; CT- Conventional tillage, ZT- Zero tillage, R- previous crop residue, *fb*- followed by

SKUAST, Jammu

In wheat during 2021-22, the study area comprised weed flora such as *Phalaris minor*, *Rumex* spp., *Anagallis arvesnsis*, *Medicago* spp., *Ranunculus arvensis*, *Melilotus* spp., and other weeds like *Vicia* spp. Among the tillage and residue management treatments, significantly lower grassy weed, broad-leaf weeds (BLWs), total weed density, and weed dry weight were recorded in ZT (DSR)/ZT (DSR) + R - ZT (wheat) + R plots as compared to CT (wheat) and ZT (wheat). The density of *Phalaris minor*, *Rumex* spp., *Ranunculus arvensis*, *Anagallis arvesnsis*, *Melilotus* spp., and other weeds were significantly lower in ZT (DSR)/ZT (DSR) + R - ZT (wheat) + R plots as compared to CT (transplanted rice) - CT (wheat), CT (transplanted rice) – ZT (wheat) and CT (DSR) - CT (wheat). However, the significantly lower density of *Medicago* spp. was observed in CT (transplanted rice)-CT (wheat) as compared to ZT (DSR)/ZT (DSR) + R - ZT (wheat) + R and CT (transplanted rice) - ZT (wheat) and it was statistically at par with CT (DSR) - CT (wheat) The highest grain yield was recorded in ZT (DSR) + R – ZT (wheat) + R which were significantly higher than CT (transplanted rice) - ZT (wheat) without residue. The highest B:

C was also recorded in ZT (DSR) + R – ZT (wheat) + R (**Table 1.2.1**).

At 60 DAS, among weed management practices, all weed management treatments recorded significantly lower weed density and weed dry weight as compared to the weedy check. The integrated weed management (IWM, sulfosulfuron + metsulfuron 30+2 g/ha at 30 DAS *fb* HW at 45 DAS) recorded significantly lowest density and dry weight of weeds as compared to weedy check and herbicidal treatment (sulfosulfuron + metsulfuron 30+2 g/ha at 30 DAS). Significant interactions were found between tillage and weed management practices to weed density and weed dry weight. Adoption of IWM recorded significantly higher grain yield of wheat as compared to weedy check and herbicidal treatment. The highest B: C was recorded in IWM. A non-significant interaction was found between tillage and weed management treatments to growth, yield attributes, and yield of wheat.

Table 1.2.1: Effect of tillage and weed management practices on weed dry weight and WCE at 60 DAS of wheat (*Rabi* 2021-22).

Treatments	Weed dry weight (g/m²) at 60 DAS			WCE (%) at 60 DAS	Grain yield (t/ha)	Net returns (Rs./ha)	B: C
	Grassy	BLWs	Total				
Tillage and residue management							
1 (TRM 1)	5.63 (30.73)	6.65 (43.24)	8.66 (73.97)	57.70	3.72	46939	1.53
2 (TRM 2)	4.72 (21.26)	7.60 (56.80)	8.89 (78.06)	58.31	3.57	47958	1.80
3 (TRM 3)	5.19 (25.93)	6.39 (39.90)	8.17 (65.83)	57.50	3.91	50831	1.66
4 (TRM 4)	3.00 (8.01)	5.18 (25.87)	5.91 (33.88)	61.76	4.23	62357	2.44
5 (TRM 5)	2.97 (7.80)	5.11 (25.11)	5.82 (32.91)	61.88	4.31	64035	2.51
SEm ±	0.05	0.10	0.08	-	0.11		
LSD (p=0.05)	0.15	0.33	0.27	-	0.36		
Weed management							
Herbicide (W1)	3.30 (9.92)	4.25 (17.05)	5.29 (26.97)	81.72	4.25	60972	2.26
IWM (W 2)	1.86 (2.45)	1.99 (2.98)	2.54 (5.43)	96.57	4.65	66651	2.27
Weedy (W 3)	6.70 (43.87)	9.77 (94.52)	11.81 (138.39)	0.00	2.94	35649	1.43
SEm ±	0.06	0.06	0.07	-	0.07	-	-
LSD (p=0.05)	0.18	0.17	0.20	-	0.21	-	-
Interaction	S	S	S	-	NS	-	-

Data were subjected to square root transformation " X+1". Original values are in parenthesis

During *Kharif* 2022 in rice, the study area comprised *Echinochloa* spp., and *Digitaria sanguinalis* amongst grassy weeds; *Caesulia axillaris* and *Physalis minima* amongst BLWs and *Cyperus* spp. Other weeds like *Commelina benghalensis*, *Alternanthera philoxeroides*, *Phyllanthus niruri*, and *Cucumis* spp. were also recorded.

At 60 DAS, total weed density and dry weight were significantly ($p<0.05$) influenced by tillage and residue management practices. The lowest total weed density and weed dry weight were recorded in CT + R than other treatments. Growth parameters and yield attributes along with yield were non-significant, but a better response was recorded with CT + R followed by ZT + R. However, economic parameters like net returns and B: C was more with ZT + R.

Among weed management practices, lower weed density and dry weight were observed in IWM [pendimethalin 678 g/ha *fb* bispyribac sodium 25 g/ha (20 DAS) *fb* hand weeding (40 DAS) *fb* weed seed harvest] than herbicide alone and weedy check. Adoption of weed management practices enhances the growth parameters and yield attributes of rice resulting in higher grain and straw yield. Imposition of IWM had recorded with the highest followed by herbicides alone and the lowest with a weedy check (**Table 1.2.2**).

Table 1.2.2: Effect of tillage and weed management on growth yield economics parameters in DSR (*Kharif* 2022).

Treatments		Total weed density at 60 DAS (no./m²)	Total weed dry weight at 60 DAS (g/m²)	Grain yield (t/ha)	Straw yield (t/ha)	B: C
1.	CT	7.15 (50.11)	6.44 (40.43)	3.33	4.65	1.85
2.	CT+R	6.51 (41.33)	5.91 (33.91)	3.54	4.97	2.04
3.	ZT	7.37 (53.33)	6.73 (44.25)	3.28	4.64	2.20
4.	ZT+R	6.81(45.33)	6.29 (38.52)	3.46	4.85	2.39
SEm ±		0.08	0.08	0.08	0.10	
L.S.D (p=0.05)		0.27	0.27	NS	NS	
Weed management						
1.	HR: Pendimethalin 678 g/ha *fb* bispyribac-sodium 25 g/ha at 20 DAS	4.92 (23.25)	4.89 (22.93)	3.69	5.26	2.41
2.	IWM: Pendimethalin 678 g/ha *fb* bispyribac-sodium 25 g/ha at 20 DAS *fb* HW at 40 DAS *fb* weed seed harvest	2.48 (5.17)	1.85 (2.41)	4.26	5.85	2.48
3.	Unweeded check	10.73 (114.17)	9.67 (92.48)	2.26	3.21	1.47
SEm ±		0.09	0.09	0.08	0.13	
L.S.D (p=0.05)		0.28	0.26	0.25	0.38	

Data were subjected to square root transformation " X+1". Original values are in parenthesis

CCSHAU, Hisar

In wheat during 2021-22, the higher weed density (69/m²) and weed dry weight (43.4 g/m²) of *Phalaris minor* was recorded in CT as compared to ZT conditions with density (15.5-20.5/m²) and dry weight (16.6-29.8 g/m²).

While, higher density and dry weight of *Rumex dentatus* and *Medicago denticulata* were observed in ZT conditions with dry weight 14-21.5 and 10-16.9 g/m^2 as compared to CT with 5.5 and 3.5 g/m^2, respectively under unweeded conditions. Significantly higher grain yield was recorded under with and without waste decomposer under ZT with retention of full unchopped rice residue (4891-4950 kg/ha) than ZT anchored wheat (4280 kg/ha) and CT wheat (3740 kg/ha) (**Table 1.2.3**). Higher reduction in grain yield under CT wheat was associated with more infestation of weeds especially *Phalaris minor* in wheat under weedy scenario and heat stress scenario.

Table 1.2.3: Effect of tillage, rice residue and weed management practices on yield and yield attributes of wheat.

Treatments	Plant height (cm)	Effective tillers/ m.r.l	Grain yield (kg/ha)
ZTW + Full Residue (Happy seeder) + WD	99.6	87	5238
ZTW + Full Residue (Happy seeder)	98.8	84	5264
ZTW + Partial Residue (Happy seeder)	99.4	84	5113
ZTW + Residue Removal (Happy seeder)	98.3	79	4714
CTW (Drill sown)	96.2	74	4244
CD 5%	1.5	8.2	256
Integrated weed management	97.8	88	5655
Recommended herbicides	98.5	86	5633
Weedy check	99.0	70	3456
CD 5%	NS	3.7	137

Soil temperature under ZT was less as compared to CT at 9.00 am and 2.00 pm, however, the difference was less in the morning hours than afternoon (**Figure 1.2.1**).

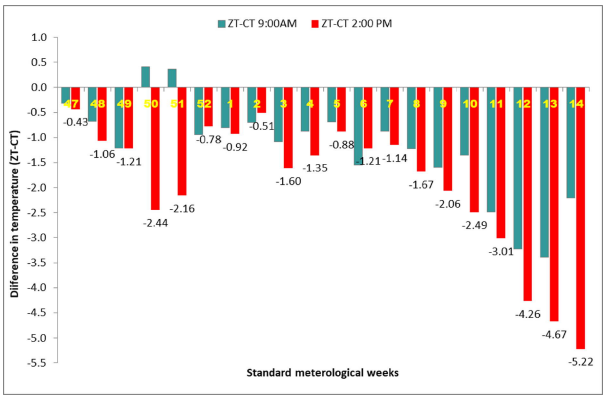


Fig. 1.2.1. Deviation in soil temperature (9:00 am and 2:00 pm) under zero tillage (mean values of all ZT treatments) in comparison to conventional tillage in wheat with respect to standard meteorological weeks (47-14 SMW)

During *Kharif* 2022, tillage and residue management and weed management practices did not influence yield attributes and rice grain yield. There was only *Echinochloa crus-galli* in the plots which was later controlled by the post-emergence application of bispyribac sodium (25 g/ha) for all subplots treatments including farmers' practice (pendimethalin 1000 g/ha as PE *fb* bispyribac sodium 25 g/ha as PoE). It was also noted that the application of pendimethalin 38.7% CS at 678 g/ha under IWM and HR showed poor efficacy in controlling *Echinochloa crus-galli* (5.9-7.2 g/m^2) as compared to Farmers' practices i.e. pendimethalin 1000 g/ha with weed dry weight (2.1 g/m^2) (**Table 1.2.4**).

Table 1.2.4: Effect of tillage and weed control treatments on weed infestation and rice grain yield (*Kharif* 2022).

Treatments	*Echinochloa crus-galli* (before spray of PoE)		Plant height (cm) (at harvest)	Grain yield (kg/ha)
Main plot	No./m^2	g/m^2		
CT	5.6 (32.4)	5.1	60	4757
CT+R	5.4 (29.5)	5.1	57	4827
ZT+R	5.2 (26.2)	4.5	58	4830
ZT	5.6 (33.1)	5.6	59	4893
CD(*P=0.05*)	NS	NS	NS	NS
Sub plot				
IWM	6.1 (36.7)	5.9	58	4816
HR	5.9 (35.3)	7.2	59	4748
FP	4.4 (19.0)	2.1	59	4917
CD(*P=0.05*)	0.6	2.2	NS	NS

GBPUAT, Pantnagar

In *Rabi* 2021-22, major weeds under weedy situation were recorded as *Phalaris minor* (17.7%), *Melilotus indica* (23.8%), *Medicago denticulata* (16.4%), *Rumex acetosella* (15.6%) and *Melilotus alba* (15.0%) at 60 DAS. Other weeds like, *Chenopodium album*, *Coronopus didymus*, *Fumaria parviflora*, *Solanum nigrum*, *Vicia sativa* and were also recorded at this stage, however, they have minimal contributed to the total weed density.

Among establishment methods, DSR + RC- ZT + RR- Sesbania (Inc) recorded a significantly lower density of *Phalaris minor* than the other treatments. Among BLWs, *Chenopodium album*, *Fumaria parviflora*, *Melilotus alba* and *Vicia sativa* were completely controlled with TPR + RC - ZTW + RR - Sesbania (Inc) and DSR + RC - ZT + RR - Sesbania (Inc). The lowest density of *Solanum nigrum* was recorded with only DSR + RC - ZT + RR - Sesbania (Inc). The density of *Rumex acetosella* and *Coronopus didymus* was significantly suppressed with DSR - CT among all the establishment methods. The density of *Medicago denticulata* and *Melilotus indica* was significantly suppressed with TPR + RC - ZT + RR - Sesbania (Inc). The interaction effects of the establishment methods and weed management practices on total weed density of grassy and broadleaf weeds had been found significant at 60 DAS. Yield attributing characters and yields of wheat were attained highest with DSR + RC- ZT + RR - Sesbania (Inc). The highest grain yield (5.3 t/ha) and straw yield (7.9 t/ha) were achieved with DSR + RC – ZT + RR-Sesbania (Inc) followed by DSR + RC – CT + R - Sesbania (Inc). Similarly, the highest net returns (Rs. 1.15.304/ha) and benefit-cost ratio (4.1) were recorded in the plots imposed with DSR + RC- ZT + RR - Sesbania (Inc) **(Table 1.2.5).**

Among weed management practices, *Chenopodium album*, *Medicago denticulata*, *Fumaria parviflora*, *Melilotus alba*, and *Vicia sativa* were completely controlled with both the recommended herbicides (clodinafop propargyl + metsulfuron methyl 60+4 g/ha PoE) and IWM (Rec. herbicide *fb* one hand weeding at 60 DAS) practices. However, *Phalaris minor*, *Coronopus didymus*, *Solanum nigrum*, and *Melilotus indica* were completely controlled with IWM practices, which also recorded the lowest density of *Rumex acetosella*. Yield and yield attributing characters of wheat

were highest with IWM with grain yield (5.0 t/ha) and straw yield (7.5 t/ha) as compared to the rest of the weed management practices. Likewise, IWM also recorded the highest net returns (Rs. 99691/ha) but the highest benefit-cost ratio (3.5) was recorded with RH.

Table 1.2.5: Effect of crop establishment methods and weed management on yield attributes, yield and economic parameters of wheat under rice-wheat cropping system.

Treatments	Grains /spike	Grain yield (t/ha)	Straw yield (t/ha)	Net returns (Rs./ha)	B:C
Rice (TPR)-Wheat (CTW)	45.9	4.5	6.7	89484	**3.1**
Rice (TPR) + RC- Wheat (CTW)+RC-*Sesbania* (Inc)	47.4	4.3	6.4	81892	3.0
Rice (TPR) + RC- Wheat (ZTW)+RR-*Sesbania* (Inc)	50.5	4.5	6.7	93192	3.5
Rice (DSR) -Wheat (CTW)	48.1	4.3	6.6	85044	3.0 3.0
Rice (DSR) + RC-Wheat (CTW)+RC-*Sesbania* (Inc)	51.5	4.6	6.8	91073	3.2
Rice (DSR) + RC- Wheat (ZTW)+RR-*Sesbania* (Inc)	55.6	5.3	7.9	115304	4.1
SEm±	**0.8**	**0.1**	**0.2**		
LSD (p=0.05)	**2.4**	**0.4**	**0.6**		
Clodinafop propargyl (15%) + MSM (1% WP 60+4 g/ha as post-emergence)	50.7	4.7	7.0	97513	3.5
IWM (Rec. herbicide *fb* one hand Weeding at 60 DAS/DAT)	52.9	5.0	7.5	99691	3.2
One-hand weeding (60 DAS)	45.8	4.0	6.0	80791	3.2
SEm±	**0.5**	**0.0**	**0.1**	**-**	**-**
LSD (p=0.05)	**1.4**	**0.1**	**0.2**	**-**	**--**

-DSR: direct-seeded rice; TPR- transplanted rice; CT- conventional tillage, ZT- zero tillage, RC-residue incorporation, RR- residue –retention, Inc- Incorporation

During *Kharif* 2022, the major weed flora recorded under weedy situations are *Echinochloa colona, E. crus-galli, Eleusine indica, Panicum maximum, Leptochloa chinensis, Caesulis auxillaris, Eclipta alba, Alternanthera sessilis, Ammania baccifera, Mallugo* spp., *Cyperus iria, Cyperus difformis etc*. At 60 DAS, the lowest density of *P. maximum* and *L. chinensis* among the grassy weeds and *C. auxillaris, E. alba* and *Mollugo* spp. among the BLWs and *C. difformis* was the sedge recorded under DSR (ZT + R) - wheat (ZT + R) - green manure (ZT + R) system. *E. alba* was completely controlled by DSR under ZT with or without R. DSR (ZT+R) – wheat (ZT+R) – green manure (ZT+R) recorded either complete control or lowest weed dry weight of all the weeds except *E. colona* among the grassy weeds, and *A. sessilis* and *A. baccifera* among the BLWs and *C. iria* among the sedges. All yield and yield attributing characters were non – significant by the tillage methods. The highest grain yield (3.3 t/ha) was recorded under DSR (ZT+R) – wheat (ZT+R) – GM (ZT+R), which were at par with all other treatments except DSR (ZT) - wheat (ZT) - GM (ZT). The highest straw yield (6.7 t/ha) was achieved with DSR (ZT) - wheat (ZT) - GM (ZT). This led to achieving

the highest net returns and benefit-cost ratio of Rs 39,355/ha and 1.97, respectively under DSR (ZT+R) – wheat (ZT+R) – GM (ZT+R)

Among weed management practices, IWM [pendimethalin 678 g/ha (2 DAS) *fb* bispyribac sodium 25 g/ha (20 DAS) *fb* hand weeding (40 DAS) *fb* weed seed harvest] recorded complete control of all the weeds except *E. crus-galli, E. indica* and *P. maximum* among the grasses and *A. baccifera* among the BLWs. Pendimethalin 678 g/ha (2 DAS) *fb* bispyribac sodium 25 g/ha (20 DAS) recorded complete control *of E. indica* among the grasses and *E. alba* among the BLWs and *C. difformis* among the sedges **(Table 1.2.6)**. The interaction effects of the crop establishment methods and weed management practices on weed density had been found significant at 60 DAS, except *E. indica* among the grassy weeds. IWM was recorded with the highest grain yield (4.3 t/ha) which may be attributed to more panicles and grains/panicles. The highest straw yield (8.0 t/ha) was recorded under both the integrated and chemical weed management systems. IWM recorded the highest net returns and benefit-cost ratio of Rs 57732/ha and 2.29, respectively.

Table 1.2.6: Effect of crop establishment methods and weed management on yield attributes, yield of rice under rice-wheat cropping system.

Treatments	Panicles (no./m²)	Grain yield (t/ha)	Straw yield (t/ha)	Cost of cultivation (Rs/ha)	Net returns (Rs /ha)	B: C
Tillage and residue management						
DSR (CT) -wheat (CT) - GM (CT)	153.0	3.0	5.8	44245	26688	1.59
DSR (CT+R)- wheat (CT+R)- GM (CT+R)	148.8	3.1	6.4	44245	29808	1.66
DSR(ZT)- wheat (ZT) -GM (ZT)	149.3	3.2	6.7	40245	36288	1.89
DSR (ZT+R)- wheat (ZT+R) -GM (ZT+R)	156.3	3.3	5.9	40245	39355	1.97
SEm±	2.3	0.1	0.2			
LSD(p=0.5)	NS	0.2	NS			
Weed management practices						
Pendimethalin 678 g/ha (2 DAS*) fb* bispyribac sodium 25 g/ha (20 DAS)	179.3	3.7	8.0	40368	47932	2.20
Pendimethalin 678 g/ha (2 DAS) *fb* bispyribac sodium 25 g/ha (20 DAS) *fb* hand weeding (40 DAS) *fb* weed seed harvest	187.8	4.3	8.0	44868	57732	2.29
Partially weedy (weeds removed after critical period)	88.6	1.5	2.5	41500	-6560	0.85
SEm±	**2.1**	**0.1**	**0.3**			
LSD(p=0.5)	**6.4**	**0.14**	**0.8**			

DAS: days after sowing; HW- hand weeding; DSR: direct seeded rice; ZT- zero tillage; GM- green manure; CT- conventional tillage; NS: non-significant

PAU, Ludhiana

In wheat, *Rabi* 2021-22, *Phalaris minor*, *Rumex dentatus, Coronopus didymus, Anagallis arvensis, Medicago denticulata,* and *A. ludoviciana* were major weeds. At 60 DAS, all tillage and

residue management treatments had similar weed density and dry weight (**Table 1.2.7**). All tillage and residue management treatments recorded similar wheat grain yields. DSR-ZT obtained the highest wheat grain yield and the highest B: C. DSR-ZT noted the highest crop dry weight and effective tillers which were similar to PTR-CT (MB/R) but significantly higher than PTR-CT.

Among weed control, at 30 and 60 DAS, weed density and dry weight were significantly less in RH and IWM than in the weedy check; IWM and RH had similar densities and dry weight of weeds. IWM and herbicides recorded similar wheat grain yield and yield attributes which were significantly higher than weedy check; RH had the highest B: C followed by IWM (**Table 1.2.8**).

Echinochloa crus-galli, E. colona, and *Dactyloctenium aegyptium* were major weeds in the soil weed seed bank. All tillage and residue management treatments had similar seed bank of *E. colona* and *E. crus-galli*, in the case of *D. aegyptium* the seed bank was the highest under PTR-CT (R) which was at par with DSR-ZT. Among weed management, IWM had a significantly low density of all weed seeds in soil than RH; both had significantly weed seed bank than weedy check (**Table 1.2.9**).

Harvest time residues of metribuzin and clodinafop-propargyl, under RH and IWM treatments, were below the detectable limit of <0.01 and <0.05 µg/g in soil and wheat grains, respectively. Soil enzymatic activity was significantly higher in ZT (surface residue retention) than in CT (residue incorporation); CT without residue had significantly low enzymatic activity. IWM had significantly higher soil enzymatic activity than RH alone and both had significantly higher enzymatic activity than unsprayed check at harvest.

Table 1.2.7: Effect of tillage, residue and weed management on weed density and dry weight at 60 DAS in wheat during *Rabi* 2021-22.

Treatments	Weed density (no./m²)						Weed dry weight (g/m²)	
	P. minor	*R. dentatus*	*M. denticulata*	*A. arvensis*	*C. didymus*	*A. fatua*	Grass	Broadleaf
Tillage and residue management								
PTR-CT	2.98 (12)	1.80 (4)	3.62 (13)	2.07 (5)	2.72 (9)	1.24 (1)	4.33 (31.4)	4.12 (22.8)
PTR- CT (MB)	2.72 (10)	1.83 (4)	2.54 (9)	1.99 (4)	2.59 (9)	1.47 (2)	3.44 (18.2)	3.03 (15.4)
PTR- ZT	3.05 (12)	2.08 (5)	2.93 (10)	1.89 (4)	3.01 (11)	1.84 (3)	4.41 (26.8)	4.89 (30.6)
DSR - ZT	2.78 (10)	2.08 (4)	2.74 (10)	1.91 (4)	2.79 (10)	1.71 (2)	3.83 (22.2)	4.90 (35.2)
PTR- CT (R)	2.76 (10)	1.97 (4)	3.46 (13)	1.95 (5)	2.87 (10)	1.57 (2)	3.18 (16.3)	3.71 (20.7)
SEm±	0.25	0.07	0.22	0.12	0.13	0.07	0.33	0.36
LSD (p=0.05)	NS	NS	0.66	NS	NS	0.21	NS	1.07
Weed management practices								
Weedy check	5.34 (28)	3.48 (11)	5.08 (25)	3.63 (12.4)	5.08 (25)	2.39 (5)	7.79 (62.5)	8.00 (65.1)
RH	1.78 (3)	1.33 (1)	2.32 (5)	1.26 (1)	1.88 (3)	1.28 (1)	2.36 (5.36)	2.62 (7.1)
IWM	1.44 (2)	1.05 (0)	1.77 (3)	1.00 (0)	1.42 (1)	1.03 (0)	1.36 (1.14)	1.77 (2.6)
SEm±	0.41	0.13	0.43	0.29	0.38	0.21	0.76	0.51
LSD (p=0.05)	0.67	0.21	0.69	0.48	0.61	0.34	1.23	0.82
Interaction LSD (p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

Data subjected to square root transformation. Figures in parentheses are means of original values.

Table 1.2.8: Effect of tillage, residue and weed management on crop growth, grain yield and economic parameters of wheat during *Rabi* 2021-22.

Treatments	Plant height (cm)	Tiller (no./m²)	Plant height (cm)	Crop biomass (g/m²)	Effective tiller (no./m²)	Grain yield (t/ha)	Straw yield (t/ha)	Variable cost (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha	B:C
	60 DAS		90 DAS								
Tillage and Residue management											
PTR-CT	34.4	323	71.7	1118.2	264	3.745	4.358	35225	75462	40237	2.14
PTR-CT (MB)	37.3	339	75.4	1183.0	282	3.969	4.487	38225	79975	41750	2.09
PTR- ZT	38.7	336	73.7	1173.9	278	3.871	4.405	32725	78001	45276	2.38
DSR – ZT	42.8	352	76.1	1228.7	295	4.132	4.744	32725	83260	50535	2.54
PTR- CT (R)	42.6	348	75.8	1211.5	289	4.055	4.682	33225	81708	48483	2.46
SEm±	1.2	13	1.0	25.1	7	0.117	0.270				
LSD (p=0.05)	2.7	NS	2.3	57.9	16	NS	NS	-	-	-	-
Weed management practices											
Weedy check	40.0	301	71.9	1063.4	256	3.462	3.915	31125	69759	38634	2.24
RH	38.5	354	74.7	1226.1	288	4.122	4.769	33075	83058	49983	2.51
IWM	38.9	364	77.0	1259.7	300	4.279	4.923	39075	86222	47147	2.21
SEm±	1.1	10	1.1	35.3	8	0.060	0.066				
LSD (p=0.05)	NS	20	2.4	73.7	16	0.125	0.243	-	-	-	-
Interaction LSD (p=0.05)	NS	NS	NS	NS	NS	NS	NS	-	-	-	-

Table 1.2.9: Effect of tillage, residue and weed management on weed seed bank after wheat harvest *Rabi* 2021-22.

Treatment	No. of seeds/m² up to the depth of 10 cm		
	E. colona	*E. crus-galli*	*D. aegyptium*
Tillage and Residue Management			
PTR-CT	19.39 (402)	17.84 (332)	19.69 (409)
PTR- CT (MB)	19.19 (412)	20.39 (431)	21.06 (457)
PTR- ZT (HS)	19.26 (393)	19.01 (375)	20.59 (442)
DSR - ZT (HS)	21.06 (453)	20.34 (431)	24.07 (598)
PTR- CT (R)	21.92 (497)	21.27 (479)	25.09 (656)
SEm±	2.26	1.46	1.08
LSD (p=0.05)	NS	NS	2.50
Weed management practices			
Weedy check	24.48 (603)	23.95 (578)	27.02 (742)
RH	20.76 (437)	19.65 (401)	21.72 (482)
IWM	15.26 (255)	15.71 (250)	17.56 (313)
SEm±	0.73	0.96	0.75
LSD (p=0.05)	1.51	0.70	1.57
Interaction LSD (p=0.05)	NS	NS	NS

IGKV, Raipur

In wheat 2021-22, the experimental field was heavily infested with *Medicago denticulata*, followed by *Echinochloa colona* and *Chenopodium album*. The other weed flora found in the field was *Anagallis arvensis, Melilotus indica, Rumex dentatus* etc. lower in number. The *Medicago denticulata* was found to be the most serious weed. At 60 DAS, weed density was less under ZT (DSR) + R – ZT+ R over other tillage practices, whereas the CT-CT system under transplanted and DSR conditions produced higher weed density. The ZT (DSR) + R – ZT + R system was recorded with significantly lower weed dry weight (3.11 g/m^2) followed by ZT + R as compared to CT-CT and CT-ZT. Significantly higher grain yield (2.85 t/ha) was obtained under ZT (DSR) + R - ZT + R compared to ZT (DSR) - ZT without residue. However, CT (TPR) – ZT - ZT comparable with CT (TPR) – CT - CT and CT (Direct seeded) – CT - ZT produced significantly lower yield (2.64 t/ha) than that of ZT (Direct seeded) + R – ZT + R – ZT + R. The net returns and B: C were also high under ZT + R (**Table 1.2.10**).

The weed density and dry weight were found to be remarkably low due to both the weed management approaches *i.e.* IWM (clodinofop + metsulfuron 60+4 g/ha PoE *fb* HW 40 DAS) and recommended (clodinofop + metsulfuron 60+4 g/ha PoE) practices over control. The significantly higher grain yield (3.50 t/ha) was recorded under IWM over others. Integrated weed management was found more profitable in terms of net profit (Rs 48665/ha) as well as B: C (3.43) over recommended herbicide practice.

Table 1.2.10: Weed dry weight, grain yield and economics as influenced by crop establishment methods and weed management practices in wheat, *Rabi* 2021-22.

Treatments	Weed dry weight (g/m^2)	Grain yield(t/ha)	Net income (Rs./ha)	B: C
Tillage and residue management				
CT (Transplanted) -CT-CT	4.87(23.23)	2.75	31579	2.35
CT (Transplanted) -ZT-ZT	5.42(28.87)	2.64	32018	2.69
CT (Direct seeded)-CT-ZT	5.19(26.43)	2.70	30592	2.31
ZT (Direct seeded)-ZT+R-ZT	4.98(24.35)	2.72	34487	2.78
ZT (Direct seeded)+R - ZT+R-ZT+R	4.32(18.17)	2.85	37054	2.92
SEm±	**0.03**	**0.07**	-	-
LSD (P= 0.05)	**0.09**	**0.20**	-	-
Weed management practices				
Recommended (clodinofop + metsulfuron 60+ 4 g/ha PoE)	4.65(21.12)	3.04	36780	2.58
Integrated (clodinofop + metsulfuron 60+ 4 g/ha PoE*fb* HW 40DAS)	4.09(16.24)	3.50	48665	3.43
Weedy check	6.14(37.24)	1.65	13994	1.82
SEm±	**0.37**	**0.10**	-	-
LSD (P= 0.05)	**0.11**	**0.30**	-	-
Interaction T x W	**NS**	NS	-	-

In cowpea during the summer 2022, the experimental field was dominated by *Echinochloa colona* and *Cynodon dactylon* among grasses and *Alternanthera sessilis,* among BLW. *Cyperus iria, Brachiaria ramose,* etc. were the other weeds present in small numbers. At 40 DAS, *Echinochloa colona* was dominated among weeds in all tillage practices. The weed densities and dry weight were lowest under ZT (DSR) + R - ZT+R - ZT+R but were comparable with others except for CT (TPR) –CT - CT might be due to a continuous layer of crop residues between rows resulted in suppression of emerging weeds. Significantly higher fodder yield (12.26 t/ha) and net returns and B: C was recorded under ZT (DSR)+ R-ZT + R –ZT+R followed by ZT (DSR)- ZT+R-ZT (**Table 1.2.11**).

Among weed management practices, the lowest weed density and dry weight were observed under IWM (pendimethalin 1.0 kg/ha as PE *fb* 1 HW at 20 DAS) followed by pendimethalin 1 kg/ha (PE). The maximum weed density and weed dry weight was observed under weedy check. Adoption of IWM achieved maximum green fodder yield (16.42 t/ha), net returns, and B: C over the rest of the treatments. The lowest green fodder yield, net returns, and B: C were obtained under weedy check.

Table 1.2.11: Weed dry weight, plant height at 40 DAS, green fodder yield, net returns and B: C of cowpea as influenced by weed management in conservation agriculture during summer 2022.

TreatmentsMain-Plots	Weed dry weight (g/m²)	Plant height (cm)	Green fodder yield (t /ha)	Net returns (Rs./ha)	B: C
Tillage and residue management					
CT (Transplanted) –CT-CT	6.64(43.55)	41.38	9.91	2066	1.07
CT (Transplanted) –ZT-ZT	5.80(33.18)	42.71	11.12	9012	1.40
CT (Direct seeded)-CT- ZT	6.16(37.42)	43.55	10.81	8206	1.38
ZT (Direct seeded)-ZT+R-ZT	5.38(28.42)	43.76	11.54	10104	1.43
ZT (Direct seeded)+R-ZT +R-ZT+R	5.09(25.37)	46.12	12.26	11976	1.52
SEm±	**0.43**	**0.41**	**0.33**	**-**	**--**
LSD (P= 0.05)	**1.41**	**1.36**	**1.08**	**-**	**-**
Weed management practices					
Pendimethalin 1.0 kg/ha	5.63(31.24)	43.81	12.86	11871	1.68
Pendimethalin 1.0 kg/ha + HW at 20 DAS	4.44(19.21)	45.63	16.42	20422	1.82
Weedy check	7.36(53.74)	41.06	4.12	-7474	0.58
SEm±	**0.40**	**0.34**	**0.32**	**-**	**-**
LSD (P= 0.05)	**1.18**	**1.02**	**0.98**	**-**	**-**
Interaction T x W	NS	NS	NS		

Price: Cowpea green fodder Rs.2600/t

In rice during 2022, the experimental field was comprised of *Echinochloa colona* among grasses, *Cyperus iria* among sedges, and *Alternanthera sessilis* among BLWs. The BLWs and sedges dominated the weed flora at all the growth stages as compared to grasses and other weeds. Other weeds like *Brachiaria ramosa, Sporobolus diander, Cynotis axillaris, Commelina benghalensis, Ludwigia parviflora* etc. were also found in irregular and fewer numbers. *Cyanotis axillaris* and *Sporobolus diander* being late *kharif* weeds, dominated the weed flora during the maturity of the crop.

Weed density and weed dry weight recorded at 30, 60 DAS/T, and at harvest revealed that tillage practices caused remarkable variation at all the stages of crop growth. The lowest weed density and dry weight were found under CT+R - CT+R - CT+R over CT – CT- CT, ZT-ZT- ZT, and over ZT+R – ZT+R – ZT+R at all stages. However, weed density and dry weight were lower in ZT (DSR) + R as compared to ZT alone, this might be due to retaining crop residues between the rows. The highest effective tillers and grain yield of rice were recorded under CT over ZT. CT + R produced the highest grain yield of 5.16 t/ha over CT with lesser net returns. Contrarily, ZT + R incorporation produced a little higher yield over nonresidue (**Table 1.2.12**).

As regards of weed management, the lower density of total weeds and dry weight was less under IWM followed by RH over control. IWM [pendimethalin 678 g/ha (2 DAS) *fb* bispyribac sodium 25 g/ha (20 DAS) with hand weeding (40 DAS) *fb* weed seed harvest] produced significantly the highest grain yield (6.25 t/ha) over RH [pendimethalin 678 g/ha (2 DAS) *fb* bispyribac sodium 25 g/ha at 20 DAS] (5.74 t/ha). Partially weeded plots produced the lowest yield of rice. IWM also generated the highest net returns (Rs 90424/ ha) while the RH fetched the highest B: C (3.86) over the rest of the two practices.

Table 1.2.12: Weed dry weight, test weight, grain yield and economics of rice as influenced by weed management practices in conservation agriculture, *Kharif* 2021.

Treatments	Weed dry weight (g/m²) at 60 DAS	Test weight(g)	Grain yield (t/ha)	Net income (Rs/ha)	B: C
Tillage and residue management					
CT-CT-CT	6.64(43.6)	28.81	5.02	68108	3.04
CT+R-CT+R-CT+R	6.47(41.3)	28.98	5.16	65964	2.72
ZT-ZT-ZT	7.01(48.6)	28.21	4.32	58828	3.10
ZT+ R- ZT+ R- ZT+ R	6.79(45.7)	28.56	4.56	57424	2.66
SEm±	0.02	0.20	0.05	-	-
LSD (P= 0.05)	0.06	0.68	0.20	-	-
Weed management practices					
Recommended (pendimethalin 678 g/ha (2DAS) *fb* bispyribac sodium 25 g/ha (20 DAS)	5.03(24.8)	29.41	5.74	86596	3.86
Integrated weed management (pendimethalin 678g/ha (2 DAS) *fb* bispyribac sodium 25 g/ha (20 DAS) *fb* hand weeding (40 DAS) *fb* weed seed harvest	3.84(14.3)	29.93	6.25	90424	3.48
Partially weedy (weeds removed after critical period)	11.3(127.5)	26.57	2.31	10723	1.29
SEm±	0.01	0.18	0.09	-	-
LSD (P= 0.05)	0.03	0.55	0.27	-	-
Interaction T x W	NS	NS	NS	-	-

Price of rice in Chhattisgarh: Rs 20400/tonne

BCKV, Kalyani

In *Rabi* 2021-22, the experimental field was dominated by weed species *Amaranthus viridis, Physalis minima, Trianthema portulacastrum, Phyllanthus niruri* among BLWs; in grassy weeds *Cynodon dactylon, Digitaria sanguinalis, Dactyloctenium aegyptium* etc., and *Cyperus rotundus, Cyperus difformis* among sedges. Rapeseed sown with minimum tillage (CTTPR-MT) after conventionally tilled transplanted rice recorded the least weed density and weed dry weight at all stages of growth followed by CTTP-CT. The beneficial effect of mulch in controlling weeds was also observed over the plots having no mulch. Treatment receiving MT+R-MT+R showed better performance in weed management over treatment receiving MT-MT. At 30 DAS, grassy weed showed their dominance over BLWs and sedges. CTDSR-CT treatment showed better performance in controlling weed over MT+R-MT+R. At 60 and 90 DAS treatments showed the same pattern of weed management (**Table 1.2.13**).

Pendimethalin 1.0 kg/ha PE along with mechanical weeding at 30 DAS recorded the lowest number and dry weight of weeds followed by pendimethalin 1.0 kg/ha alone. One-hand weeding at 30 DAS recorded the highest number and dry weight of weed throughout the growth period of rapeseed. Yield attributes and yield of rapeseed, and B: C were better with CTTP-MT followed by CTTP-CT while the lowest values were observed with MT-MT, whereas the lowest B: C obtained with MT + R- MT + R. Likewise, IWM recorded the highest seeds/siliqua, siliqua/plant, and yield and was followed by pendimethalin 1.0 kg/ha (PE). The lowest yield parameters and yield was recorded with one hand weeding at 30 DAS.

Table 1.2.13: Effect of tillage, residue and weed management practices on weed parameters yield attributes yield and economics of rapeseed during *Rabi*, 2021-22.

Treatments	Weed density (No./m²)	Weed dry weight (g/m2)	No. of siliqua/plant	Seed yield (t/ha)	Stalk yield (t/ha)	B:C
T_1 (CTTP-CT-CT)	5.36 (28.28)	4.07 (16.07)	90.77	1.19	3.74	1.34
T_2 (CTTP-MT-MT)	5.24 (27.01)	3.85 (14.31)	93.12	1.25	3.76	1.51
T_3 (CTDSR-CT-MT)	5.63 (31.21)	4.42 (18.99)	84.54	1.16	3.64	1.31
T_4 (MT-MT-MT)	6.36 (39.98)	4.83 (22.81)	77.13	1.02	3.56	1.23
T_5 (MT+R-MT+R-MT+R)	5.93 (34.66)	4.56 (20.33)	81.86	1.14	3.63	1.11
SEm±	-	-	0.697	0.003	0.005	-
LSD (P=0.05)	-	-	2.307	0.009	0.017	-
W_1 Pendimethalin 1.0 kg/ha PE	7.69 (58.59)	4.09 (16.22)	89.26	1.19	3.80	1.49
W_2 Pendimethalin 1.0 kg/ha PE + mechanical weeding at 30DAS	7.64 (57.92)	4.05 (15.92)	93.22	1.24	3.82	1.28
W_3 One hand weeding at 30 DAS	7.09 (49.82)	4.88 (23.36)	74.00	0.99	3.36	1.13
SEm±	-	-	0.338	0.003	0.002	-
LSD (P=0.05)	-	-	1.003	0.010	0.007	-

In greengram during the summer 2022, the study area comprised *Trianthema portulacastrum*, *Digitaria sanguinalis*, *Physalis minima* and *Phylanthus niruri* as BLWs, *Cynodon dactylon* and *Dactyloctenium aegyptium* as grassy weed, *Cyperus rotundus* as sedge. At 60 DAS, CTTP-MT-MT recorded the lowest weed density and weed dry weight, and better yield attributes (pods/plant, seeds/pod, seed, and straw yield) followed by CTTP-CT-CT. Treatment CTDSR-CT-MT recorded a better performance in controlling weed number and dry weight over MT-MT-MT.

Among weed management practices, IWM (quizalofop-ethyl 50 g/ha at 20 DAS *fb* mechanical weeding at 30 DAS) recorded the lowest weed number and dry weight with higher yield attributing characters. The lowest yield attributes and yield were recorded with one hand weeding at 30 DAS. The interaction of tillage (CTTP-MT-MT) and weed management practices (IWM) recorded least weed density, weed dry weight and highest WCE (83.48%). Treatment combination MT-MT-MT along with one hand weeding at 30 DAS recorded the highest weed density and weed dry weight.

OUAT, Bhubaneswar

In maize, during *Rabi* 2021-22, at 25 DAP, ZT (DSR)+R -ZT+R-ZT+R recorded significantly higher weed density (61.6/m²) followed by ZT (DSR)+ ZT+R-ZT method (53.9/m²) and CT (DSR)-CT-ZT(49.4/m²) and the density was lowest CT (TPR)-ZT-ZT method (42.3/m²). The weed densities at 60 DAP and at harvest followed a similar trend with the lowest values of 33.5/m² and 43.9/m², respectively, in CT (TPR)-ZT-ZT method and ZT (DSR)-ZT+R-ZT. The inclusion of CT in the tillage methods reduced the weed

densities to the tune of 21.1%, 19.6%, and 28.1% respectively, during different growth stages over the ZT-ZT method. Weed dry weight followed a similar trend of weed density. Lower weed density and dry weight resulted in CT (TPR)-ZT-ZT system obtaining significantly higher grain yield in *Rabi* maize (6.5 t/ha). The practice of ZT (DSR)-ZT+R-ZT+R system resulted in the lowest grain yield and the yield reduction was to the tune of 25% and 22% as compared to CT-CT-ZT and CT-ZT-ZT, respectively. Weed index values were observed to be maximum in the ZT-ZT-ZT system (24.7%) in comparison to CT(TPR)-ZT-ZT system (6.7%). CT(TPR)-ZT-ZT method recorded the highest B: C of 3.5 in the *Rabi* maize followed by CT(DSR)-CT-ZT (2.8). The lowest value, however, was observed in ZT(DSR)-ZT+R-ZT (2.5).

Among the various weed management practices, the IWM (tank mix of atrazine+pendimethalin 0.5 + 0.5 kg/ha *fb* one manual weeding) recorded significantly the lowest weed density (23.4/m^2) at 25 DAP as compared to the solely recommended herbicide (pendimethalin 1.0 kg/ha) (66.2 m^{-2}) and one manual weeding (165.5/m^2). The IWM, however, reduced the weed density by 44.1% and 50.1% at later stages of crop growth (60 DAP and at harvest). IWM recorded the highest grain yield (6.0 t/ha) in comparison to the sole herbicide with yields of (4.2 t/ha). IWM produced better B: C (3.78) over sole herbicide application (2.57).

Zero tillage + control

Conventional tillage + Pendimethalin 1.0 kg/ha

In cowpea during the summer 2022, the floristic composition of the experimental site during the season was dominated by grasses (63%) followed by BLWs (20%) and sedges (7%). *Dactyloctenium aegyptium* (11%), *Digitaria sanguinalis* (7%) and *Cynodon dactylon* (4%) were observed to be the dominant grasses. *Celosia argentea* (12%), *Euphorbia hirta* (8%) and *Heliotropium indicum* (6%) were the major BLWs. *Cyperus difformis* (12%) and *Cyperus iria* (3%) were the important sedges observed in the experimental site. Other minor weeds observed were *Ageratum conyzoides*, *Chorchorus* sp., *Scoparia dulcis, Trianthema portulacastrum* etc.

At 25 DAS, ZT(DSR)+R -ZT+R-ZT+R recorded significantly higher weed density (82/m^2) followed by ZT(DSR)+ ZT+R-ZT method (34/m^2) and CT(DSR)-CT-ZT (29/m^2) and the density was lowest CT (TPR)-ZT-ZT method (13/m^2). The weed densities at 60 DAP and at harvest followed a similar trend with the lowest values of 30/m^2 and 41/m^2, respectively, in CT (TPR)-ZT-ZT method and ZT (DSR)-ZT+R-ZT. The inclusion of CT in the tillage methods reduced the weed densities to the

tune of 18%, 20%, and 28% respectively, during different growth stages over the ZT-ZT method. The inclusion of CT in the tillage system reduced the weed dry weight over ZT to the tune of 20%, 27%, and 24% at 25 DAP, 60 DAP, and at harvest, respectively, during the season. CT (TPR)-ZT-ZT system recorded significantly higher pod yield in cowpea (8.5 t/ha), whereas the lowest pod yield obtained with ZT(DSR)-ZT+R-ZT+R and the yield reduction was in the tune of 35% and 32% as compared to CT-CT-ZT and CT-ZT-ZT, respectively. CT (TPR)-ZT-ZT also recorded the highest B: C (4.2) followed by CT (DSR)-CT-ZT (3.0) and the lowest with ZT (DSR)-ZT+R-ZT (1.8). Weed index values were observed to be maximum in ZT-ZT-ZT (34%) over CT (TPR)-ZT-ZT (11%).

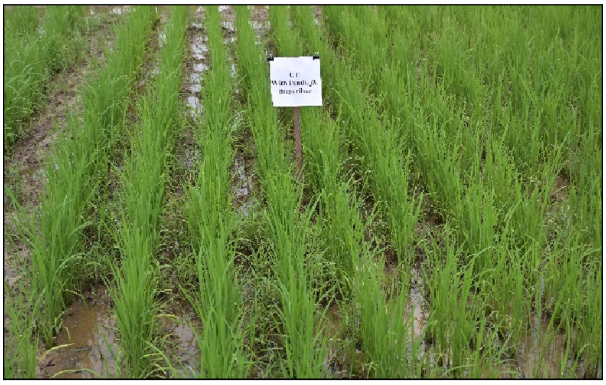
Among weed management practices, the IWM (pendimethalin 0.75 kg/ha *fb* one manual weeding) recorded significantly the lowest weed density (13/m^2) at 25 DAS as compared to one manual weeding (89/m^2). The practice of IWM, however, reduced the weed density by 34% and 50% at later stages of crop growth (60 DAS and at harvest). IWM significantly reduced the weed dry weight over RH in cowpea (60.9%). However, IWM reduced the weed dry weight by 42 % over RH. IWM recorded the highest pod yield (9.8 t/ha) in comparison to sole herbicide with 6.8 t/ha pod yield. IWM also produced better B: C (3.95) than sole herbicide (2.35).

In rice during 2022, the floristic composition of the experimental site during the season was dominated by grasses (55%) followed by BLWs (30%) and sedges (15%). The trend observed in different categories of weeds from the year of initiation of the experiment was *Panicum repens* (21 %), *Echinochloa crus-galli* (17 %) and *Echinochloa colona* (14 %) were observed to be the dominant grasses. *Marselia quadrifolia* (18 %) and *Alternanthera sessilis* (27 %) were the major BLWs. *Cyperus difformis* (12 %) and *Cyperus iria* (3 %) were the important sedges observed in the experimental site. Other minor weeds observed were *Ludwigia parviflora, Leptochloa chinensis, Cyperus rotundus, Paspalum scrobiculatum* and *Dactyloctenium aegyptium*. The CT method of tillage recorded significantly the lowest weed density at 60 DAP over ZT methods. The average weed dry weight (54 g/m^2) in ZT was found to be 35 % more than the weed dry weight (38 g/m^2) found in the CT plots. However, covering the soil with paddy straw as mulch reduces 24% the average weed population in case of CT plots in comparison to 16% in case of ZT plots (**Table 1.2.14**).

The recommended practice pendimethalin 678 g/ha (2 DAS) *fb* bispyribac sodium 25 g/ha (20 DAS) at 1st year significantly lowered the weed densities (41/m^2) over the unweedy check (115/m^2) at 60 DAS and the decrease was in the tune of 57 %. Imposition of IWM [pendimethalin 678 g/ha (2 DAS) *fb* bispyribac sodium 25 g/ha (20 DAS) *fb* hand weeding (40 DAS) *fb* weed seed harvest] reduced the weed population significantly (64%) over unweedy check. Integration of the CT method and IWM obtained the maximum B: C in the *Kharif* rice. The composition of the weed seed bank in the ZT system was dominated by grasses (54%) followed by BLWs (26%) and sedges (20%) and the corresponding values in the CT system were 48%, 35% and 17%.

Table 1.2.14: Effect of tillage and weed management practices on weed density and dry weight at 60 DAS, rice yield and economic parameters under conservation agriculture

Treatments	Total weed density (no./m²)	Total weed dry weight (g/m²)	Yield (t/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C
Tillage and residue management						
CT –CT-CT	79.4	22.58	2.51	48520	11782	1.95
CT +R-CT+R-CT+R	51.3	18.67	2.62	48213	11231	1.87
ZT-ZT-ZT	108.4	48.25	1.85	41213	10895	1.74
ZT+R-ZT+R-ZT+R	78..6	24.31	2.02	42411	9895	1.68
LSD (P=0.05)	18.4	8.81	0.35	-	-	
Weed management practices						
Recommended herbicides with rotation	48.4	21.8	2.37	51621	11354	2.01
IWM	32.8	17.5	2.63	53412	12987	1.88
Partial weed check	123.4	39.5	1.80	34213	1542	0.74
LSD (P=0.05)	21.42	8.54	0.29	-	-	-



CT with partially weedy *VS* application of pendi methalin *fb* bispyribac at 30 DAS

CSKHPKV, Palampur

In wheat during 2021-22, the weeds associated were *Cynodon dactylon, Phalaris minor, Vicia* sp., *Coronopus didymus, Anagallis arvensis, Stellaria* sp., *Avena ludoviciana, Trifolium repens, Lolium temulentum, Lathyrus aphaca, Tulipa* sp., *Euphorbia heterophylla, Poa annua, Daucus carota* and *Galium aparine* (**Fig 1.2.2**). Weed management treatments significantly affected the count of *Vicia* sp. (**Fig 1.2.2**).

Imposition of tillage systems such as CT-CT and ZT-ZT had a significantly lower count of *Stellaria media* as compared to CT-ZTR and ZTR-ZTR. The count of white clover was significantly affected due to tillage and weed control treatments and their interaction. The build up of the perennial weed was mostly in the ZT plots. *Tulipa sp*. was the new invasion and was mostly found in the CT-CT treatment. The density of *Poa annua* was significantly lower in the CT-ZTR, ZT-ZTR, and ZTR-ZTR treatments as compared to CT-CT and ZT-ZT treatments. The total weed count followed a similar trend. In the aerobic rice-wheat system, conservation tillage (ZTR-ZTR) gave comparable wheat grain equivalent yield, gross and net returns, and B: C as conventional tillage (CT-CT) (**Table 1.2.15**).

The treatment receiving RH-RH and IWM-IWM remaining at par with each other resulted

in a significantly lower count of *Vicia sp.* over the HW-HW treatment combination. Weed dry weight was significantly lowest under RH-RH followed by IWM-IWM. The highest weed dry weight was recorded in the HW-HW sequence. IWM in both crops resulted in over 13.2% higher aerobic rice yield, 15.8% higher wheat grain equivalent yield, and 12.2% higher systems net returns over H-H or HW-HW treatments.

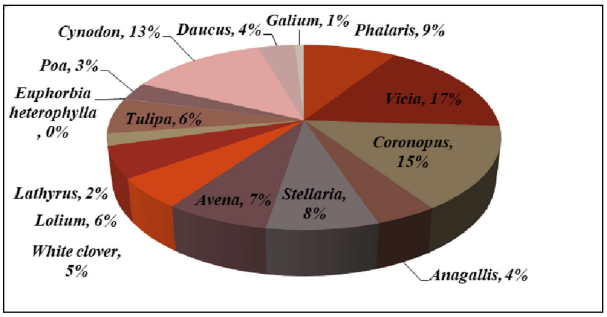


Fig. 1.2.2. Relative weed density in wheat crop

Table 1.2.15: Effect of treatments on yield (kg/ha) during 2021-22

Weed control	Tillage treatment					
	T1	T2	T3	T4	T5	Mean
Wheat						
W1	3300	3215	2963	3114	3636	3246
W2	2929	2424	2357	2997	3401	2822
W3	3131	2677	2828	3300	3283	3044
Mean	3120	2772	2716	3137	3440	
LSD (P=0.05)		M	S	M*S		
		412	NS	NS		
Rice						
W1	3595	3432	2736	3191	3040	3199
W2	4630	3883	2938	2913	3746	3622
W3	3463	3570	2820	2534	3393	3156
Mean	3896	3628	2831	2879	3393	
LSD (P=0.05)		M	S	M*S		
		198	253	472		
Wheat grain equivalent						
W1	6595	6361	5471	6039	6423	6178
W2	8058	6767	5699	7350	7908	7156
W3	6305	5949	5413	5623	6393	5937
Mean	6986	6359	5528	6337	6908	
LSD (P=0.05)		M	S	M*S		
		424	406	NS		
Net returns (Rs/ha)						
W1	153385	155102	132622	144009	142780	145580
W2	177919	147994	135832	167699	187520	163393
W3	117743	112621	102814	115050	131516	115949
Mean	149682	138572	123756	142253	153939	
LSD (P=0.05)		M	S	M*S		
		8815	16789	NS		
B:C						
W1	2.07	2.21	2.20	2.27	2.12	2.17
W2	2.13	1.89	1.99	2.35	2.45	2.16
W3	1.14	1.14	1.15	1.25	1.36	1.21
Mean	1.78	1.75	1.78	1.95	1.98	
LSD (P=0.05)		M	S	M*S		
		0.11	0.22	NS		

M: main plot, S: Subplot; M*S: Interotion, and NS: significant

WP 1.2.3 Weed management under conservation tillage system in maize-based cropping systems

Objectives:

- To monitor weed and pest dynamics, crop-cum-energy productivity, resource use efficiency, profitability under long-term conservation tillage and weed management practices
- Study on weed seed bank dynamics
- To study change in physico-chemical and biological properties of soil

Cooperating centers:

CCSHAU, Hisar, PAU, Ludhiana, UAS, Bengaluru, RVSKVV, Gwalior,

Treatment	Maize	Mustard	Greengram
Mainplot	**Tillage**		
	CT	CT	CT
	CT+R	CT+R	CT+R
	ZT	ZT	ZT
	ZT+R	ZT+R	ZT+R
Subplot	**Weed management**		
Herbicide rotation	Atrazine 1.0 kg/ha (2 DAS) *fb* topramezone 25.2 g/ha (20 DAS)	Pendimethalin 339 g/ha (2 DAS) *fb* pinoxaden 50 g/ha (after first irrigation)	Pendimethalin + imazethapyr 1.0 kg/ha (2 DAS)
IWM	Atrazine 1.0 kg/ha (2 DAS) *fb* topramezone 25.2 g/ha (20 DAS) *fb* hand weeding (40 DAS) *fb* weed seed harvest	Pendimethalin 339 g/ha (2 DAS) *fb* hand weeding (30 DAS) fb WSH	Pendimethalin 678 g/ha (2 DAS) *fb* hand weeding (30 DAS)
Unweeded check	Partially weedy (weeds removed after critical period)	Partially weedy (weeds removed after critical period)	Partially weedy (weeds removed after critical period)

CCSHAU, Hisar

The density of *Cyperus rotundus* was significantly influenced by tillage and residues, while *Echinochloa colona* and *Dactyloctenium aegyptium* did not differ significantly. Weed dry weight and yield attributes did not influence by tillage and residues. Yield was at par in conventional and zero tillage with and without residue. Application of atrazine (1000 g/ha, EPoE) *fb* topramezone 25.2 g/ha (PoE) significantly reduced the density and dry weight of weeds, with taller plants and longer cobs, and higher grain yield as compared to weedy check (**Table 1.2.16**).

Table 1.2.16: Effect of different treatments on yield parameters and yield of maize.

Treatment	Dry matter (g/m^2)	Plant height at harvest (cm)	No. of cobs/plant	Cob length (cm)	Yield (kg/ha)
Crop establishment methods					
CT	12.7 (195.0)	170.8	1.2	12.5	1659
CT + R	12.7 (197.0)	175.1	1.1	12.9	1684
ZT	13.2 (209.0)	174.1	1.2	13.0	1702
ZT + R	13.1 (202.0)	171.8	1.2	12.8	1670
SEm (±)	0.2	3.4	0.03	0.3	86.5
CD (p=0.05)	NS	NS	NS	NS	NS
Weed management practice					
Atrazine *fb* topramezone (1000 fb 25.2 g/ha) *fb* HW	8.6 (72.7)	196.1	1.2	14.2	2172
Atrazine *fb* topramezone (1000 fb 25.2 g/ha)	8.8 (77.7)	194.5	1.2	14.0	2243
Weedy Check	21.3 (456.7)	128.3	1.0	10.2	621
SEm (±)	0.16	3.0	0.03	0.3	75
CD (p=0.05)	0.5	8.9	NS	0.8	156

PAU, Ludhiana

In maize during 2022, *Cyperus compressus, Cyperus rotundus, Digitaria sanguinalis, Acrachne racemose, Echinochloa colona* were major weeds at 30 days and *Trianthema portulacastrum* and *Commelina benghalensis* were also recorded at 60 DAS. Tillage and residue treatments had similar weed density and dry weight.

Among weed control, at 30 DAS, topramezone at 25.2 g/ha significantly reduced the density of *D. sangninalis, A. racemose* and *E. colona*, however, it had no significant effect on sedges. At 60 DAS, it had significantly low density of grass weeds *D. sanguinalis, A. racemose* and *E. colona* and *C. rotundus* than unsprayed control. However, it was at par to control with respect to *C. benghalensis, T. portulacastrum*, and *C. compressus; C. benghalensis* and *T. protulacastrum* emerged after herbicide application. Topramezone significantly reduced dry weight of grass and sedge weeds and did not affect BLWs at 60 DAS. Application of topramezone at 25.2 g/ha recorded similar maize grain yield and yield attributes to its IWM as topramezone provided effective control of most of the weeds; both these treatments had significantly higher maize grain yield and yield attributes than control in which weeds were removed after critical period. All tillage and residue management treatments had similar yield and yield attributes (**Table 1.2.17**).

Table 1.2.17: Effect of tillage and weed management on weed density at 60 DAS in maize and grain yield during *Kharif* 2022.

Treatments	Weed density at 60 DAS (No./m²)							Grain yield (t/ha)
	D. sanguinalis	*Acrachne racemosa*	*E. colona*	*C. compressus*	*C. rotundus*	*C. benghalensis*	*T. portulacastrum*	
Crop establishment methods								
CT	2.70 (8)	1.17 (1)	1.80 (3)	6.84 (51)	3.14 (12)	3.01 (12)	1.84 (3)	3.264
CT+R	2.48 (7)	1.28 (1)	1.81 (3)	6.95 (56)	1.76 (3)	2.17 (5)	1.21 (0)	3.034
ZT	1.93 (4)	1.12 (0)	2.02 1(4)	6.69 (49)	2.51 (7)	1.78 (4)	1.46 (1)	3.402
ZT+R	2.02 (4)	1.13 (0)	1.39 (1)	7.17 (61)	2.14 (6)	1.79 (3)	1.56 (2)	3.132
SEm±	0.33	0.09	0.20	0.74	0.37	1.11	0.12	0.28
LSD (p=0.05)	NS	NS	NS	NS	NS	NS	0.32	NS
Weed management practices								
Weedy check	3.27 (11)	1.53 (2)	2.61 (6)	8.85 (84)	3.66 (14)	2.39 (6)	1.75 (3)	2.762
Atrazine 1.0 kg/ha *fb* topramezone 25.2 g/ha	2.58 (7)	1.00 (0)	1.66 (2.25)	8.30 (79)	2.51 (8)	3.17 (11)	1.82 (3)	3.247
IWM	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	3.616
SEm±	0.23	0.07	0.22	0.83	0.38	0.71	0.17	0.20
LSD (p=0.05)	0.48	0.16	0.44	1.71	0.78	0.62	0.30	0.425
Interaction LSD (p=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Data subjected to square root transformation. Figures in parentheses are means of original values.

UAS, Bengaluru

In maize during *Kharif* 2022, major weed flora observed in the experimental plots were sedges - *Cyperus rotundus*, grasses - *Eleusine indica, Bracharia repens* and *Digitaria marginata*. Whereas, among BLWs: *Borreria hispida, Ageratum conyzoides, Commelina benghalensis, Acanthospermum hispidium, Lonaidium sufruiticesum, Oldenlandia corymbosa, Cleome viscose* and *Celosia argentea* were dominant. Among tillage practices, CT + R recorded the lowest weed density (20.78 no./m²) and weed dry weight (4.85 g/m²) compared to other tillage practices. Grain yield did not vary significantly, however, CT + R recorded the highest grain yield (4.49 t/ha) and was superior compared to other tillage practices. The highest gross returns and net returns were recorded from the CT + R (Rs. 98.780/ ha and Rs 62.714/ ha, respectively).

At 30 DAS and 60 DAS, IWM of atrazine 1.0 kg/ha *fb* topramezone 25.2 g/ha (20 DAS) *fb* HW (40 DAS) recorded significantly lower weed density (24.73 no./m² and 19.53 no/m² respectively) and dry weight (4.98 g/m² and 6.65 g/m², respectively) compared to other treatments. Unweeded recorded the highest weed density of 27.72 no./m² at 30 DAS and 20.47 no./m² at 60 DAS. The treatment atrazine 1.0 kg/ha *fb* topramezone 25.2 g/ha (20 DAS) recorded the lowest weed density during the early stage of the crop. Imposition of IWM recorded significantly the highest yield (3.32 t/ha) compared to partially weedy check (2.12 t/ha) and RH recorded a yield of 3.20 t/ha which was on par with the best treatment. IWM recorded the highest B: C of 2.31 **(Table 1.2.18)**.

Table 1.2.18: Effect of tillage and weed management practices on weed density and dry weight, yield, cost of cultivation (Rs/ha), gross return (Rs/ha), net returns (Rs/ha) and B:C in maize during *Kharif*, 2022.

Treatments	Total weed density (no./m²)	Total weed dry weight (g/m²)	Grain yield (t/ha)	Weed index (%)	CoC (Rs/ha)	Net returns (Rs/ha)	B:C
T_1	4.23 (17.67)	2.85 (7.73)	3.93	--	36,066	50,394	2.40
T_2	5.02 (25.33)	2.85 (7.87)	4.49	--	36,066	62,714	2.74
T_3	5.39 (28.67)	3.08 (9.13)	4.04	--	37,116	51,764	2.39
T_4	5.42 (28.89)	3.42 (11.37)	3.61	--	37,116	42,304	2.14
SEm±	0.10	0.20	0.38	NA	NA	NA	NA
LSD (P=0.05)	0.34	0.71	NS				
W_1	4.07 (20.33)	2.48 (7.36)	3.20	3.61	30,438	39,962	2.31
W_2	3.93 (19.53)	2.32 (6.65)	3.32	0.00	34,438	38,602	2.12
W_3	4.05 (20.47)	2.51 (7.65)	3.12	6.02	31,342	37,298	2.19
SEm±	0.13	0.28	0.22	NA	NA	NA	NA
LSD (P=0.05)	0.36	0.10	0.65				

RVSKVV, Gwalior

In maize during *Kharif* 2022, the experimental area comprised *Setaria glauca, Echinochloa colona, Acrachne racemosa, Brachiaria reptans, Cynodon dactylon* and *Celosia argentea* as narrow leaved weeds, *Commelina benghalensis, Trianthema monogyna, Phyllanthus niruri* and *Digera arvensis,* as BLWs and *Cyperus rotundus* as sedges. Among these, the density of *Cyperus rotundus* was very high and BLWs were less.

The ZT + R suppressed the narrow and BLWs and did not affect sedges during the entire period of experimentation. Growth and yield attributes did not vary significantly affected by different tillage practices, however, ZT+R-ZT+R-ZT+R recorded better values. ZT+R-ZT+R-ZT+R recorded with higher grain and stover yield (3.01 and 6.91 t/ha, respectively) followed by CT+R-CT+R-CT+R (2.88 and 6.37 t/ha, respectively). The lowest grain yield was recorded with ZT-ZT-ZT (1.87 and 6.12 t/ha, respectively). The maximum net returns (Rs. 54276/ha) with BC ratio (2.84) were obtained with ZT+R-ZT+R-ZT+R followed by CT-CT-CT **(Table 1.2.21)**. However, the lowest production and profitability were recorded in ZT-ZT-ZT.

Among weed management practices, IWM (atrazine 1.0 kg/ha *fb* topramezone 25.2 g/ha with one hand weeding) suppressed the weed population and weed dry weight and recorded 66% of WCE at 60 DAS, which was 20% higher as compared to the application of RH (atrazine 1.0 kg/ha *fb* topramezone 25.2

g/ha). IWM was recorded with more growth and yield attributes followed by RH. IWM recorded with better growth and yield attributes resulted in higher grain and stover yield (2.99 and 7.04 t/ha, respectively).

Table 1.2.19: Effect of different tillage and weed management practices on weeds, yields and economics of maize crop at harvest stage.

Treatment	Weed density (no./m²)	Weed dry weight (g/m²)	Grain yield (t/ha)	Stover yield (t/ha)	Total cost of cultivation (Rs/ha)	Net returns (Rs/ha)	BC ratio
Tillage and residue management							
CT-CT-CT	20.55(427.44)	7.57	2.78	6.37	30762	46334	2.49
CT+R-CT+R-CT+R	19.88(401.33)	7.47	2.88	6.25	34211	44784	2.30
ZT-ZT-ZT	20.18(415.56)	7.69	1.87	6.12	26418	30052	2.14
ZT+R-ZT+R-ZT+R	20.11(417.33)	6.40	3.01	6.91	29233	54276	2.84
SEm (±)	**39.98**	**0.63**	**0.05**	**0.10**	**85.1**	**954.8**	**0.032**
CD at 5%	**138.35**	**2.18**	**0.17**	**0.36**	**294.6**	**3304.2**	**0.111**
Weed management practices							
Atrazine 1.0 kg/ha *fb* topramezone 25.2 g/ha	19.27(375.92)	5.81	2.75	6.60	30117	46947	2.57
Atrazine 1.0 kg/ha *fb* topramezone 25.2 g/ha fb HW fb WSH	18.41(344.83)	4.37	2.99	7.04	32635	50824	2.54
Partially weedy	22.87(525.50)	11.69	2.16	5.60	27717	33813	2.22
SEm (±)	**26.83**	**0.48**	**0.06**	**0.08**	**48.58**	**1364.5**	**0.05**
CD at 5%	**80.45**	**1.44**	**0.19**	**0.25**	**145.65**	**4090.7**	**0.14**

Weed management in pearlmillet/maize-mustard-cowpea cropping system under conservation agriculture

In mustard during *Rabi* 2021-22, the experimental field comprised *Phalaris minor*, *Spergula arvensis*, and *Cynodon dactylon* as grasses and *Chenopodium album*, *Chenopodium murale*, *Anagallis arvensis*, *Convolvulus arvensis* and *Medicago hispida* as major BLWs. *Cyperus rotundus* was the most dominating sedge among all the weeds in four years. The *Chenopodium murale* has been seen in 2020-21 and 2021-22 up to 30 DAS only and after that, it was suppressed by the tillage and different weed management practices whereas, the *Phalaris minor* emerged after 60 DAS in 2020-21 but 2021-22 it was appeared before 30 DAS and stagnated up to harvest stage of the crop.

Among crop establishment methods, ZT+R- ZT+R- ZT+R gave maximum seed yield (2.36 t/ha) and it was at par with ZT–ZT+R–ZT and CT-CT-F as compared to other tillage practices. Similarly, the BC ratio (4.46) was also recorded as maximum in ZT+R- ZT+R- ZT+R which was at par with CT-CT-F (3.91). Therefore, conservation agriculture, especially ZT+R- ZT+R- ZT+R followed by the application of CT-CT-F, can contribute to decreasing the narrow and BLWs and give higher productivity and profitability of mustard in pearlmillet-mustard- cowpea cropping system. Application of preceding crop residues with zero tillage, it prevents the germination, growth, and development of weeds in the initial and subsequent stages of weed growth. Similarly, the application of plant residues can be more environment friendly.

Based on four years' experimentation, it was found the IWM (oxyfluorfen 0.23 kg/ha PE with one HW at 35 DAS) obtained maximum seed yield (2.22 t/ha) as well as reduced the weed density and dry weight of

weeds followed by RH (oxyfluorfen 0.23 kg/ha as PE) (2.07 t/ha). Although, the BC ratio (4.03) was maximum with the RH (**Table 1.2.20)**.

Table 1.2.20: Tillage and weed management practices influence on weeds, yield and economics in mustard under pearlmillet based cropping system (pooled 2018-19, 2019-20, 2020-21 and 2021-22)

Treatment	Dry matter production (g/m²)		Grain yield (t/ha)		Stover yield (t/ha)		Net returns (Rs/ha)		BC ratio	
	2021-22	Pooled	2021-22	Pooled	2021-22	Pooled	2021-22	Pooled	2021-22	Pooled
Tillage and residue management										
CT-CT-F	132.97	128.18	1.93	2.03	6.34	6.89	87552	70279	3.80	3.91
CT-ZT-ZT	130.99	125.49	1.88	1.78	6.65	6.04	85596	60642	3.78	3.59
ZT-ZT-ZT	124.92	119.74	1.41	1.45	6.46	5.94	57517	45351	2.88	2.98
ZT-ZT+R-ZT	133.94	128.10	2.53	2.06	7.37	6.64	121401	73425	4.53	3.85
ZT+R-ZT+R-ZT+R	140.33	133.09	2.69	2.36	7.58	7.73	132288	87171	4.98	4.46
SEm (+_)	**1.03**	**2.231**	**0.16**	**0.226**	**0.23**	**0.349**	**9825.9**	**10614.9**	**0.31**	**0.418**
CD at 5%	**3.36**	**6.499**	**0.54**	**0.659**	**0.77**	**1.016**	**32044.0**	**30917.1**	**1.02**	**1.219**
Weed Management practice										
Oxyflourfen	134.18	129.53	2.26	2.07	7.19	6.91	107078	73731	4.32	4.03
Oxyflourfen+ 1 HW	135.48	129.31	2.34	2.22	7.34	7.25	110016	78469	4.23	4.00
Weedy check	128.23	121.92	1.67	1.51	6.11	5.79	73517	49921	3.43	3.24
SEm (+_)	**0.57**	**1.301**	**0.11**	**0.094**	**0.22**	**0.273**	**6311.9**	**4690.5**	**0.20**	**0.143**
CD at 5%	**2.25**	**3.675**	**0.42**	**0.265**	**0.87**	**0.771**				
TxW	**NS**	**Sig**	**NS**	**Sig**	**Sig**	**Sig**				

ZTR and oxyflourfen 0.23 kg/ha with one HW

ZT in weedy check plot

WP 1.2.4. Weed management under conservation tillage system on soybean-based cropping system

Objectives:

- To monitor weed dynamics, crop productivity resource use efficiency and herbicide residues under long-term tillage and residue management practices.
- To study C-sequestration, and changes in physico-chemical and biological properties of soil.

Cooperating centres: MPUAT, Udaipur, CSKHPKV, Palampur

Treatment details:

Treatment	Soybean	Wheat	Greengram/green manure
Mani plot: Tillage and residue management			
TRM1	CT	CT	CT
TRM2	CT+R	CT+R	CT+R
TRM3	ZT	ZT	ZT
TRM4	ZT+R	ZT+R	ZT+R
Sub plot: Weed management			
W1 Diclosulam 28 g/ha (2 DAS) *fb* imazethapyr 100 g/ha (20 DAS)			
W2 Pendimethalin+imazethapyr 1.0 kg/ha (2 DAS) *fb* hand weeding (30 DAS) *fb* weed seed harvest			
W3 Partially weedy (weeds removed after critical period)			

MPUAT, Udaipur

In soybean during *Kharif* 2022, the experimental plot was infested with *Echinochloa colona* (11.36%), *Eleusine indica* (12.04%), *Dinebra retroflexa* (36.94%), *Digera arvensis* (6.65%), *Commelina benghalensis* (3.95%), *Physalis minima* (5.86%), *Trianthema portulacastrum* (18.30%), *Cynadon dactylon* (3.05%) and *Amaranthus viridis* (1.84%). At 60 DAS, soybean (ZT)- wheat(ZT)-greengram(ZT) resulted in lowest weed density and dry weight and harvest. However, CT-CT-CT resulted in the maximum no. of pods per plant, pod weight per plant, and seed yield. The highest net returns (Rs. 41822/ha) and B C ratio (1.51) were realized with CT-CT-CT among tillage and residue management.

Among weed management, IWM [pendimethalin+imazethapyr 1.0 kg/ha (2 DAS) *fb* hand weeding (30 DAS) *fb* weed seed harvest] resulted in the lowest weed density and dry weight at 60 DAS and harvest. Yield attributes and yield was recorded higher with IWM. While IWM registered maximum net returns (Rs. 49881/ha) and BC ratio (1.53) (**Table 1.2.21**).

Table 1.2.21: Effect of tillage, residue and weed management on yield and yield attributes of soybean 2022.

Treatment	No. of pods per plant	Seed yield (kg/ha)	Haulm yield (kg/ha)	Net returns (Rs/ha)	B:C
Tillage and residue management					
TRM1	46.28	1331	1771	41822	1.51
TRM2	42.52	1297	1797	36322	1.09
TRM3	43.36	1249	1715	38218	1.32
TRM4	37.26	1117	1513	28481	0.90
S.Em.±	1.99	44	61		
LSD (P=0.05)	NS	NS	NS		
Weed management					
W1	49.55	1508	2066	46637	1.54
W2	52.30	1574	2241	49881	1.53
W3	25.21	664	791	12114	0.55
S.Em.±	1.60	34	35		
LSD (P=0.05)	4.79	101	106		
Interaction LSD	Sig	NS	NS		

CSKHPKV, Palampur

In soybean during *Kharif* 2022, the experimental field diverse weed flora comprised of *Ageratum* sp., *Digitaria sanguinalis*, *Bidens pilosa*, *Cyperus* sp., *Galinsoga parviflora*, *Commelina* sp., *Polygonum alatum*, and *Echinochloa sp.* were found growing in association with soybean. CTR-CTR recorded a significantly lower count of *Polygonum alatum*. Tillage treatments could not influence soybean seed yield.

In the CT-CT and CTR-CTR, IWM -IWM treatment being at par with herbicide rotation treatment (HR-HR) resulted in a significantly lower count of *Polygonum alatum* than the partially weed check treatment. While IWM - IWM had, a higher count of the weed under ZTR-ZTR treatment. HR-HR and IWM-IWM resulted in higher yield, net returns, and BC ratio of soybean over the partially weedy check. The interaction between tillage and weed management treatments was significant for the seed yield of soybean.

WP 1.2.5 Weed management under conservation tillage system on cotton based cropping system.

Objectives:

- To monitor weed dynamics, crop productivity, resource use efficiency and herbicide residues under long term tillage and residue management practices
- To study C-sequestration and changes in physico-chemical and biological properties of soil

Weed management in cotton – maize – green manure systems

Cooperating centres: AAU, Anand; TNAU, Coimbatore; PJTSAU, Hyderabad,

Treatment:

A. Tillage and crop residue management (Main plot)

Treatment	1st Crop *Kharif* & *Rabi* (Cotton)	2nd Crop Summer (Greengram)
T1	CT	CT
T2	CT	ZT
T3	ZT	ZT
T4	ZT	ZT + R
T5	ZT + R	ZT + R

B. Weed management practices (Sub plot)

Treatment	1st Crop (Cotton)	2nd Crop (Green gram)
W1	Pendimethalin 900 g/ha PE *fb* quizalofop ethyl 50 g/ha +pyrithiobac sodium 62.5 g/ha PoE (tank mix)*fb* HW at 60 DAS	Imazethapyr 75 g/ha PoE *fb* HW at 30 DAS
W2	Quizalofop ethyl 50 g/ha + pyrithiobac sodium 62.5 g/ha PoE (tank mix) *fb* HW at 40 and 60 DAS	Imazethapyr 75 g/ha PoE *fb* HW at 40 DAS
W3	HW at 20, 40 and 60 DAS	HW at 20 and 40 DAS

AAU, Anand

Weed management in cotton-greengram cropping system under conservation agriculture

In cotton, at 90 DAS, among tillage, the significantly lower density and dry weight of dicot weed (2.97/m^2 and 1.69 g/m^2, respectively) and total weed (5.96/m^2 and 2.70 g/m^2, respectively) was observed under CT - CT but it was at par with CT-ZT. Seed cotton yield was comparable among tillage, but numerically higher and lower seed cotton yield (1.57 and 1.96 t/ha, respectively) was recorded under CT-CT followed by CT-ZT+R and ZT+R-ZT+R, respectively **(Table 1.2.23)**. Seed cotton equivalent yield was recorded significantly higher (2.39 t/ha) under ZT+R-ZT+R but it was at par with ZT-ZT+R which recorded 2.25 t/ha seed cotton equivalent yield. The maximum benefit-cost ratio of 1.33 was observed under ZT+R-ZT+R which was closely followed by ZT-ZT+R which recorded B: C of 1.27.

Among weed management practices, the density of monocot, dicot, and total weed was unaffected while significantly the lowest dry weight of monocot and total weed (7.50 and 9.61 g/m^2, respectively) was observed under hand weeding done at 20, 40, and 60 DAS. Whereas, the dry weight of dicot weed was noted significantly lower (5.26 g/m^2) under the application of quizalofop ethyl 50 g/ha + pyrithiobac sodium 62.5 g/ha PoE (tank mix) *fb* HW at 40 and 60 DAS but it was at par with hand weeding done at 20, 40 and 60 DAS. Weed management practices showed a non-significant influence on stalk yield but numerically higher stalk yield (3.13 t/ha) was recorded under the application of pendimethalin 900 g/ha PE *fb* quizalofop ethyl 50 g/ha + pyrithiobac sodium 62.5 g/ha PoE (tank mix) *fb* HW at 60 DAS. Seed cotton equivalent yield numerically higher value (2.19 t/ha) was noted under hand weeding done at 20, 40, and 60 DAS which was closely followed by application of pendimethalin 900 g/ha PE *fb* quizalofop ethyl 50 g/ha + pyrithiobac sodium 62.5 g/ha PoE (tank mix) *fb* HW at 60 DAS (2.12 t/ha). The maximum B: C of 1.28 was observed under application of pendimethalin 900 g/ha PE *fb* quizalofop ethyl 50 g/ha + pyrithiobac sodium 62.5 g/ha PoE (tank mix) *fb* HW at 60 DAS.

In greengram, the density and dry weight of monocot, dicot, and total weed was significantly influenced except dry weight of dicot weed. Significantly the lowest density of monocot, dicot, and total weed (6.62, 1.92 and 6.87/m^2, respectively) was noted under CT-CT. While the lowest dry weight of monocot and total weed (2.26 and 2.60 g/m^2, respectively) was also observed under CT-CT. Plant stand recorded at 15 DAS (no./m^2) and plant height recorded at 30 and 60 DAS showed non-significant. ZT+R-ZT+R recorded significantly higher plant height of 15.7 and 41.5 cm at 30 and 60 DAS, respectively but it was at par with ZT-ZT+R. The seed and haulm yield of greengram was recorded significantly higher (340 and 528 kg/ha, respectively) under ZT-R-ZT+R but it was at par with ZT-ZT+R (329 and 489 kg/ha, respectively).

Among weed management practices, hand weeding carried out at 20 and 40 DAS recorded significantly higher seed and haulm yield (331 and 506 kg/ha, respectively) as compared to the application of imazethapyr 75 g/ha PoE *fb* HW at 40 DAS. Complete control of monocot, dicot, and total weed was observed under application of imazethapyr 75 g/ha PoE *fb* HW at 30 DAS hence, dry weight of monocot, dicot, and total weed was not observed.

In cotton and greengram, the highest improvement in soil microbial properties was recorded in treatment receiving ZT+R it also enhanced all microbial properties in comparison to initial properties. Total bacterial, fungal, diazotrophs, PSM population, and soil dehydrogenase activity were significantly influenced, while the total actinobacterial population was not influenced significantly at harvest. Moreover, there was not any adverse effect recorded of different weed management practices on the microbial properties of soil.

TNAU, Coimbatore

Weed management in cotton – baby corn-based cropping system under conservation agriculture

In baby corn during *Rabi* 2021-22, the weed flora of the experimental field consisted of thirteen species of BLWs, six species of grasses, and a sedge weed. The predominant BLWs were *Amaranthus viridis, Cleome viscose, Trianthema Portulacastrum,* and *Parthenium hysterophorus*. Among the grass, *Cynodon dactylon, Setaria verticiliata, Dactyloctenium aegyptium* and *Chloris barbata* were the dominant ones. *Cyperus rotundus* was the only sedge present in the experimental field.

Among tillage methods, significantly lower total weed density and dry weight (7.4/ m^2 and 2.2 g/m^2) were recorded in the CT-ZT-ZT system at 30 DAS. At 45 DAS, a higher WCE of 80.5% was recorded in CT- ZT- ZT system. Significantly higher plant height and dry matter production with a higher grain yield of 5049 kg/ha was recorded with CT-CT-ZT.

Among weed management practices, application of topramezone 12.5 g/ha (EPoE) *fb* brush cutter at 20-35 DAS (W_2) recorded lower weed density and dry weight (13.1 / m^2 and 4.7 g / m^2) with higher WCE (82.3%) in baby corn and it was followed by EPoE topramezone 12.5 g/ha *fb* EPoE 2,4 D at 20-35 DAS. Application of topramezone 12.5 g/ ha *fb* brush cutter at 20-35 DAS significantly recorded a higher yield 7440 kg/ha, whereas a significantly lower grain yield was recorded with unweeded check (**Table 1.2.23**).

In cotton, among tillage methods, significantly lower total weed density and dry weight (3.88/m^2 and 2.71g/m^2) were recorded in the CT-ZT-ZT system at 30 DAS.

In cotton, among weed management practices, application of pendimethalin (CS) 680 g/ha (PE) *fb* directed spray of paraquat 0.6 kg/ha recorded lower weed density and dry weight (3.78/ m^2 and 3.27 g/m^2). At 60 DAS, a higher WCE of 82.1% was recorded in the CT-ZT-ZT system. Similarly, pendimethalin (CS) 680 g/ha (PE) *fb* directed spray of paraquat 0.6 kg/ha recorded higher WCE (85.9%) in cotton.

Table 1.2.22: Effect of tillage and weed management practices in cotton-based cropping system at Coimbatore centre.

Treatment	Babycorn			Green manure biomass yield (t/ha)	Cotton		
	Plant height (cm)	DMP (kg/ha)	Cob yield (kg/ha)		Total weed density (No./m^2)	Total weed dry weight (g/m^2)	WCE (%)
Tillage & residue management							
T1(CT-CT-ZT)	166.2	6496	5049	14.6	5.88 (28.6)	5.33 (23.3)	60.8
T2(CT-ZT-ZT)	144.1	6115	4230	15.8	4.75 (22.1)	3.26 (8.7)	82.1
T3(ZT+(R)-ZT+(R)- ZT+(R))	147.8	5946	4003	13.6	5.12 (25.9)	3.80 (12.2)	79.1
SEd	3.9	187	169	0.70	0.07	0.03	-
CD(P=0.05)	12.3	315	281	NS	0.21	0.09	-
Weed management practices							
W1- Recommended herbicides	169.6	6505	5206	15.1	4.20 (17.4)	2.94 (8.5)	85.9
W2- Herbicide + BC	178.6	7248	7440	17.6	4.79 (23.5)	3.17 (9.5)	81.0
W3- Herbicide Rotation	170.9	6194	6305	18.8	5.13 (26.2)	3.56 (12.5)	78.8
W4- (UWC)	82.0	4799	3150	16.4	11.11 (124)	6.04 (40.1)	-
SEd	4.2	195	196	0.73	0.09	0.04	-
CD(P=0.05)	12.2	357	401	NS	0.19	0.09	-

Baby corn: W1: Recommended herbicides (pendimethalin 1.0 kg/ha); W2: PE atrazine 1.0 kg/ha *fb* BC on 45 DAS; W3: EPOE topramezone 12.5 g/ha *fb* 2,4 D 500 g/ha at 20-25 DAS; W4: unweeded check

Green manuring: W1-W4: hand weeding at 20-25 DAS

Cotton W1: Recommended herbicides (PE pendimethalin (CS) 680 g/ha *fb* directed spray of paraquat 0.6 kg/ha; W2: PE pendimethalin (CS) 680 g/ha *fb* BC on 60 DAS; W3:PE diuron 750 g/ha *fb* EPOE pyrithiobac sodium 75g/ha at 20-25 DAS; W4: Unweeded check

PJTSAU, Hyderabad

Weed management in cotton – maize – green manure under conservation agriculture systems

In maize 2021-22, the total weed density recorded at 30 and 60 DAS reveals that there was no significant difference among tillage methods because in ZT plots *Cynodon dactylon* and *Cyperus rotundus* dominated while in CT plots, BLWs like *Alternanthera sessilis* and *Parthenium hysterophorus* occupied in large numbers. The weed dry weight was significantly lower in CT plots compared to ZT and ZT + R plots both at 30 and 60 DAS. Both ZT and ZT+ R were statistically similar to each other at both observations. The highest grain yield of maize was obtained in ZT+R compared to ZT and CT plots **(Table 1.2.23).** In turn, ZT was superior to CT. The yield enhancement in ZT+R was 10.1 and 20.0% over ZT and CT, respectively while it was 9.0% in ZT over CT plots. The stover yield in ZT+R and ZT were statistically similar and superior to CT plots.

Among the weed management practices, at 30 DAS weed density was lower in chemical treatments compared to IWM, and the reverse trend was observed at 60 DAS. Both chemical treatments were compared with others. Chemical weed control and herbicide rotation recorded equal weed dry weight at 30 DAS. EPoE application of atrazine + tembotrione had significantly higher weed dry weight. But at 60 DAS, significantly lower weed dry weight was recorded with IWM compared to RH and HR. The interaction effect indicates that the weed control was poor with halosulfuron methyl in ZT and ZT+R plots which were dominated by *Cynodon dactylon*. Higher grain yield was obtained in chemical weed control followed by IWM both of which were superior to herbicide rotation and HW at 50 DAS. The cost of cultivation was higher with CT compared to ZT and ZT+R plots due to enhanced yields. The gross returns, net returns, and B-C ratio were superior in ZT and ZT+R plots compared to CT. The highest B-C ratio was obtained in ZT+R with chemical weed control (2.98) followed by ZT+R with IWM (2.65).

Table 1.2.23: Weed density, dry weight, yield and economics as influenced by tillage and weed management in maize under conservation agriculture (*Rabi*, 2020-21).

Treatment	Weed density at 30 DAS (no./m²)	Weed density at 60 DAS (no./m²)	Weed dry weight at 30 DAS (g/m²)	Weed dry weight at 60 DAS (g/m²)	Grain yield (kg/ha)	Stover yield (kg/ha)	Net Returns (Rs./ha)	B: C
Tillage and residue management								
T_1 :(CT-CT)	8.80	5.03	5.97	6.67	7370	9237	77635	2.30
T_2 :(CT-ZT-ZT)	8.65	5.28	7.73	7.89	6947	9310	72383	2.27
T_3 :(ZT+R-ZT+R-ZT+R)	9.02	5.06	7.00	7.91	7244	9056	77860	2.37
CD at 5%	NS	NS	0.14	1.04	NS	NS	NS	NS
Weed management practices								
W_1 – Chemical Management	8.44	5.77	6.53	9.14	8420	9702	98646	2.71
W_2 – Herbicide rotation	8.09	6.35	6.91	9.25	7913	10090	89295	2.54
W_3– IWM	8.43	5.31	6.41	7.62	7013	9808	71022	2.19
W_4– HW at 50 DAS (control)	10.33	3.06	7.74	3.96	5402	7204	44875	1.81
CD at 5%	0.58	0.83	0.42	0.67	684.5	591.0	12777	0.22

In cotton, light yellowing of margins of cotyledon leaves was observed due to diuron application, which later on disappeared. No phytotoxic symptoms were observed on true leaves. Among crop establishment methods, the highest weed density and dry weight were recorded in ZT+R compared to CT plots. The seed cotton yield was the highest in ZT+R – ZT+R-ZT+R which was 5.3% superior to CT-ZT-ZT and 11.9% more than CT-CT. The CEY in CT-ZT-ZT was also superior by 6.2% over CT-CT.

Among the weed management methods, the lowest weed density and dry weight were observed in IWM. The IWM treatment was ineffective as the weeds rejuvenated, especially grassy weeds, immediately after brush cutting. But in IWM, early boll bursting was noticed. Chemical weed control (diuron *fb* pyrthiobac+quizalofop ethyl *fb* paraquat) recorded the highest seed cotton yield which was at par with herbicide rotation (pendimethalin *fb* pyrthiobac+ quizalofop ethyl *fb* paraquat) and superior to IWM (**Table 1.2.24**). The highest CEY was obtained in chemical weed control (W_1) which was superior to the other methods. IWM (W_3) was the next best method. Similarly, the highest gross returns, net returns, and B-C ratio were registered with ZT+R- ZT+R- ZT+R + chemical weed control (264725, 150779 Rs/ha, and 2.32, respectively). It was followed by CT-ZT-ZT + chemical weed control with 236347, 122401 Rs/ ha, and 2.07, respectively.

Table 1.2.24: Weed density, dry weight and yield as influenced by tillage and weed management in cotton under conservation agriculture (*Kharif 2022*).

Treatment	Weed density at 30 DAS (no./m²)	Weed density at 60 DAS (no./m²)	Weed dry weight at 30 DAS (g/m²)	Weed dry weight at 60 DAS (g/m²)	Kapas yield (kg/ha)
Tillage and residue management					
T_1- CT(cotton) - CT (maize)	6.92 (49.51)	5.76 (34.58)	5.92 (36.58)	6.80 (45.41)	1495
T_2- CT(cotton) - ZT (maize) - ZT (GM)	7.36 (55.56)	5.87 (31.83)	5.68 (33.08)	6.83 (45.84)	1540
T_3- ZT+R(cotton) - ZT+R(maize) - ZT+R(GM)	8.02 (67.05)	6.25 (38.08)	7.24 (55.57)	9.23 (87.05)	1528
CD at 5%	0.69	0.17	0.51	0.33	10.2
Weed management practices					
W_1 – Chemical weed control	6.72 (44.59)	6.81 (44.44)	5.10 (25.67)	7.66 (60.54)	1775
W_2 – Herbicide rotation	5.79 (33.07)	5.97 (34.89)	4.46 (19.01)	7.72 (59.72)	1726
W_3 – IWM	7.27 (52.77)	7.17 (46.22)	7.14 (51.58)	8.57 (75.70)	1326
W_4- Control	9.96 (99.08)	3.90 (13.78)	8.42 (70.71)	6.53 (41.76)	1256
CD at 5%	0.46	0.27	0.44	0.31	41.8

Effect of tillage treatments and weed management options on cotton growth

T_1W_1

T_1W_2

T_1W_3

T_1W_4

WM-1.3 Weed management strategies in organic agriculture/natural farming

WP-1.3.1 Weed management in organically grown direct-seeded finger millet – pulse cropping system

Cooperating centres: UAS, Bengaluru, OUAT, Bhubaneswar, ICAR-DWR Jabalpur

UAS, Bengaluru

Major weeds observed in the experimental plots were sedges, grasses and broad-leaved weeds. Among sedges dominant weed species was *Cyperus rotundus.* Among grasses *Echinochloa colona, Digitaria marginata* and *Cynodon dactylon,* whereas among the broad-leaved weeds *Borreria hispida, Acanthospermum hispidium, Commelina benghalensis, Cleome viscosa, Sida acuta, Alternanthera sessilis, Oldenlandia corymbosa* and *Lonaidium sufruiticesum* were dominant.

Among the different category of weeds, sedges dominated the weed density followed by broad-leaved weeds and grasses but with respect to weed dry weight broad-leaved weeds recorded the highest dry weight followed by sedges and grasses. All treatments recorded the lowest density and dry weight of weeds compared to weedy check at both the interval (30 DAS and 60 DAS).

Among the non-chemical methods of weed control, two hand weeding at 20 and 40 DAS recorded the highest WCE of 40% and 30.7% at 30 DAS and 60 DAS, respectively followed by crop residue mulch @ 6 t/ha *fb* 1 HW 20 DAS (39.23%) and stale seedbed *fb* 1 HW 20 DAS (37.30%) at 30 DAS and even at latter stage of the crop.

Two hand weeding at 20 DAS and 40 DAS recorded significantly higher grain yield (1.40 t/ha) compared to all other treatments. Crop residue mulch @ 6 t/ha *fb* 1 HW 20 DAS (1.29t/ha) and stale seedbed *fb* 1 HW 20 DAS (1.19 t/ha) were on par with above treatment. The highest grain yield might be due to better control of weeds at tillering stage which is the critical stage of crop weed competition.

Un-weeded control treatment recorded the lowest grain yield of 0.53 t/ha due to severe weed infestation. The sesbania in situ incorporation at 30 DAS treatment also recorded the lowest grain yield due to early competition between the crop and sesbania during the critical crop growth period. Same trend of grain yield was observed in the straw yield.

The BC ratio was higher in reduced spacing (20 cm) *fb* 1 HW 20 DAS (2.09) and crop residue mulch @ 6 t/ha *fb* 1 HW 20 DAS (2.05). However un-weeded treatment recorded the lowest BC ratio of 0.97 due to severe weed infestation.

Among the non-chemical methods of weed control in finger millet, two hand weeding at 20 DAS and 40 DAS was superior compared to other treatments. Crop residue mulch @ 6 t/ha *fb* 1 HW 20 DAS, Stale seedbed *fb* 1 HW 20 DAS (Rs 37,905/ha) and reduced spacing (20 cm) *fb* 1 HW 20 DAS could be the alternative method for non-chemical weed management in finger millet.

OUAT, Bhubaneswar

The predominant weed flora observed in the experimental site were *Echinochloa crusgalli, Dactyloctenium aegyptium* and *Eleusine indica* among grasses, *Cyperus rotundus* and *Cyperus iria* among sedges, *Commelina benghalensis, Ageratum conyzoides, Oldenlandia corymbosa* among broad-leaved weeds. The practice of stale seed bed (3 light tillage operations after weed emergence) *fb* one hand weeding (20 DAS) recorded the highest finger millet yield of (2.2 t/ha) over other treatment combinations.

ICAR-DWR, Jabalpur

The field experiment on weed management in direct-sown organic finger millet crop (var. GPU 45) was conducted during *Kharif* 2022. Eight treatments were evaluated in RBD replicated thrice. The crop was applied vermicompost @ 5 t/ha. The weeds comprised of *Dinebra retroflexa* (84.2%), *Cyperus rotundus* (12.2%), *Eclipta alba* (1.88%) and others.

Higher WCE was recorded under two HW (20 & 40 DAS) (95.8%), mechanical weeding 20 DAS *fb* 1 HW 40 DAS (95.6%) and reduced spacing (20 cm) *fb* 1HW 20 DAS (83.4%).

The highest grain yield of 2.15 t/ha was obtained under reduced spacing (20 cm) *fb* 1HW 20 DAS which was significantly similar to stale seedbed *fb* 1 HW 20 DAS, crop residue mulch @ 6 t/ha *fb* 1HW 20 DAS, two HW (20 & 40 DAS) and mechanical weeding 20 DAS *fb* 1 HW 40 DAS. Yield reduction under unweeded check was 66.9%.

Higher B:C was obtained under reduced spacing *fb* 1 HW (3.26), mechanical weeding 20 DAS *fb* 1 HW 40 DAS (3.09) and Stale seedbed *fb* 1 HW 20 DAS (2.99).

UAS, Bengaluru

Weed management in organically grown *Kharif*- Kodo millet- *Rabi*- Blackgram

Blackgram (2021- 22)

Among broad- leaved weeds *Borreria hispida*, *Ageratum conyzoides*, *Commelina benghalensis*, *Cleome viscosa*, *Amaranthus viridis* and *Alternanthera sessilis* were the major one. *Eleusine indica*, *Echinochloa colona*, *Digitaria marginata* and *Cynodon dactylon* were the dominant grass species and the *Cyperus rotundus* was the only sedge present in the experimental field. At both the stages (30 DAS and 60 DAS) sedges dominated the weed density followed by BLW and grasses.

Hand weeding at 20 and 40 DAS is the best non-chemical method of weed control which produces significantly the highest yield. The labor availability is a problem besides high cost involved in hand weeding resulted in lower BC ratio and net returns. Stale seed bed technique + intercultivation at 25 DAS & 45 DAS and inter-cultivation at 25 DAS + 1 Hand weeding at 45 DAS could be the alternative for weed management through non-chemical method in blackgram cultivation.

Kodo millet (2020 & 2021)

Major weed flora observed in the experimental plots was Sedges- *Cyperus rotundus*; Grasses- *Cynodon dactylon, Digitaria marginata, Echinochloa colona, Dactyloctenium aegyptium, Eleucine indica.* In Broad leaf weeds *Borreria hispida, Commelina benghalensis, Phyllanthus niruri, Alternanthera sessili, Spilanthus acmella, Oldenlandia corymbosa, Ageratum conyzoides, Amaranthus viridis, Cleome viscosa and Portulaca oleracea.*

Among the weed control treatments hand weeding at 20 DAS and 40 DAS recorded the lower weed dry weight at all stages of observation (30 DAS, 60 DAS and at 90 DAS). The best treatment (hand weeding) was comparable with straw mulching 5t/ha at 10-15 DAS and stale seed bed technique + intercultivation at 25 DAS & 45 DAS at 30 DAS and 60 DAS, respectively.

Hand weeding at 20 & 40 DAS recorded significantly higher seed yield (1.48 t/ha) compared to all other treatments. stale seed bed technique + intercultivation at 25 DAS & 45 DAS (1.24 t/ha) was on par with Intercultivation at 25 DAS + one hand weeding at 45 DAS (1.20 t/ha) and two mechanical weeding (Cycle weeder) at 20 and 40 DAS (1.20 t/ha) and Kodo millet + Fodder cowpea as intercrop with *in-situ* incorporation on 35 DAS + 1 intercultivation at 40 DAS (1.19 t/ha). Unweeded control resulted in the lowest grain yield (0.57 t/ha) due to severe weed infestation.

The benefit cost ratio was higher in hand weeding twice at 20 and 40 DAS (2.3) and stale seedbed technique + intercultivation at 25 DAS & 45 DAS (2.35) which is almost comparable with intercultivation at 25 DAS + 1 hand weeding at 45 DAS (2.20).

Blackgram (2020-21)

Major weed species observed in the experimental plots were *Cyperus rotundus* (among sedges). *Eleusine indica*, *Digitaria marginata, Echinochloa crusgalli, Cynodon dactylon* (among grasses). Whereas among broad leaf weeds - *Borreria hispida*, *Ageratum conyzoides*, *Alternanthera sessilis*, *Commelina benghalensis*, *Cleome viscosa* and *Amaranthus viridis*. At 30

DAS and 60 DAS, the density of sedges showed the dominance over the grasses and sedges.

Among weed control treatments, hand weeding at 20 and 40 DAS recorded significantly lower weed dry weight (g/mt^2) at all stages of observation (30 DAS and 60 DAS). The best treatment (hand weeding) was on par with stale seed bed technique + intercultivation at 25 DAS & 45 DAS followed by intercultivation at 25 DAS + 1 hand weeding at 45 DAS.

Hand weeding at 20 and 40 DAS is the best non-chemical method of weed control which produces significantly the highest yield. The labor availability is a problem besides high cost involved in hand weeding resulted in lower BC ratio and net returns. Stale seed bed technique + intercultivation at 25 DAS & 45 DAS and inter-cultivation at 25 DAS + 1 Hand weeding at 45 DAS could be the alternative for weed management through non-chemical method in Kodo millet - blackgram cropping system.

WP 1.3.2: Weed management in organically grown fennel-sweet corn cropping system

AAU, Anand

The sequence of crops was modified, the trial is in progress.

WP 1.3.3. Weed management in organically grown maize-wheat cropping system

CSKHPKV, Palampur

Maize (*Kharif* 2020)

Weed flora in maize was diverse i.e., *Ageratum* (32%), *Cyperus* (26%), *Echinochloa* (10%), *Panicum dichotomiflorum* (6%), *Polygonum alatum* (6%) and *Digitaria sanguinalis* (5%) were the major weeds found growing in association with maize crop. Weed control treatments brought about significant variation in the count of *Galinsoga parviflora*, *Coronopus didymus*, *Polygonum alatum* and *Digitaria sanguinalis*. The combined count of broad-leaved weeds and total weed count and dry weight were also significant owing to weed control treatments. The minimum count was recorded in the crop rotation treatment and minimum dry weight was recorded in the SSB+mulch treatment.

Weed control treatments gave significant variation in the maize cob equivalent yield. Intensive cropping, crop rotation, intercropping and RSSB+mulch resulted in significantly higher maize equivalent yield over the mechanical check. Highest net returns were accrued in the intensive cropping treatment followed by intercropping because of more crops raised in these treatments. Highest B:C was in the intensive cropping followed by crop rotation and intercropping treatments.

Pea (*Rabi* 2021-22)

In the organically managed maize – peas cropping system greater weed diversity was found in the *rabi* season. *Tulipa asiatica* (29%), *Spergula arvensis* (15%), *Stellaria media* (17%), *Phalaris* and *Ranunculus* 7% each, *Euphorbia* (6%) and *Coronopus* and *Poa* 5% each were the major weeds. Weed control treatments brought about significant variation in the count of *Tulipa asiatica*, *Spergula arvensis*, and *Stellaria media*.Crop rotation treatment effectively reduced the total weed count and total weed dry weight.

Intensive cropping and intercropping treatments resulted in 70 and 40% higher maize cob equivalent yield over the mechanical check, respectively. The rest of the treatments except mulch only and rotation were comparable to the mechanical check. Intensive cropping followed by intercropping resulted in highest net returns over the other cultural weed management treatments. Highest B:C of 2.94 was found in case of intercropping treatment followed by intensive cropping.

WP 1.3.4: (i) Weed management in organically grown rice based cropping system (Rice – vegetable pea – sweet corn) (Collaboration with Network project on organic farming)

GBPUAT, Pantnagar

Vegetable Pea (*Rabi* 2021-22)

Density of grasses & sedges at 30 DAS

were significantly influenced by both the establishment methods and weed management practices adopted in rice. However, density of BLWs remained non- significant to the establishment methods. Among different establishment systems, stale seed bed-direct seeded rice + *Sesbania* and *Sesbania* (GM)-transplanted rice recorded lowest weed density of grasses and sedges, respectively. Mechanical weeding with one pass of conoweeder *fb* one HW and mechanical weeding with two pass of conoweeder recorded the lowest density of grasses, broad leaf and sedges among different weed management practices.

Stale seed bed-direct seeded rice + Sesbania with mechanical weeding one pass of conoweeder *fb* one HW resulted in lowest density of grassy weeds which was statistically at par with combination of mechanical weeding one pass of conoweeder *fb* one HW with direct seeded rice (without stale seed bed and transplanted rice and stale seed bed-direct seeded rice + Sesbania with mechanical weeding with two pass of conoweeder **(Fig 1.3.1).**

Among different establishment methods, the highest net return (Rs. 122492/ha) and benefit cost ratio (2.6) was recorded with stale seed bed-direct seeded rice + *Sesbania* (M1). However, within non-chemical weed management practices, mechanical weeding (25 DAS/DAT) by hoe *fb* one hand weeding (45 DAS/DAT) (S3) recorded the highest net return (Rs.1,19,046/ha); while all the treatment showed similar benefit cost ratio (2.6).

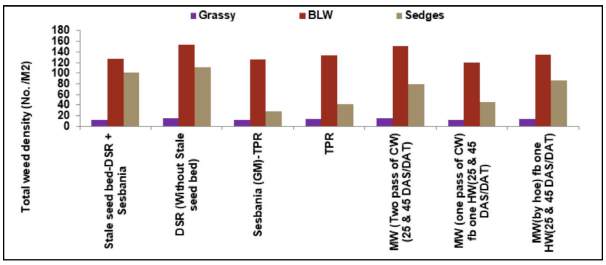


Fig. 1.3.1 : Effect of establishment methods and weed management on total weeds density on grassy, broad leaf and sedges at 30 DAS in vegetable pea under rice-vegetable pea-sweet corn cropping system.

Sweet corn (spring 2022)

The total weed density and dry matter accumulation of weeds were significantly influenced by different establishment methods at 30 DAS. stale seed bed-direct seeded rice + *Sesbania* (M1) recorded the lowest total weed density and dry matter accumulation among the establishment methods. *Sesbania* (GM)-transplanted rice (M3) were found at par with stale seed bed-direct seeded rice + *Sesbania* (M1) with respect to their total weed dry weight. However, none of the weed management practices adopted in rice had significant effect on the total weed density and weed dry matter accumulation at 30 DAS **(Fig 1.3.2).**

None of the weed management practices adopted in rice, had significant effect on yield and yield attributes of sweet corn. However, numerically, the mechanical weeding with two pass of cono weeder *fb* two hand weeding (S1) was recorded with highest final plant population (59800/ha) and individual cob weight (329.5 g). The highest number of cobs (44000/ha) and cob yield (14.6 t/ha) were recorded with mechanical weeding one pass of conoweeder *fb* one HW (S2).

Cost of cultivation across the treatments remained same for the sweet corn as treatments were applied to the preceding rice crop. Among different establishment methods, the highest and net return of (Rs. 2,70,000/ha) and benefit cost ratio of (9.7) were recorded with stale seed bed-DSR + *Sesbania* (M1). However, within non-chemical weed management practices, mechanical weeding with one pass of cono weeder (25 DAS) *fb* one hand weeding (45DAS) (S1) recorded the highest net return of Rs.2,59,833/ha and benefit cost ratio of 9.1.

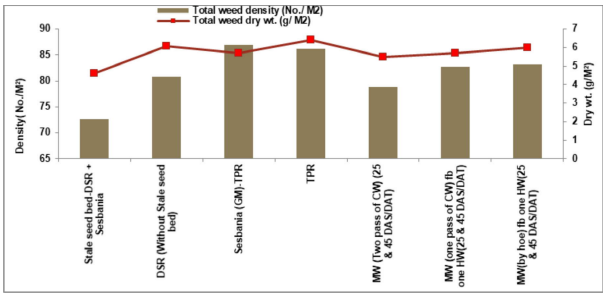


Fig 1.3.2 : Effect of establishment methods and weed management on total weeds density and dry weight at 30 DAS in spring maize under rice-vegetable pea-sweet corn cropping system.

Rice (*Kharif* 2022)

At 30 DAS/DAT, under different establishment methods, Sesbania (GM) *fb* transplanted rice recorded the lowest weed density and dry matter accumulation of grasses and sedges, which were at par with transplanted rice, only for density and dry weight of sedges, whereas, transplanted rice at par with Sesbania (GM) *fb* transplanted rice recorded the lowest density and dry weight of BLWs.

Among weed management practices, significantly lowest total weed density and dry matter accumulation of all types of weeds were recorded under mechanical weeding (one pass of conoweeder fb one HW) at 30 and 60 DAS/DAT, which were at par with Mechanical weeding (Two pass of conoweeder) only for total weed dry weight of BLWs at 30 DAS/DAT and with Mechanical weeding (By hoe) and one hand weeding (25 and 45 DAS/DAT) for density and dry weight of all the weeds except total weed dry weight of grasses at 60 DAS/DAT.

At 60 DAS/DAT, direct-seeded rice (without stale seed bed) recorded lowest total weed density of grassy, whereas, transplanted rice and Sesbania (GM) fb Transplanted rice recorded the lowest value of broad-leaved weeds and sedges, respectively. Among the establishment system, lowest weed dry matter accumulation of all the weeds were observed in Sesbania (GM) *fb* transplanted rice which was at par with transplanted rice for both the grasses and sedges. Among weed management practices, significantly lowest total weed density and dry matter accumulation of all the weeds were observed under mechanical weeding (one pass of conoweeder fb one HW) which were at par with mechanical weeding (by hoe) and one hand weeding (25 and 45 DAS/DAT) for both the grasses and BLWs. **(Fig 1.3.3).**

Under organic mode, grain and straw yield were observed singnificant with respect to establishment system and non-chemical weed management practices. Highest grain and straw yield of rice (3.4 and 6.0 t/ha), respectively, was achieved under Sesbania (GM) fb transplanted rice which were at par with transplanted rice. Under non- chemical weed management practices, highest grain and straw yield (3.5 and 6.1 t/ha) was recorded under mechanical weeding (one pass of conoweeder fb one HW) which was fb mechanical weeding (by hoe) and one hand weeding (25 and 45 DAS/DAT).

Among different establishment methods, the highest net return (Rs. 39044/ha) was recorded under Sesbania (GM)-TPR while benefit cost ratio (1.8) was recorded under stale seed bed-direct seeded rice + Sesbania. Within non- chemical weed management practices, mechanical weeding (one pass of conoweeder fb one HW) practice recorded the highest net return (Rs. 43925/ha) and highest benefit cost ratio (1.8).

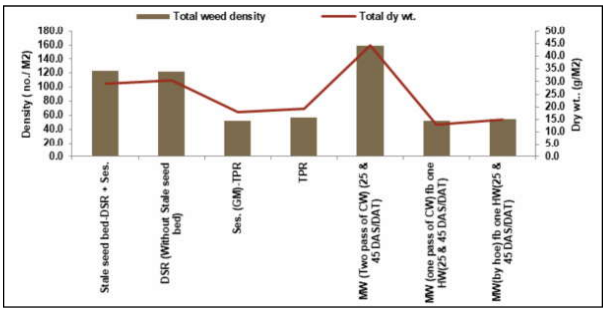


Fig. 1.3.3 : Effect of establishment methods and weed management on total weeds density & dry weight at 60 DAS in rice under rice-vegetable pea-sweet corn cropping system.

ii. Comparison of weed management in rice-vegetable pea- sweet corn cropping system under natural farming, organic farming and chemical farming.

***Kharif* 2022**

A new experiment entitled "comparison of weed management in rice-vegetable pea-sweet corn cropping system under natural farming, organic farming and chemical farming" was started from *Kharif* 2022 with the transplanted rice crop variety *"PUSA- 1509"*. Before starting of rice cultivation, *Sesbania* was sown on June 02, 2022. The Sesbania crop was incorporated in the main field on July 8, 2022. The rice nursery was sown on June 15, 2022 and the seedlings were transplanted on July 10, 2022. The crop was harvested on October 28, 2022.

In a natural farming method, all crops receive beejamrit seed treatment, and kunap jal is employed to control nutrient levels. To control weeds water stagnation up to 15DAT *fb* weed uprooting at 45 DAT and the uprooted weeds were used as mulch in this system.

In an organic farming system, a uniform dose of Sesbania 25 kg/ha, FYM 10 t/ha (basal) *fb* vermi-compost 5 t/ha (top dressing after mechanical weeding with one pass of conoweeder at 25 DAT) will be applied to the crop. Weed control was carried out using a single pass of a cono weeder at 25DAT (August 02, 2022) and one-handed weeding at 45DAT (August 23, 2022). *Sesbania* green manuring is used both in natural and organic farming.

In chemical farming system of rice, post–emergence herbicide (penoxsulam + cyhalofop –butyl 135g/ha) was sprayed on July 22, 2022 by using knapsack sprayer fitted with flat fan boom nozzle with 500 litres volume of water/ha.

Among all the type, natural, organic and chemical farming system, observation on weeds were recorded at 60 DAT. The experimental field was mainly infeasted with *E. colona*, *E. crus-galli*, *D. aegyptium*, *C. auxillaris* and *I. rugosum* among the grassy weed, *C. auxilaris*, *E. alba* and *A. baccifera*, among the BLWs and *C. diffromis*, *F. milliacea*, *C. iria* and *C. rotundus*, among the sedges.

The population of grassy weeds like *E. crus-galli*, *P. maximum* and *D. aegyptium* were recorded significantly lower among chemical and organic farming in comparison to natural farming while the population of *E. colona*, *D. sanguinalis* and *I. rugosum* were not affected significantly in all the above mentioned farming system.

Among broad leaved weeds, density of *E. alba* was significantly lowest in chemical farming while *A. baccifera* population was significantly lower in natural and was not affected significantly due to different type of farming i.e. natural, organic and chemical.

The population of all the *Cyperus* spp. and *F. milliaceae* was significantly affected due to all types of farming. The population of *C. difformis* and *C. iria* was significantly lowest in chemical system while the population of *C. rotundus* and F. *milliaceae* was significantly lower in chemical and organic type farming in comparison to natural farming.

Total density of grassy weeds and sedges were significantly lowest in chemical farming while grassy weed density was also statistically at par with organic farming while broad leaf weeds was not significantly affected. Total weed dry wt. (g/m^2) was also significantly lowest in chemical farming system.

Yield and yield attributes as no. of panicles/m^2, grains/panicle and 1000 grain weight (g) were significantly affected with different farming system. Number of panicles/m^2, grains/panicle and 1000 grain weight were highest with chemical farming and grain as well as straw yield (3.4 and 6.1t/ha) were also highest in chemical farming which was at par with organic farming (3.1 and 5.5 t/ha)

The highest net return (Rs. 34500/ha) and benefit cost ratio (6.1) was recorded under chemical farming system *fb* organic farming system (Rs. 30800/ha, 1.6).

Chemical farming

Natural farming

Organic farming

WP 1.3.5.: Weed management in organically grown aromatic rice in transplanted rice and tomato crop

IGKV, Raipur

Aromatic rice (*Kharif* 2022)

The major weed flora during the *Kharif* season of first year 2022 of the experiment was *Echinochloa colona, Cyperus iria, Alternanthera sessilis, Cynotis axilaris and Celosia argentea*. While, *Fimbristylis miliacea, Cynodon dactylon, Eclipta alba* and *Phylanthus niruri* among the other weed species.

Weed management through motorized weeder twice (single row type)+one intra row HW reduced the weed density appreciably as compared to the other treatments. Highest weed numbers of *Echinochloa colona, Cyperus iria, Alternanthera sessilis, Cynotis axilaris and Celosia argentea* were registered under the denseplanting (closer spacing of 15x10 cm) as compared to the others treatment at all the growth stages. However, *Echinochloa colona* disappeared during later stages and the population of *Fimbristylis miliacea* increased. At harvest, the weed free treatment recorded lowest total weed biomass (18.34 g/m^2).

Among the treatments, the highest number of effective tillers and grain yield (3.65 t/ha) was recorded under the application of Hand weeding (HW) twice at 20 and 40 DAT. Among the mechanical weeding practices, mechanical weeding through Ambika paddy weeder at 20 DAT + one intra row HW (3.53 t/ha) and motorized weeder twice (single row type) + one intra row HW at 20 and 40 DAT (3.51 t/ha) produced the comparable yield to that of hand weeding twice. Highest net return from mechanical weeding options was also recorded from the Hand weeding (HW) twice at 20 and 40 DAT Lowest grain yield (1.82 t/ha) was recorded under the weedy check.

Sweetcorn (*Rabi* 2021-22)

Medicago denticulata, Alternanthera sessilis, Chenopodium album and *Echinochloa colona* were the major weeds observed in the experimental field while the density of *Cyperus* spp, *Ammania baccifera,* and *Cynodon dactylon* observed lesser and grouped as other weeds

At 20 DAS among various weed management practices, the black polythene mulch treatment was found superior over all the treatment as there were lowest (0.71 m^{-2}) weeds in this treatment). Stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding was found to be next in order as second lowest count of *Medicago denticulata, Echinochloa colona, Chenopodium album, Alternanthera sessilis* and others weeds were observed in this treatment which was closely followed by mulching with paddy straw mulch 5 t/ha. Weed count data recorded at 60 DAS and at harvest revealed that among various weed management practices the lowest count of *Medicago denticulata, Echinochloa colona* were observed under black polythene mulch, whereas, *Alternanthera sessilis, Chenopodium album* and other weeds was observed the lowest in stale seed bed +25% higher plant density + mulching with paddy straw + one hand weeding **(Table 1.3.1).**

At harvest among the various weed management practices compared with live mulching with green gram (incorporation 30 DAS) as check, black polythene mulch (20 micron thickness (88.44%) was found superior over all the treatments. Stale seed bed + 25% higher plant density + mulching with paddy straw + hand weeding had WCE % of 65.35 %followed by paddy straw mulch 5 t/ha (61.41%). Lowest weed control efficiency found under weed mulching 20 DAS (in-situ mulching of weeds in between rows) + one hand weeding at 40 DAS (21.14 %).

The weed management practices had significant effect on green cob yield of sweet corn under organic farming system (Table 6). Significantly the highest green cob yield (6.86 t/ha) of sweet corn was recorded in black polythene mulch (20 micron thickness). It was found at par with the treatment having stale seed bed + 25% higher plant density + mulching with paddy straw + one hand weeding (6.55 t/ha). Although grain yield in other weed management practices was significantly lower than black polythene mulch (20 micron thickness) treatments but higher than live mulching with green gram (incorporation 30 DAS).

Table 1.3.1: Weed dry weight (at harvest), WCE, green cob yield and economics of organically grown sweet corn as affected by different weed management options in transplanted rice-sweet corn cropping system.

Treatment	Weed biomass atharvest (g/m^2)	Weed control efficiency (%)	Green cob yield (t/ha)	Net Return (Rs/ha)	BC Ratio
Hand weeding twice at 20 & 40 DAS	4.39 (18.79)	57.92	5.80	117450	3.08
Black polythene mulch (20 micron thickness)	2.38 (5.16)	88.44	6.86	147450	3.53
Paddy straw mulch 5 tonne/ ha	4.21 (17.23)	61.41	6.23	132050	3.41
Stale seed bed +25% higherplant density) + mulching with paddy straw + one hand weeding	4.00 (15.47)	65.35	6.55	138450	3.39
Hand hoe twice 20 & 40 DAS	5.55 (30.33)	32.07	5.30	107250	3.07
Live mulching with green gram (incorporation 30 DAS)	6.72 (44.65)	-	3.65	57950	2.12
Live mulching with green gram (incorporation 30 DAS) + one intra row hand weeding	5.82 (33.39)	25.22	4.85	91650	2.70
Weed mulching 20 DAS (in- situ mulching of weeds inbetween rows) + one hand weeding at 40 DAS	5.98 (35.21)	21.14	5.12	100350	2.88
SEm ±	0.14	-	0.23	-	-
CD (P=0.05)	0.41	-	0.70	-	-

OUAT, Bhubaneswar

Weed management in organically grown rice-tomato-okra system

The floristic composition of the experimental in tomato were *Digitaria sanguinalis, Eleusine indica, Echinochloa colona, Panicum repens, Cynodon dactylon* among grasses, *Cyperus iria* and *C.rotundus* among sedges and *Chenopodium album, Amaranthus viridis, Eclipta alba, Trianthema portulacastrum, Oldenlandia corymbosa Euphorbia hirta* and *Heliotropium indicum* among broad- leaved weeds.

The application of application of 1/3 recommended dose of N each through FYM, vermicompost and neemcake with the bio-fertiliser of Azotobacter + PSB to tomato along with one manual weed + one mechanical weeding (T4) in rice resulted in reduction in weed population and dry weight and its found to be at par with other organic method of weed control practices. At 50 DAT the treatment where two manual weddings were carried out in all other organic practices like T2 & T3 were found to be the best treatment w.r.t controlling the weed population and weed dry weight and it's well comparable to T4 **(Table1.3.2).**

Application of same proportion of organics through FYM, Vermicompost and Neem cake + Azotobacter + PSB to tomato with one mechanical weeding at 25 DAS/DAT and one manual weeding at 50 DAS/DAT (T4) in tomato resulted in the maximum fruit yield of tomato (17.79 t/ha) followed by T_1 and T_5.The higher yield of T_4 over other organic combinations was supported by favorable yield attributing characters of the crops in the treatment.

Table 1.3.2: Weed dynamics in *Rabi* tomato under organic package.

Treatment	Weed population/m² at 20 DAP			Weed population/m² at 40 DAP			Weed dry weight (g/m²) at 40 DAP
	Monocot	Dicot	Total	Monocot	Dicot	Total	
T_1	65	28	93	34	28	62	27.4
T_2	56	32	88	35	24	59	26.9
T_3	58	36	94	36	25	61	28.3
T_4	51	34	85	38	24	62	26.7
T_5	48	31	79	32	21	53	23.7
T_6	46	33	79	41	39	80	24.0

WP 1.3.6 Organic weed management practices for coconut plantations

KAU, Thrissur

The data on weed seed bank study shows that the soil of the experimental site had good weed seed density, and grasses were the dominant flora, followed by broadleaf weeds. Sedges were not present. Also there was high seed load in surface compared to subsurface layer. There was a decline in germination percentage in case of both soil layers with advancement of time, which shows that weed seed bank get depleted by this time.

On an average 60 weed seedlings were emerged by 30th day in surface and 23 numbers from subsurface layer. Grass weeds constituted 66% of the total weed population.

Weed flora constituted mainly of grasses followed by broadleaf weeds. In both soil layers the constitution of weed spectrum remained the same. The broadleaf weeds observed were *Celosia argentea*, *Borreria hispida* and *Cleome* spp, *Borreria* being the dominant one. Major grasses were *Panicum maximum* and *Pennisetum pedicellatum.*

In treatments in-situ green manuring

using horse gram and mulching with Oushadhi waste, weed population was found to be zero at 2 Month After Treatment (MAT). *In-situ* green manuring with daincha and cowpea recorded 7.64 and 6.37 weeds/m^2, respectively. In plots intercropped with turmeric, weed population was very high compared to the legume intercropped plots with a weed density of 62.37 weeds/m^2.

Weed dry weight was also recorded at two-month interval and here also same trend as that of weed count was observed. At 2 MAT, in-situ green manuring using horsegram and mulching with Oushadhi waste were most effective with 100% reduction compared to control. In-situ green manuring with cowpea and daincha showed a weed dry matter reduction of 99% and 98%, respectively compared to unweeded control and were statistically comparable. In intercropping with turmeric, 82% reduction in weed dry matter was observed. The highest weed dry matter was recorded from unweeded control, followed by ploughing alone. At 4 MAT also, similar trend was noticed.

Among different treatments, both *in-situ* green manuring with horse gram and intercropping with turmeric recorded the highest organic carbon content in the soil three months after sowing of the green manure crops (1.04%) followed by both *In-situ* green manuring with daincha in the interspaces) and (*In-situ* green manuring with cowpea in the interspaces) (1.03%). The pH was in the range of 4.69-5.71. The average nitrogen, phosphorus and potassium content in the soil were 86.43 kg/ha, 52.42 kg/ha and 232.62 kg/ha, respectively **(Table 1.3.3).**

Table 1.3.3: Soil chemical analysis (3 months after intercropping).

Treatments	pH	EC (µS/m)	Organic carbon (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
T_1 *In-situ* green manuring with daincha in the interspaces	5.15	40.33	1.03	91.99	26.93	190.51
T_2 *In-situ* green manuring with cowpea in the interspaces	5.00	71	1.03	100.53	54.59	215.71
T_3 *In-situ* green manuring with horse gram in the interspaces	5.09	51.33	1.04	87.81	58.35	231.09
T_4 Mulching interspaces of coconut trees using Oushadhi Waste @20 t/ha	5.71	73	1.12	76.90	33.73	296.49
T_5 Ploughing alone	5.05	61	0.99	83.63	67.91	222.24
T_6 Intercropping with turmeric	4.69	300.67	1.04	101.43	55.96	282.02
T_7 Control	5.11	40.33	0.96	62.72	69.47	190.25

***In-situ* green manuring with horse gram in the interspaces**

Mulching interspaces of coconut using Oushadhi Waste 20 t/ha

Inter cropping with turmeric

***In-situ* green manuring with dhaincha in the interspaces**

Ploughing alone

Unweeded control

WP 1.3.7: Weed management practices in organically grown cotton

PDKV, Akola (Year of commencement *Kharif* 2021)

The major weed flora during *Kharif* season in cotton crop in the selected area composed of following weed species. *Cynodon dactylon, Cyperus rotundus, Commelina benghalensis, Digitaria sanguinalis, Dinebra retroflexa* were the monocots while, the dicots were *Digera arvensis, Euphorbia geniculata, Parthenium hysterophorus, Celosia argentea, Alternanathera triandra, Portulaca oleracae, Amaranthis viridis, Acalypha indica, Ipomoea reniformis, Phyllanthus niruri.*

The highest weed control efficiency was recorded with plastic mulching throughout the growth stagesfollowed by soil solarization + hand weeding twice this may be due to better control of weeds **(Table 1.3.4)**. While lowest weed control efficiency was noticed in hand weeding + wheat straw mulching at 30 and 60 DAS, however, at 90 and 120 DAS farmers practice recorded lowest weed control efficiency.

Lowest weed index was recorded with plastic mulching on BBF at the time of sowing followed by soil solarization *fb* hand weeding at 20 & 40 DAS.

Table1.3.4: Weed control efficiency as influenced by different treatments.

Treatment	Weed Control Efficiency (%)				Weed index (%)
	30 DAS	60 DAS	90 DAS	120 DAS	
Stale seedbed preparation + Hand weeding at 20 & 40 DAS	29.90	59.02	60.04	60.06	26.61
Soil solarization + Hand Weeding at 20 & 40 DAS	66.02	65.46	76.91	74.31	11.93
Plastic mulch at sowing on BBF	80.01	80.50	87.40	86.19	0.00
Intercrop/Cover crop (Greengram in *khar*if) 1:2	39.13	18.41	61.91	60.13	26.61
Green manuring (Incorporation of Sunhemp 30 DAS)	51.54	39.27	75.90	69.73	19.27
Hand Weeding once at 20 DAS +Straw mulch (5 t/ha) at 20 DAS)	25.34	30.92	64.24	61.31	22.02
Farmers practice(3 Hoeings 20 Days interval *fb* 2 HW 20 & 40 DAS)	63.41	38.51	42.38	37.76	39.45
Weedy check	0.00	0.00	0.00	0.00	88.07

Significantly higher number of bolls was observed in plastic mulching on BBF which was at par with soil solarization + hand weeding twice and stale seed bed + hand weeding twice. Boll weight per plant was significantly influenced over weedy check, however, the difference among different treatments were found at par. Lowest boll number and boll weight per plant was recorded in weedy check.

Weed control practices caused significant variation on seed cotton yield. The highest seed cotton yield (1.09 t/ha) was registered with plastic mulching at sowing on BBF. Next best treatments were stale seed bed and soil solarization *fb* hand weeding twice, respectively. Similar trend of result was noticed in stalk yield (t/ha). The lowest seed cotton yield was recorded with weedy check. The highest gross, net monetary return and benefit cost ratio was recorded with plastic mulch at sowing followed by stale seed bed + hand weeding twice.

WP 1.3.8. Weed management in tomato-beetroot-watermelon cropping system under organic agriculture

PJTSAU, Hyderabad

The weed flora observed during crop growing season consists of: *Cyperus rotundus,*

Parthenium hysterophorus, *Alternanthera sessilis, Digera arvens, Amaranthus viridis, Amaranthus polygamus, Aacalypha indica, Dactyloctenium aegyptium, Portulaca oleracea, Oldenlandia corymbosa, Ocimum tenuiflorum and Euphorbia geniculata at various stages of observation.*

Weed density recorded at 30 DAT was the lowest with stale seed bed *fb* HW at 20 and 40 DAT which was at par with poly mulch + intra row HW at 30 DAT and rice straw mulch 5 t/ha + intra row HW at 30 DAT. The other treatments were inferior. At 60 DAT also, the above mulch treatments could reduce the weed density significantly compared to weedy check. Hoeing twice at 30 & 50 DAT + intra row HW was also at par with the mulch treatments. The weed dry matter exhibited same trend to that of weed density both at 30 and 60 DAT. The weed control efficiency at 30 DAT was the highest with with stale seed bed *fb* HW at 20 and 40 DAT which was comparable with poly mulch + intra row HW at 30 DAT and rice straw mulch 5 t/ha + intra row HW at 30 DAT. At 60 DAT also, poly mulch or rice straw mulch or hoeing supplemeted with intra row HW recorded comparable WCE and superior to *dhaincha* live mulch or stale seed bed or intercropping green leaf vegetable (Table 1.3.5).

Among the treatments, highest tomato yield was recorded in polymulch + intra row HW at 30 DAT which was followed by rice straw mulch 5t/ha + intra row HW at 30 DAT. In the remaining treatments, the yield levels were reduced significantly.

Based on the first-year experimental results, it can be concluded that polymulch + intra row HW at 30 DAT or rice straw mulch 5t/ ha + intra row HW at 30 DAT were found to be effective non-chemical weed control methods and realized higher tomato yield in tomato-beet root-water melon cropping system.

Table 1.3.5: Weed control efficiency (WCE) (%) and fruit yield (t/ha) in tomato as influenced by non-chemical weed management practices in tomato-beet root-water melon cropping system (*Kharif*, 2022).

Treatment	WCE (%)		Fresh tomato yield (t/ha)
	30 DAT	60 DAT	
Live mulch with *dhiancha* and incorporation at 30 DAT	51.6	58.7	6.18
Stale seed bed *fb* HW at 20 & 40 DAT	85.2	74.9	15.28
Poly mulch + intra row HW at 30 DAT	82.0	83.3	21.34
Rice straw mulch 5 t/ha + intra row HW at 30 DAT	78.7	82.3	19.04
Hoeing twice at 30 & 50 DAT+intra row HW	63.9	84.6	10.80
Intercrop green leaf vegetable *fb* HW at 40 DAT	48.4	69.9	7.60
Unweeded control	-	-	2.17
SE(m) ±	-	-	0.67
CD (P=0.05)	-	-	2.09

Treatment effects at 30 DAT

Polythene mulch

Stale seed bed

Rice straw mulch

Dhaincha live mulch

WP 1.3.9. Non-chemical weed management in Brinjal

TNAU, Coimbatore

Grasses and broad-leaved weeds were dominant in all the treatments at 20 & 40 DAT. This was followed by grasses and sedges. Among the broad-leaved weeds, *Digeria arvensis, Trianthema portulacastrum* were predominant and *Dactyloctenium aegyptium, Cynodon dactylon* were dominant species in grasses.

At 20 DAT, lower weed density and weed dry weight were recorded with weed mulch @ 5t / ha (T_2) and it was on par with biodegradable polythene mulch (T_1). Higher weed control efficiency of 62.5% was recorded with T_2 at 20 DAT and it was followed by T_1. At 40 DAT also the similar trend was observed with weed density, dry weight and weed control efficiency **(Table1.3.6)**.

The crop is in flowering and fruiting stage. The trial is under progress.

Table 1.3.6. Total weed density and total weed dry weight at 20 & 40 DAT as influenced by non-chemical weed management in brinjal

	20 DAT			40 DAT		
Trt	**Total weed density (No/m²)**	**Total weed dry weight (g/m²)**	**WCE (%)**	**Total weed density (No/m²)**	**Total weed dry weight (g/m²)**	**WCE (%)**
T1	1.75 (2.55)	1.6 (2.15)	62.1	2.0 (3.56)	1.99 (3.5)	61.5
T2*	1.74 (2.52)	1.55 (1.9)	62.5	1.96 (3.37)	1.54 (1.89)	62.7
T3	1.82 (2.84)	1.96 (3.36)	57.9	2.04 (3.9)	2.11 (4.05)	55.2
T4	2.37 (5.15)	2.41 (5.58)	23.4	2.54 (6.05)	2.51 (5.78)	35.0
T5	2.24 (4.65)	2.27 (4.71)	31.1	2.41 (5.33)	2.39 (5.28)	41.5
T6	2.09 (3.85)	2.01 (3.53)	42.7	2.2 (4.37)	2.34 (5.16)	52.0

T7	1.96 (3.35)	1.96 (3.46)	50.0	2.13 (4.07)	2.23 (4.52)	55.9
T8	2.51 (5.81)	2.62 (6.56)	13.6	2.76 (7.19)	2.93 (8.14)	21.0
T9	2.69 (6.72)	2.96 (9)	0.0	3.11 (9.16)	3.51 (11.86)	0.0
SEd	0.12	0.38	-	0.23	0.23	-
CD 5%	0.25	0.81	-	0.49	0.49	-

Figures in parenthesis are means of original values; Data subjected to square root transformation
* Weed mulch @ 5 t/ha

WP 1.3.10 Weed management in organically grown baby corn - fenugreek cropping system (in collaborative with NPOF)

MPUAT, Udaipur

Fenugreek

The major dicot weeds in the experimental field were *Chenopodium album* (21.09%), *Chenopodium murale* (17.48%), *Fumaria parviflora* (6.85%), *Convolvulus arvensis* (11.23%), *Melilotus alba* (11.23%) and *Malva parviflora* (11.48%) and *Phalaris minor* (8.44%),*Cynodon dactylon* (4.53%) and *Cyperus rotundus* (7.67%) were the monocot weeds at 30 DAS.

Weed density of grassy and broad leaf weeds were recorded significantly lower in both stale seed bed and soil solarization in comparison to weedy check. Among these primary treatments soil solarization recorded lowest weed density and dry matter. The treatment of plastic mulch with the basic treatments of stale seed bed or soil solarization recorded significantly lower weed density. Both these treatments of plastic mulching were at par and significantly superior over other treatments like stale seedbed *fb* interculture at 20DAS *fb* mechanical weeding at 40 DAS and Soil solarization *fb* Inter culture at 20 DAS *fb* mechanical weeding at 40 DAS.

Weed dry matter recorded at 30 and 60 DAS was significantly influenced by organic weed management practices. Treatment with plastic mulch proved most effective and recorded nil population of weeds with zero dry matter at 30 DAS in comparison to weedy check (60.48 g/m^2). Maximum weed control efficiency at 30 DAS (99.99%) was observed with Stale seedbed and solarization with plastic mulch. Like wise at 60 DAS, the maximum weed control efficiency (99.96%) was observed in stale seed bed technique with plastic mulch.

Maximum values of seed yield (1823 kg/ha) and haulm yield (4492 kg/ha) of fenugreek were recorded with crop sown with treatment of stale seed bed technique with plastic mulch, which was at par with plastic mulch with soil solarization. All the organic weed management treatments proved statistically superior over weedy check.

The highest net return (Rs 91099 /ha) was obtained with stale seed bed technique with plastic mulch whereas maximum B:C ratio (2.71) was recorded with Inter culture at 20 DAS *fb* mechanical weeding at 40 DAS.

Baby corn

The major broadleaf weeds in the experimental fields were *Digera arvensis* (9.65%), *Amaranthus viridis* (10.91%), *Trianthema portulacastrum* (11.31%), *Physalis minima* (8.17%) and *Commehina benghalensis* (13.02%). The grassy weeds were *Echinochloa colona* (24.62%) and *Eleusine indica* (12.59%), *Cynadon dactlyon* (9.72%).

The treatment of plastic mulch with the basic treatments of stale seed bed or soil solarization recorded significantly lowest weed density. All these treatments of plastic mulching were at par and significantly superior over other treatments like staleseed bed *fb* interculture at 20DAS *fb* mechanical weeding at 40 DAS and Soil solarization *fb* Inter culture at 20 DAS *fb* mechanical weeding at 40 DAS.

Treatment with plastic mulch proved most effective and recorded nil population of weeds with dry matter at 30 DAS in comparison to weedy check (47.94 g/m^2). Maximum weed control efficiency at 30 DAS was observed with the treatment of stale seedbed and solarization followed plastic mulching at sowing. Likewise at 45 DAS, also maximum weed control efficiency (99.94%) observed stale seed bed technique with plastic mulch.

Maximum green cob yield (2483 kg/ha) was recorded with treatment in which baby corn field prepared with soil solarization followed by plastic mulching, however it was found at par with other treatments of plastic mulch and stale seedbed preparation *fb* straw mulch (5 t/ha) at 20 DAS *fb* Inter culture at 20 DAS *fb* hand weeding at 40 DAS. Superiority of plastic mulch in non chemical weed management with soil solarization and stale seed bed was also observed by yield attributes.

The highest net return (Rs 71760 /ha) and B:C (3.30) was obtained with Soil solarization *fb* Sesbania as smothering crop in between rows and used same as mulch after 30 days *fb* 1 HW at 40 DAS.

SSB *fb* PM at sowing

SSB *fb* SM (5 t/ha) at 20 DAS *fb* IC at 20 DAS *fb* HW at 40 DAS

Effect of weed management in baby corn

SSB *fb* SM (5 t/ha) at 20 DAS *fb* IC at 20 DAS *fb* HW at 40 DAS

SSB *fb* PM at sowing

Effect of weed management in fenugreek

PJTSAU, Hyderabad

Non-chemical weed management practices in baby corn – cabbage organic cropping system

The lowest weed density was observed with rice straw mulch 5t/ha + intra row HW at 30 DAT which was significantly lower than all the other weed management practices. It was followed by hoeing twice at 15 & 30 DAT which was at par with groundnut shell mulch 2 t/ha, poly mulch + intra row HW at 30 DAT and intercropping green leaf vegetable (fenugreek) fb HW at 40 DAT. Rice husk mulch 3 t/ha was on par with unweeded control with respect to weed density at 25 DAT.

At 50 DAT, no weed was recorded in intercrop treatment. The next best treatment was polymulch + intra row HW and it was at par with rice straw mulch and was significantly lower than other treatments.

Unlike weed density, weed biomass at 25 DAT was the lowest in hoeing twice at 15 & 30 DAT followed by rice straw mulch and poly mulch. At 50 DAT, the weed biomass was nil in intercropping with green leaf vegetable *fb* HW at 40 DAT. Among the mulches, lowest weed biomass was observed in poly mulch which was at par with rice straw mulch and hoeing twice. Groundnut shell mulch significantly reduced the weed biomass over unweeded control but rice husk mulch recorded on par weed biomass.

Highest yield/ha was also recorded in groundnut shell mulch followed by rice straw mulch which were at par with each other. Poly mulch was the next best treatment. Intercropping with fenugreek gave 2620 kg/ha of green leafy vegetable.

The cost of cultivation was higher with poly mulch followed by rice husk mulch and rice straw mulch. However, highest gross and net returns were realized in groundnut shell mulch due to higher yields which was followed by rice straw mulch and poly mulch. Similar trend was observed with B-C ratio as well **(Table 1.3.7)**.

Among the weed management treatments, the highest Baby Corn Equivalent Yield (BCEY) was obtained in live mulching with dhaincha in baby corn *fb* groundnut shell mulching in cabbage which was majorly due to higher cabbage yields. It was followed by rice straw mulch in both the crops.

Table 1.3.7: Economics of cabbage as influenced by non-chemical weed management practices in baby corn – cabbage organic cropping system (*Rabi*, 2021-22).

Treatment	Cabbage equivalent yield (t/ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs./ha)	Net Returns (Rs./ha)	B-C ratio
Groundnut shell mulch 2 t/ha	35.10	168250	701920	537170	4.26
Rice husk mulch 3 t/ha	14.03	176750	280587	107337	1.62
Polymulch + intra row hand weeding at 30 DAT	28.04	196750	560733	367483	2.90
Rice straw mulch 5 t/ha+ intra row HW at 30 DAT	30.11	173500	602100	432100	3.54
Hoeing twice at 15 & 30 DAT	24.13	173390	482693	312803	2.84
Intercrop green leaf vegetable *fb* HW at 40 DAT	22.76	169570	455200	289130	2.74
Unweeded control	12.25	164750	245007	83757	1.52

Treatmental effects at 50 DAT

Groundnut shell mulching

Paddy straw mulching

Plastic mulching

Rice husk mulching

Hoeing

Unweeded check

WP 1.3.12: Weed management in organically grown basmati rice-vegetable pea-sweet corn cropping system

SKUAST, Jammu

Rice (*Kharif*-2022)

The experimental field was dominated by *Echinochloa* spp. amongst grassy weeds; *Alternanthera philoxeroides* and *Ammannia baccifera* amongst broad-leaved weeds and *Cyperus* spp. Beside, these major weeds *Caesulia axilaris* and *Commelina benghalensis* were recorded as other weeds.

The lowest individual weeds as well as total weed density was recorded in two hand weeding at 40 and 40 DAT at 30, 60 DAT and at harvest. Also, the lowest biomass of weeds was observed in two hand weeding at 40 and 40 DAT at 60 DAT and at harvest.

The highest growth, yield attributes and yield of basmati rice were recorded in *Sesbania* green manure before transplanting *fb* 1 hand weeding at 30 DAT followed by *Sesbania* green manure before transplanting *fb* 1 mechanical weeding at 30 DAT. Also, highest gross returns, net returns and B:C ratio were recorded in *Sesbania* green manure before transplanting *fb* 1 hand weeding at 30 DAT followed by *Sesbania* green manure before transplanting *fb* 1 mechanical weeding at 30 DAT.

Weed management in organically grown basmati rice-knol khol cropping system (Collaboration: AICRP on Vegetable, SKUAST-J)

Knol-khol (*Rabi*-2021-22)

The different weed management treatments had significant effect on weed density and weed biomass at 30 and 50 days after transplanting. The paddy straw mulch (8 t/ha) +1 hand weeding at 30 DAT recorded significantly lower weed density and weed biomass than other treatments except two hand weeding at 20 and 40 DAT.

Weed management treatment had a significant influence on knol-khol yield. The highest knol-khol yield was recorded paddy straw mulch (8 t/ha) +1 hand weeding at 30 DAT which was statistically at par with all other treatments except paddy straw mulch 4

t/ha. Also, highest BC ratio was recorded in paddy straw mulch (8 t/ha) +1 hand weeding at 30 DAT followed by paddy straw mulch (8 t/ha).

WP 1.3.13: Weed management in organically raised sugarcane-ratoon system

PAU, Ludhiana

The research trial on 'Weed management in organically raised sugarcane-ratoon system' is under progress. As per approved technical program, for soil fertility enhancement for sugarcane, first filler crop of *sunhemp* (*Crotalaria juncea*) was taken as green manure in *kharif* 2022 and incorporated into soil. The field was first laser levelled. After the layout of the field, *sunhemp* was sown on 25 July 2022 and incorporated on 8 September 2022. At the time of incorporation, the average crop height was 184 cm and average crop dry biomass was 7.09 kg/m^2. Second filler crop of *Egyptian clover* was sown on 05 October 2022 and will be incorporated in February 2023. First cutting of berseem for forage was done on 12 Dec 2022. The crop dry biomass at first cutting 0.244 kg/m^2. The sugarcane will be planted, as per treatments, in 2nd half of February 2023.

WP 1.3.14: Weed management in organically grown sweetcorn-potato-green manure cropping system (2020-21 and 2021-22)

RVSKVV, Gwalior

Sweetcorn

The major weed flora observed at experimental site during *Kharif* 2020, 2021 and 2022 was *Cynodon dactylon, Brachiaria reptans, Setaria glauca Echinochloa crus-galli* and *Acrachne racemose* as narrow leaved weeds (NLW's), *Digera arvensis* and *Commelina benghalensis* as broad-leaved weeds (BLW's). During all the three seasons the *Cyperus rotundus as sedged* was the most problematic weed in the

experimental site. The broad-leaved weed *Commelina benghalensis* was not seen in the experimental site up to 30 DAS, however *Digera arvensis* emerged in 2020 and 2022 not appeared in 2021 up to 30 DAS. The *Cynodon dactylon* appeared first time in 2022 as it was not seen in last two years.

The population and dry weight of *Setaria glauca* and *Echinochloa crus-galli* was significantly higher as compared to last year. However, the density of *Acrachne racemose* was either less or nil where plastic mulch, soil solarization and straw mulch was applied. The *Cynodon dactylon* was not appeared in 2021 during entire the crop growth period, however it was appeared in 2022 in less quantity in comparision to other weeds. The total weed population and dry weight was recorded significantly lower where one hand weeding at 20 DAS *fb* straw mulch (5t/ha) at 25 DAS was applied and it was at par with the treatment soil solarization *fb* plastic mulch, soil solarization *fb* hand weeding, and plastic mulch alone as compared to weedy check. The broad-leaved weeds were not observed in all the treatments at 30 DAS in 2021, whereas they were present in 2020 and 2022 in the experimental plots. However, at 60 DAS, the broad-leaved weeds were suppressed by the treatment where soil solarization was done *fb* one HW at 40 DAS and it was significantly very less in the weedy check plot. The maximum weed control efficiency (75%) was recorded where one hand weeding at 20 DAS *fb* straw mulch (5t/ha) at 25 DAS was done *fb* hoeing (20 and 40 DAS) (64%) and soil solarization with one hand weeding at 40 DAS (56%).

The maximum cob yield (7.83 t/ha) was fetched in the treatment where one hand weeding at 20 DAS *fb* straw mulch (5t/ha) at 25 DAS was done which was at par with straw mulch of the previous crop at 5 DAS (7.51 t/ha) soil solarization *fb* one hand weeding at 40 DAS (7.47 t/ha) and black plastic mulch (25µ) (7.41 t/ha). The maximum stover yield (25.55 t/ha) was recorded in one hand weeding at 20 DAS with straw mulch (5t/ha) at 25 DAS *fb* hoeing at 20 and 40 DAS (21.89 t/ha).

On the basis of three-year experimentation, it was concluded that the maximum cob yield (7.83 t/ha) with net income Rs. 283109/ha and BC ratio (4.48) was recorded where one hand weeding at 20 DAS *fb* straw mulch (5t/ha) at 25 DAS was done. It also gave better response to suppress the narrow and broad-leaved weeds with 75% WCE. However, the straw mulch of previous crop at 5 DAS was at par with soil solarization *fb* hand weeding at 40 DAS in terms of productivity and profitability. Therefore, among all the non-chemical weed management practices, one hand weeding at 20 DAS *fb* straw mulch (5 t/ha) at 25 DAS, got profitable economically and increase the productivity and profitability of sweet corn in maize-based cropping system.

Potato

The major weed flora of experimental site during crop growth period were comprised by *Cyperus rotundus*, *Phalaris minor*, *Spergula arvensis*, and *Polypogon monspeliensis* as grasses and *Chenopodium album*, *Medicago hispida*, *Anagallis arvensis and Convolvulus arvensis* were observed as major broad-leaved weeds (BLW's). The sedges *Cyperus rotundus* was most dominating among all the weeds in potato field during entire crop growth period.

Among different weed management practices up to 30 days of planting no weeds were observed in the plot where plastic mulch was applied except *Cyperus rotundus*. However, the *Polypogon monspeliensis* and *Convolvulus arvensis* was totally disappeared during both the year at 30 DAP at 60 DAP the total density of weeds was suppressed by earthing up at 20 and 40 DAP which was at par with the treatments soil solarization *fb* plastic mulch (25µ), plastic mulch alone and straw mulch of

the previous crop at 40 DAP. The weed density was significantly higher in weedy check. The population of BLWs, NLWs and sedges signigficantly controlled by earthing up at 20 and 40 DAP and soil solarization *fb* plastic mulch (25µ). Although the population of sedges was very high in the weedy check plot.

Dry weight of weeds was significantly affected by the application of different treatments. At 30 DAP the minimum dry weight production of narrow, broad and sedges was recorded in one hand weeding at 20 DAP with straw mulch at 25 DAP which was at par with plastic mulch (25µ) and earthing up at 20 and 40 DAP respectively. After 60 days of planting the minimum dry weight of narrow leaved weeds was found under soil solarization *fb* plastic mulch (25µ) and it was at par with plastic mulch, soil solarization with one hand weeding at 40 DAP, earthing up at 20 and 40 DAP and straw mulch of previous crop at 40 DAP. The maximum weed dry weight was recorded in the weedy check treatment. The maximum weed control efficiency (73%) was also recorded where soil solarization was done with plastic mulch (25µ) *fb* plastic mulch (25µ) alone (67%) and soil solarization with one hand weeding at 40 DAP (64%)

The maximum tuber yield was recorded (24.86 t/ha) in the treatment where one hand weeding at 20 DAP*fb* straw mulch (5 t/ha) at 25 DAP was done which was at par with the treatment earthing up at 20 and 40 DAP (23.26 t/ha). The lowest tuber yield (15.05 t/ha) was recorded in unweeded control plot.

Application of one hand weeding at 20 DAS *fb* straw mulch (5 t/ha) at 25 DAP fetched significantly maximum net returns (Rs.215540/ ha) and BC ratio (2.99) *fb* earthing up at 20 and 40 DAP (Rs. 193963/ha) and BC ratio (2.73). The minimum net returns (Rs. 34203/ha) and BC ratio (1.14) was recorded in the plot where soil solarization *fb* plastic mulch was done. The economics was higher for the same treatment due to higher cost of plastic mulch.

On the basis of two years data, it was concluded that the soil solarization *fb*plastic mulch (25µ) and plastic mulch (25µ) alonecan be contribute to decreased the narrow and broad-leaved weeds but higher productivity and profitability of potato crop was obtained in one hand weeding at 20 DAP*fb* straw mulch (5 t/ha) at 25 DAP which was at par with the treatmentearthing up at 20 and 40 DAP under organically grown maize based cropping system. However, the WCE was higher in soil solarization with plastic mulch treatment but it is very expensive economically and not getting returns satisfactory.

Impact of straw mulching of the previous crop at 5 DAP

Impact of earthing up at 20 and 40 DAP in potato crop

Impact of soil solarization fb one hand weeding at 40 DAP

WP- 1.4 Management of Parasitic weeds

WP. 1.4.1. (i) Management of *Orobanche* in brinjal

Cooperating centers: UAS, Dharwad, OUAT, Bhubaneswar

OUAT, Bhubaneswar

A field trial on management of *Orobanche* in brinjal crop was initiated in *Orobanche* infested vegetable tract of Cuttack disrict (Talabasta village) during November, 2022 in farmer's field. The emergence of the shoot takes around 49 days and there were on an average 5.2 shoots per single brinjal plant. The shoot of *Orobanche* goes up to a height of 14.3 cm. And the shoot dries in 38 days. The parasite produces around 4500 seeds / floret and there were 40.0 florets per shoot **(Table 1.4.1)**.

Table 1.4.1: Biology of *Orobanche* in brinjal

Parameters		Range	Mean
Days to emergence of shoot above ground (from date of planting)		43 - 56	49
No of shoots of parasite / plant		3 - 7.4	5.2
Shoot height(cm)		11.3 – 17.0	14.3
Days to flowering (from the date of planting)		50-60	55
Days to drying of shoot (from the date of emergence)		35-41	38
Dry weight / plant	Stem	1.1 – 4.5	3.0
	Florets	0.5-2.0	1.4
	Seeds	0.30-1.36	0.76
	Total	1.90 – 7.86	5.16
No. of florets / shoot		26 – 95	40.0
No. of seeds / floret		3500 – 5700	4500
No. of seeds / inflorescence		96400-550200	280000

Application of neem cake 200 kg/ha *fb* ethoxysulfuron 25 and 25 g/ha at 25 and 50 DAT recorded significantly the lowest number of *Orobanche*/plant ((9.2) at 30 DAP. However, the application of UAS- D AMF consortium (soil application @ 8 kg/acre) recorded significantly the lowest density (10.2) at 30 DAP and the reduction in density was in the tune of 25% over application of untreated check.

CCSHAU, Hisar

WP. 1.4.1. (ii) Management of *Orobanche* in tomato

Broomrape panicles did not appear even up to 90 days after transplanting (DAT) in the treatments. Application of ethoxysulfuron 50 g/ha at 60 and 90 DAT, 45 and 90 DAT provided effective control of broom rape stalks (4.0-6.0/m^2) as compared to untreated check (11.0/m^2) at harvest. Application of sulfosulfuron at 50 g/ha at 60 and 90 DAT resulted in more phyto-toxicity to crop as compared to sulfosulfuron at 25 g/ha at 60 DAT *fb* 50 g/ha at 90 DAT. Similarly, the phyto-toxicity with ethoxysulfuron ranged between 10-12% at 20 DAT. Maximum fruit yield (24.9 t/ha) was recorded from use of sulfosulfuron 50 g/ha at 60 and 90 DAT followed by sulfosulfuron 25 g/ha at 60 and 50 g/ha 90 DAT and ethoxysulfuron 50 g/ha as 45 and

90 DAT with 42.0 % increase over untreated check **(Table 1.4.2)**.

Table 1.4.2: Effect of different weed control measures on broom rape (*Orobanche*) spikes, visual control, crop toxicity and fruit yield of tomato (2021-22).

Treatment	Number of broom rape spikes/m² Harvest	Visual phytotoxicity (%) on crop 20 DAT	Visual broom rape control (%) Harvest	Fruit yield (t/ha)
Sulfosulfuron 25 g/ha as PRE and 60 DAT	2.8 (8.0)	8	60	17.6
Ethoxysulfuron 50 g/ha as 60 and 90DAT	2.6 (6.0)	10	75	21.5
Ethoxysulfuron 50 g/ha as 45 and 90DAT	2.2 (4.0)	12.0	78	22.5
Sulfosulfuron 25 g/ha at 60 DAT *fb* 50 g/ha at 90 DAT	1.7 (2.0)	15.0	80	23.3
Sulfosulfuron 50 g/ha at 60 and 90 DAT	1.0 (0.0)	20.0	85	24.9
Handpulling	1.7 (2.0)	0.0	100	16.6
Untreated check	3.5 (11.0)	0.0	0.0	14.4

WP 1.4.2 Management of *Orobanche* in mustard through use of glyphosate

CCSHAU, Hisar

Demonstrations on use of glyphosate for *Orobanche* control in mustard were carried out at 21 locations in Mahendergarh, and 10 locations in Bhiwani and Hisar districts. The average yield of mustard with use of glyphosate was 10-12% higher than the control in Mahendergarh district. This experiment will be discontinued.

WP.1.4.3. Management of *Striga* in Sugarcane

Experiments are under progress at two locations in Dharwad and at Annur Taluk of Coimbatore District.

WP. 1.4.5. Management of *Cuscuta* in berseem fodder crop

RVSKVV, Gwalior

Field experiment was conducted at the research farm of RVSKVV Gwalior during *Rabi* 2020-21and 2021-22 to investigate the interference of *C. campestris* densities and the efficacy of herbicides for its control in berseem.

Application of pendimethalin 500 g/ha as EPoE

Application of imazethapyr 40 g/ha after first cutting

On the basis of two years experimentation, it is concluded that the early post- emergence application of pendimethalin 500 g/ha at 10 DAS significantly suppressed the *Cuscuta* emergence up to 90 DAS. Whereas, the imazethapyr 40 g/ha after first cut *fb*

imazethapyr 40 g/ha after last cut provided the maximum fodder yield (61.28 t/ha) and seed yield (463 kg/ha) with BC ratio (4.02) which was at par with imazethapyr 40 g/ha after 1st cut and imazethapyr 40 g/ha after last cut. However, the application of oxyfluorfen 150 g/ha as PE showed higher level of phytotoxicity symptom in berseem crop

IGKV, Raipur

The first appearance of *Cuscuta* in the experimental field was observed after 30 DAS of berseem under the treatment herbicide applied only after 1st cut. At the time of just before first cut of berseem, highest length(56.0 cm) of *Cuscuta* with highest average number of threads (5.00/m^2) was measured under the treatment where imazethapyr 0.04kg/ha was to be applied only after last cut. While, there was no infestation of *Cuscuta* found under the treatments having pre-emergence application of herbicides *viz*. pendimethalin 1 kg/ha as PE, pendimethalin 1 kg/ha at 10 DAS as EPoE and oxyfluorfen 0.25 kg/ha as PE.

Application of oxyfluorfen 0.25 kg/ha (PE) reduced the density of *Medicago denticulata, Chenopodium album* and *Cichorium intybus*, other weeds and total weed density very effectively at 30, 60 DAS and at harvest. Using imazethapyr either at 0.04 kg/ha after first cut or at last cut and even imazethapyr at 0.04 kg/ha after 1stcutting *fb* imazethapyr at 0.04 kg/ha after last cut had least effect on controlling weed density of *Medicago denticulata, Chenopodium album* and *Cichorium intybus*. Whereas, pendimethalin 1 kg/ha as PE or at 10 DAS as EPoE have performed better to that of imazethapyr. However, imazethapyr at 0.04 kg/ha after 1st cutting *fb* imazethapyr at 0.04 kg/ha after last cut found better to control other weeds population as compared to pendimethalin 1 kg/ha as PE or at 10 DAS as EPoE.

Treatment of oxyfluorfen 0.25 kg/ha (PE) registered lowest total weed dry weight at 30, 60 DAS and at harvest (106.78 g/m^2). Pendimethalin 1 kg/ha at 10 DAS as EPoE did also well and reduced the weed dry weight significantly as compared to imazethapyr at 0.04 kg/ha after last cut at all the stages.

Oxyfluorfen 0.25 kg/ha (PE) recorded the significantly highest total green fodder (54.09 t/ha). This chemical treatment also showed its superiority at all the cutting stages than rest of the treatments at 1st, 2nd and 3rd cut. Imazethapyr at 0.04 kg/ha after last cut produced least fodder after 2nd (10.00 t/ha) and 3rd cut (15.76 t/ha) whereas, imazethapyr at 0.04 kg/ha after 1stcutting *fb* Imazethapyr at 0.04 kg/ha after last cut attained the comparable fodder yield (17.28 t/ha after 3rd cut) to that of oxyfluorfen 0.25kg/ha (PE).

Pre-emergence application of oxyfluorfen 0.25 kg/ha recorded maximum net return (Rs 74,708/ha) and BC ratio (3.18) as compared to rest of the treatments. Next was pendimethalin 1 kg/ha (EPoE) at (10 DAS) for net return (Rs 52,929/ha) and BC ratio (2.54). Imazethapyr at 0.04 kg/ha after last cut generated lowest net return of Rs 21695/ha with an ordinary BC ratio of 1.64.

WP 1.4.6: Management of *Cuscuta* in lucerne

AAU, Anand

Application of pendimethalin 38.7% EC 680 g/ha PE, pendimethalin 30% + imazethapyr 2% EC 640 g/ha PE and pendimethalin 30% + imazethapyr 2% EC 800 g/ha PE were found phytotoxic to lucerne crop and poor germination was observed in treated plot compared to untreated check. Further, fluazifop-p-butyl + fomesafen 250 g/ha PoE was also found phytotoxic to lucerne crop and showed burning effect on leaves of lucerne was observed but recovered after 10 days of application.

Application of pendimethalin 38.7% CS 680 g/ha at 10 DAS, pendimethalin 30%+imazethapyr 2% EC 800 g/ha PE and

pendimethalin 30%+imazethapyr 2% EC 800 g/ha PE found effective for *Cuscuta* management. All the herbicidal treatments recorded significantly lower fresh weight and seed yield of *Cuscuta* as compared to control plot.

Significantly higher green fodder yield (12.2 t/ha) at 60 DAS was recorded in application of pendimethalin 38.7% CS 680 g/ha at 10 DAS but remained at par with propaquizafop 2.5% + imazethapyr 3.75% ME (PM) 125 g/ha PoE imazethapyr10% SL 50 g/ha PoE and Imazethapyr 35% + imazamox 35% WG (PM) 70 g/ha PoE.

WP 1.4.8 Studies on response of hemi parasitic fern *Pyrrosia* (Dragon scale fern) on trees/ nutmeg plantations to various weed management methods

KAU, Thrissur

Pyrrosia piloselloides is a hemiparasitic fern that has a wide host range. Most of the species seen in this genus are epiphytic in nature. *P. piloselloides* is hemi-parasitic in nature, growing on tree trunks as well as young twigs and causing gradual drying and defoliation. However, the exact mechanism of its parasitic nature is not yet known. The occurrence was found in the districts of Ernakulam and parts of Palakkad district (Nelliampathy).

The weed surveillance was done by the AICRP on Weed management in collaboration with Agronomic Research Station, Chalakkudy. The infestation of this fern was found on teak, tea, coconut, arecanut, mango, nutmeg, jack, wild jack, neem and some other trees and shrubs. However, the economic loss was found in nutmeg only. Morphotypes with variation in leaf shape and thickness were also seen.

Morphology:

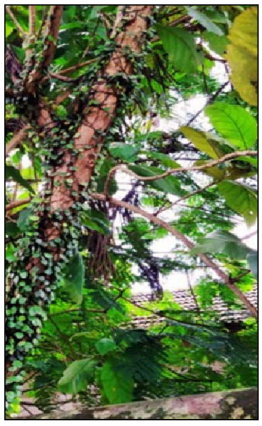
The fronds or leaves are generally oval to round shaped with leathery appearance. Both sterile and fertile fronds are visible in this group. Sterile leaves are circular with smooth surface, with an average length of 2.53 cm and width of 1.5 cm. The lower surface of fronds is light green whereas, upper surface is dark green in colour. Fertile leaves are stalked, nearly 4-5 cm long and 0.3 cm wide. The spores are produced along the margins of fertile fronds and almost completely covered the surface.

Variations in morphology

Pyrrosia

Pyrrosia infestation in different host trees

Teak



Coconut

Pruned branches of nutmeg with pyrrosia infestation

Physical removal was found effective, but, time consuming and tedious due to closely adhering roots of the fern to the host, it is also not a viable option when infestation is on small branches and pruning the branches only can help in such situations.

Observations recorded at one month after treatment application showed that ethephon (25 ml/L) was not effective against Pyrrosia and resulted in leaf fall of nutmeg. Copper sulphate (5% solution) application also did not result in phytotoxicity to the fern, though mild wilting symptoms could be observed. Glufosinate ammonium as well as glyphosate were effective and resulted in drying of fern. However, as the branches of nutmeg trees were also affected, it cannot be recommended. Hence, studies are being continued to find out a chemical management strategy for the selective control of this fern.

WP 1.5 Management of herbicide resistance in weeds

WP-1.5.1 Management of resistant *Phalaris minor* and other weeds with new herbicide combination

Monitoring and management of herbicide resistance to different herbicides in *P. minor* biotypes from farmers' fields (Pot-culture)

PAU, Ludhiana

Pre-emergence herbicide pyroxasasulfone at all doses 64, 128 (Recommended-R) and 256 g/ha recorded more than 90% control of all populations of *Phalaris minor*. In case of pendimethalin, there was significant increase in mortality of all *P. minor* biotypes with increase in its dose from 750, 1500 to 3000 g/ha.

Mortality was less than 70% at all doses of post-emergence herbicides clodinafop (30, 60 -R, 120g/ha) as well as sulfosulfuron (12.5, 25-R, 50 g/ha) except two biotypes in case of sulfosulfuron 50 g/ha; the mortality was also less than 70% for sensitive biotype with both herbicides. Mesosulfruon + iodosulfuron recorded less than 70% mortality for all biotypes including sensitive at 14.4 g/ha (R), similar was the case for pinoxaden 50 g/ha (R). There was no sunshine (0 sunshine hrs; normal is 6.0 hrs) for continuous 15 days after application of post-emergence herbicide (except first two days when it was 2.9 and 6.3 hrs) which may be reason for lower efficacy of all herbicides; even sensitive recorded only 23-68% mortality at recommended doses of all four herbicides.

CCSHAU, Hisar

All the populations showed variable phytotoxicity with graded doses of different herbicides. One populations population shows e" 70 % control with the recommended dose (60 g/ha) of clodinafop **(Fig.1.5.1)**. With the increase in the dose there was increase in the mortality rate. With the maximum dose under testing *i.e.* 2x dose of this herbicide, six populations showed more than 70 % control. Only one population out of the 12 populations under the testing shows e" 70 % control to the recommended dose of sulfosulfuron (25 g/ha),

nine to mesosulfuron + iodosulfuron (RM) (14.4 g/ha) and five to pinoxaden (50 g/ha). It shows the development of resistance to the *P. minor* populations against these tested herbicides. Herbicides were applied at 1/2X, X and 2X (where X is the recommended dose). Out of total 12 populations under testing 6,1,11 and 8 populations show e" 70 % control with the 2X dose of clodinafop, sulfosulfuron, mesosulfuron + iodosulfuron (RM) and pinoxaden respectively. This study showed that the higher level of resistance has developed against these herbicides.

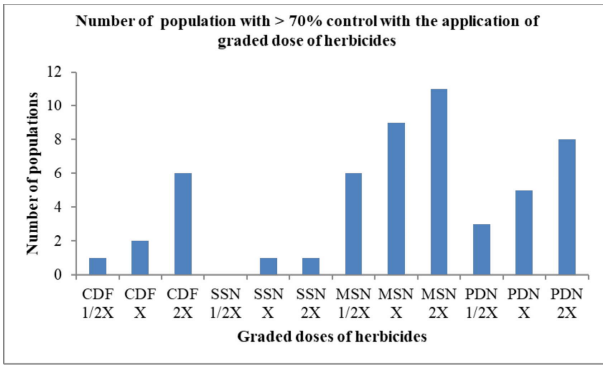


Fig.1.5.1: Efficacy (e"70%) of different herbicides against *P. minor* biotypes in pot studies

SKUAST, Jammu

Pinoxaden, mesosulfuron + iodosulfuron and, sulfosulfuron, fenoxaprop caused satisfactory control of all *P. minor* populations at recommended dose (x) as well as 2x. At recommended dose of clodinafop exhibited satisfactory control of all biotype except one biotype (P4). This indicated that clodinafop showed resistance in one biotype.

Management of multiple herbicide resistant population of *P. minor* in wheat (2020-22)

PAU, Ludhiana

Pyroxasulfone alone at 127.5 g/ha provided effective control of *P. minor* and *Rumex dentatus* and fair control of other broadleaf weeds, it was ineffective against *M. indica*. Its tank-mixture with pendimethalin improved control of broadleaf weeds and significantly reduced broadleaf weed density and dry biomass than pyroxasulfone alone.

Pyroxasulfone alone at 127.5 g/ha provided wheat grain yield and attributes at par to its tank-mixture with all doses of pendimethalin as well as sole application of ready mixtures of clodinafop + metribuzin.

CCSHAU, Hisar

Application of different herbicides, either may be pre-emergence (PRE) alone, post-emergence (PoE) or PRE-followed by PoE resulted in significantly lower weed density of grassy weed *i.e.* P minor at 90 DAS (Table 13). Application of PRE pyroxasulfone + pendimethalin (127.5 + 1000 g/ha) *fb* PoE *i.e.* clodinafop + metribuzin (RM), meso + iodosulfuron (RM), pinoxaden+ metribuzin (TM) resulted in no grassy weeds as well as broad leaf weeds at 90 DAS. As there were no grassy as well broad leaf weeds at 90 DAS, resulting in 100 % weed control efficiency at 90 DAS for both grassy as well as broad leaf weeds.

Application of different herbicides did not influence the plant height at harvest and ear length significantly, however, the number of effective tillers differ significantly due to application of different herbicides. Application of pyroxasulfone 127.5 g/ha and pinoxaden 50 g/ha resulted in at par yield with the weedy check, however, other herbicides resulted in significantly higher yield as compared to weedy check treatment. Application of PRE *fb* POE herbicides resulted in higher grain yield as compared to PRE alone or PoE alone herbicides. Weed free treatment resulted in significantly higher grain yield (5567 kg/ha) as compared to pyroxasulfone (127.5 g/ha) (4717 kg/ha), pyroxasulfone + pendimethalin 127.5 + 1000 g/ha (4876 kg/ha), pinoxaden+ metribuzin (TM) (50+105 g/ha) (4937 kg/ha) and pinoxaden 50 g/ha (4780 kg/ha) but at par with other herbicide treatments.

Management of cross resistance in *P. minor* against recommended herbicides in wheat through use of pre and post emergence herbicides (2020-22)

CCSHAU, Hisar

The experimental field was infested by *Phalaris minor* as a grassy weed, while the *Chenopodium album, Coronopus didymus, Medicago denticulata* and *Rumex dentatus* among the broad-leaved weeds. At 90 DAS, *Phalaris minor* density was significantly influenced by application of different herbicides, either may be pre-emergence (PRE) alone, post-emergence (PoE) or PRE followed by PoE. Metribuzin at 350 g/ha resulted significantly lower weed density of *P. minor, Coronopus didymus, Medicago denticulata, Rumex dentatus* at 90 DAS as compared to weedy check. Application of metribuzin (350 g/ha) through mixing with urea after first irrigation resulted in significantly lower weed dry matter accumulation by grassy weeds (7.9 g/m^2) and broad leaf weeds (15.1 g/m^2) as compared to weedy check treatment. Application of aclonifen + diflufenican (TM)) *fb* mesosulfuron+ iodosulfuron (RM) (1000+ 200 *fb* 14.4) and pyroxasulfone + pendimethalin (TM)(127.5 + 1500 g/ha, PRE) *fb* mesosulfuron + iodosulfuron (RM) (14.4 g/ha, PoE) resulted in 100 % weed control efficiency for both grassy as well as broad leaf weeds at 90 DAS. Application of metribuzin 350 g/ha through mixing with urea after irrigation had no phyto-toxicity on crop at 20 days after treatment (DAT), however metribuzin at 525 g/ha had phyto-toxicity at 20 DAT (3.3 %) which recovered later while application of metribuzin at 700 g/ha resulted in more phyto-toxicity (20%) causing yield reduction. Weed free treatment resulted in higher grain yield (5460 kg/ha) which was significantly higher than metribuzin 350 g/ha, 525 g/ha and 700 g/ha, clodinafop + metribuzin (60 +105 g/ha, TM) and weedy check treatments. Application of metribuzin 700 g/ha through mixing with urea after first irrigation resulted in lower grain yield (4393 kg/ha) as compared to other treatments due to phyto-toxicity to the crop.

Evaluation of *Rumex* population for resistance against different broad-leaved herbicides (2020-22)

CCSHAU, Hisar

The *Rumex* population showed a differential response to the application of different herbicides. The GR_{50} values for metsulfuron for the populations was less than the recommended dose (4 g/ha) except for Sollu Majra population which recorded GR_{50} values 5.34 which was more than the recommended dose. GR_{50} values for carfentrazone, carfentrazone + metsulfuron and 2,4-D ester were less than the recommended doses of these herbicides for control of broad leaved weeds, while the GR_{50} values for the sulfosulfuron + metsulfuron were higher for all populations except Gignau and for mesosulfuron + iodosulfuron, the GR 50 values were higher for the Sollu Majra and Maham populations than the recommended dose of the herbicide **(Table 1.5.1)**.

Table 1.5.1: GR_{50} (g/ha) values of *Rumex* populations for different herbicides based on per cent reduction in dry weight 30 DAT.

Populations	GR_{50} g/ha					
	Metsulfuron	Carfentra zone	Carfentrazone + metsulfuron	2,4- D ester	Sulfosulfuron + metsulfuron	Mesosulfuron + iodosulfuron
Sollu Majra	5.34	7.54	7.29	116.03	97.55	21.35
Banawali	3.95	11.32	2.77	145.06	122.06	14.76
Pillukhera	3.52	5.53	0.86	166.87	36.80	10.48
Maham	4.41	1.72	7.54	92.90	22.64	18.48
Gignau	2.14	1.20	0.48	68.57	14.63	7.19

Management of resistance in *P. minor* against recommended herbicides in wheat through use of pre and post emergence herbicides (*Rabi* 2021-22)

SKUAST, Jammu

Different treatments had significant effect on weed density and weed biomass at 60 DAS. Among the herbicidal treatments, lowest weed density as well as biomass of *P. minor* was observed in fenoxaprop-p-ethyl + metribuzin which was statistically at par with pinoxaden + metribuzin and clodinafop propargyl + metribuzin (60+210 g/ha) and significantly lower than other treatments. Clodinafop-propargyl 60 g/ha and sulfosulfuron 25 g/ha did not exhibits satisfactory control of *P. minor*.

Among the herbicidal treatments, highest wheat grain yield was observed in fenoxaprop-p-ethyl + metribuzin which was statistically at par with pinoxaden + metribuzin, clodinafop propargyl + metribuzin (60+210 g/ha), pendimethalin + pyroxasulfone as PE, and pendimethalin + metribuzin as PE, metribuzin as POE and significantly lower than other treatments. The lowest grain yield was recorded with weedy check which was statistically at par with clodinafop-propargyl 60 g/ha and sulfosulfuron 25 g/ha as POE.

CCSHAU, Hisar

Management of herbicide resistant *P. minor* at farmers' fields

The efficacy of different herbicides against resistant populations of *P. minor* was assessed at farmers' fields. The pre-emergence uses of pyroxasulfone + pendimethalin (TM) at (127.5 + 1500 g/ha) followed by PoE application of meso + iodosulfuron 14.4 g/ha and pinoxaden 50 g/ha demonstrated at eight sites in rice – wheat growing areas of Haryana provided 93.0 and 91% control of multiple herbicide resistant *P. minor* whereas application of metribuzin (urea mix) after first irrigation followed by meso + iodosulfuron 14.4 g/ha resulted in 80.9 % control of *P. minor*. Application of pyroxasulfone + pendimethalin (TM) at (127.5 + 1500 g/ha) followed by PoE application of meso + iodosulfuron 14.4 g/ha resulted in higher grain yield (53.6 q/ha) followed by pyroxasulfone + pendimethalin (TM) at (127.5 + 1500 g/ha) *fb* pinoxaden 50 g/ha (52.7 q/ha) **(Fig.1.5.2)**.

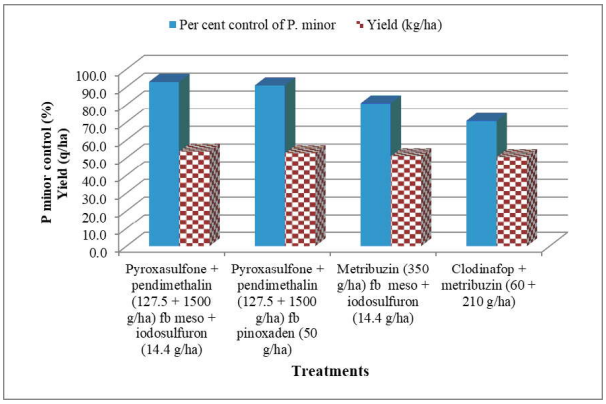


Fig.1.5.2 : Effect of different treatments on *P. minor* control (%) and yield of wheat

PAU, Ludhiana

Integrated management of *P. minor* and other weeds in wheat (*Rabi* 2021-22)

Phalaris minor has evolved multiple resistance to commonly used post-emergence herbicides in wheat in the region. Eight FLDs on control of *P. minor* with ready-mix of clodinafop 9% + metribuzin 20% at 174 g / ha were conducted in wheat. New herbicide pre-mix gave 28% higher control of *P. minor* and 18% higher wheat grain yield than clodinafop, sulfosulfuron and pinoxaden. All farmers were satisfied with results of new herbicide.

WP-2: Weed biology, weed shifts and management of weeds in non-crop areas

WP 2.1. Biology study of some invasive weeds under changing scenario

AAU, Jorhat

The biology of two invasive weeds namely *Chromolaena odorata* and *Arundo donax* was studied. Population of *C. odorata* was collected from 5 different districts of Assam *viz.*,

Dibrugarh, Dhemaji, Kamrup, Jorhat and Golaghat while the population of *Panicum repens* were selected from the Instruction-cum-Research Farm of AAU at Jorhat. The average seed production capacity of *C. odorata* was found to be 28652 (± 13488) numbers of seeds per plant in Assam condition, while, it varied greatly from place to place. In many populations, the number of cypsela per caitulum was 27 numbers, however, the average cypsela/ capitulum was computed as 29 (± 3) numbers. In *Panicum repense*, number of number of spikelets/panicle, number of panicles/m^2. and number of seeds/m^2 were recorded 224 ± 26, 87.8 ± 4.5 and 19,264 ± 2248, respectively.

MPUAT, Udaipur

The weed biology of *Rottboellia cochinchinensis* (Annual grass) was studied. No germination was observed at 17.5 cm throughout the period of data collection. Data indicated that it is a tall, tufted annual grass whose stems (culms) grow up to 230 centimetres (range from 19 to 25 com at 30 DAS & 170 to 230 cm at 60 DAS) in height with leaf-blades of up to 45 centimetres in length.

Monitoring of appearance of new weed species

PAU, Ludhiana

Phalaris minor continued as most problematic weed in wheat, *Poa annua* coming up in high moisture areas and *Polypogon monspeliensis* alongside bunds and water channels. In transplanted rice, sporadic occurrence of *Saggitatia sagittifolia* was recorded.

Surveillance and management of new / invasive / quarantine weeds

MPUAT, Udaipur

Periodical survey during *Rabi* 2021-22 and *Kharif*, 2022 at places of high risks like FCI godawns, seed processing plants, railway station yard and krishi upaj mandis, public distribution system shops of Udaipur, Dungarpur and Chittorgarh were conducted to find out the existing weed flora of the region and weed technologies adopted by the farmers. The major crops of the surveyed tehsils were maize, soybean, blackgram and green gram in *Kharif* and wheat, barley, chickpea and mustard in rabi season. During *Kharif* season grassy weeds were major weeds and most common are *Echinochloa colona*, *Eleusine indica*, *Dactyloctenium aegyptium*, *Chloris barbata* and *Cynodon dactylon and Commelina bengalensis*, *Trianthema portulacastrum*, *Parthenium hysterophorus*, *Physalis minima*, *Euphorbia hirta*, *Celosia argentea* and *Corchorus olitorius* among broad-leaved weeds whereas *Cyperus rotundus* obsereved under sedges. While in *rabi* season, the major broadleaf weeds in the surved fields were *Chenopodium album*, *Chenopodium murale*, M*elilotus indica*, *Fumaria parviflora*, *Malva parviflora*, *Asphodelus tenuifolious*, *Convolulus arvensis* and *Spergulla arvensis* were observed and *Phalaris minor and Avena ludoviciana* were among grassy weed in the surved crops. BCKV, Kalyani did not observe any new weed species. Akola center observed heavy infestation of *Hyptis suoveolenc* (*Ran Tulas*) along the road sides in Eastern Vidarbha and aquatic weed *Salvinia molesta* in Gadhchiroli district. They also observed heavy infestation of *Cuscuta* in some pocket on farmers' field on soybean and pigeonpea crop and along the road side particularly in western Vidarbha districts which needs effective weed management technology.

Monitoring of weed shift due to weed management practices, changes in cropping systems and climatic parameters prevailing ecosystems

PDKV, Akola

Wide spread appearance of *Alternanthera triandra* on fallow lands and field bunds in Eastern Vidarbha region was observed. While in some areas mostly nearby cities *Ipomoea* spp. was observed on big trees and electric poles etc. In Western and Central Vidarbha zone, predominant cropping system is soybean-based farmers growing soybean year after year and used continuous imazethapyr to control weeds, now they are facing problem of resistance of weed viz. *Commelina benghalensis* to herbicides in their fields. The centre suggested for crop rotation.

MPUAT, Udaipur

Weed shift was observed in maize- wheat cropping system in comparison to 2016-17 **(Table 2.1.1)**

Table 2.1.1: Weed shift in maize-wheat cropping system in Rajashthan.

Season	Weed status at 2016-17 in maize wheat cropping system	Weed status at 2022-23 in maize wheat cropping system
Kharif	Monocots *Echinochloa colona (33.7%), Dinebra retroflexa (30.2%), Commelina bengalensis (11.6%),* Dicots *Digera arvensis (9.6%), Trianthema partulacafram (8.8%)* and *Corchorus olitorious* (6.1%) at 30 DAS	Monocots *Echinochloa colona (35.0%), Dinebra retroflexa (18.1%), Commelina benghalensis (08.3%),* Dicots *Digera arvensis (16.2%), Trianthema partulacastrum (18.3%)* and *Corchorus olitorious* (4.1%).
Rabi	Monocots *P. minor* (39.6%) and *A. ludoviciana* (12.9%), *Dicots* *C. album* (21.6%), *C. murale* (4.1%), *Convolvulus arvensis* (4.6%), *Fumaria parviflora* (7.0%) and *Melilotus indica* (10.2%)	Monocots *Phalaris minor (12.9%) and Cynodon dactylon* (6.3%). *Dicot* *Chenopodium album (26.3%), Chenopodium murale (14.3%), Melilotus indica (2.2%), Malwa parviflora (32.4%)., Fumaria parviflora (3.2%), Coronopus didymus* (4.6%)

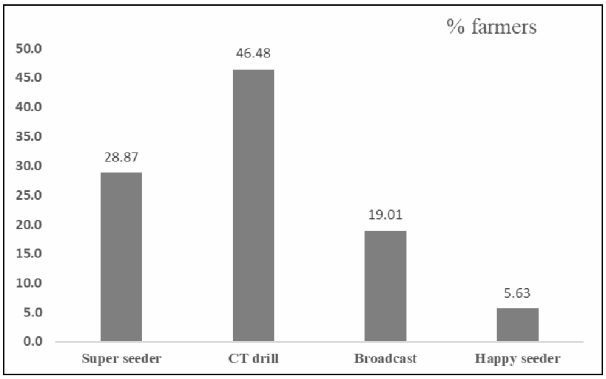
CCSHAU, Hisar

Survey was done in Hisar, Rohtak, Sonipat, Kaithal, Karnal, Jind, Bhiwani districts during *Rabi* 2021-22. Following observations were made:

- Under the rice-wheat cropping system the infestation of *Phalaris minor* varied in different districts and average population of *Phalaris minor* in Fatehabad (49/m^2), Sirsa (37/m^2), Kaithal (54/m^2), Kurukshetra (63/m^2), Karnal (35/m^2), Panipat (42/m^2), Sonipat and Rohtak (64/ /m^2) and Jind (55/m^2) was reported under poor controlled conditions.
- The pea crop in Mahendergarh district was infested with *Chenopodium album*, *Avena ludoviciana* (Wild oat), *Trifolium* sp. (Metha), *Rumex* sp. and *Sisymbrium irio* (Wild mustard).
- Infestation of parasitic weed *Orobanche* in Loharu, Jui, Tosham Blocks of Bhiwani is Mustard crop was more, while in Satnali block of Mahendergarh infestation of *Orobanche* was less.
- Regarding herbicide use, 29.5% farmers were using only pyroxasulfone, 25.9% using metribuzin broadcasting after first irrigation and subsequent application of clodinafop or pinoxaden. About 11.5% farmers were using broadcasting of only metribuzin after just first irrigation without any application of post emergence herbicide, while still 8.65 farmers were

using clodinafop in spite of its poor efficacy against herbicide resistant biotypes of *Phalaris minor* (**Fig. 2.1**).

- *Leptochloa chinensis* is being emerged as important weed both under transplanted and direct seeded rice conditions as indicated from survey of different districts of Haryana namely Karnal, Kurukshetra and Kaithal. *Dactyloctenium aegyptium*, *Echinochloa* sp., *Leptochloa chinensis* were major weed in both direct seeded rice and transplanted rice.
- Poor control of *Echinochloa colona* and *Echinochloa glabrescens* was reported in Hisar District and the seeds were collected for the resistance studies against the bispyribac-Na.



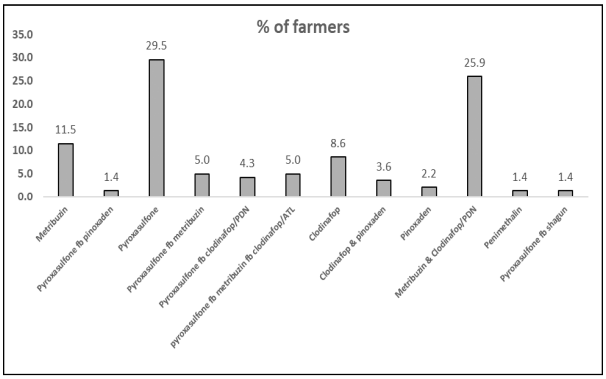


Fig 2.1 : Adoption of establishment methods and herbicide use in wheat

KAU, Thrissur

KAU, Thrissur observed invasion of *Xanthium strumarium* (Common cocklebur, Asteraceae*) from* Chimminey Wild Life Sanctuary, Thrissur District, Kerala. Incidence of this weed was earlier reported from Bharathapuzha river basin during 2008-09 and 2017 and Chaliyar river basin in 2020. Plants at different stages of growth could be observed, though, majority of the population was at senescence stage with 20-50 fruits per plant. A very high weed density ranging from 80-120 plants/m^2 was recorded during the diagnostic visit conducted in July 2022. The soil was acidic with pH of 4.8-5.0. *Cuscuta* spp., infestation is reported in different crops like pulses, chilli, amaranth, ornamentals, brinjal and tomato in Kerala, and the spread might have occurred due to the floods of 2018.

AAU, Anand

AAU, Anand observed invasion of *Argemone Mexicana* in different parts of Gujarat entering in new cultivated field as new emerging weed in Gujarat. In many areas of different districts of Gujarat weed flora shifted towards monocot weeds in wheat fields was observed due to continuous use of 2,4-D or metsulfuron-methyl to manage dicot weedswhich provide opportunities to flourish monocot weeds and that did not control by the said herbicides. Awareness campaign/ training programme/OFT/FLDs were conducted to manage complex weed flora in wheat by using premixed herbicide/s. Escape incidence of *Commelina benghalensis* after application of pendimethalin 750-1000 g/ha in cotton, greengram, soybean were observed at farmers and research farms. Escape of dicot weed *Digera arvensis* and *Phyllanthus niruri* were also observed in the research farm as a result of pre-emergence application of pendimethalin 750-1000 g/ha in cotton, greengram and soybean crops. Moreover, *Setaria* spp. was not controlled by the application of tembotrione 120 g/ha under demonstration plot at AICRP-

WM, farm showed some resistant against herbicides.

Integrated mmanagement of problematic weed *Parthenium hysterophorus* in university campus to achieve status of *Parthenium* free campus

PAU, Ludhiana

All the AICRPWM centres observed the Parthenium Awareness Week (PAW-2022) with great zeal and fervour to keep their university campuses *Parthenium* free and to make people aware about the menace and management of this weed. Every centre conducted various programmes like demonstration of chemical and biological control, ppt presentations, photo exhibitions, uprooting the weed etc. to achieve the PAW objectives. PAU, Ludhiana continued maintained the village Mansuran (Ludhiana) as *Parthenium* free village, since 2016, with support of villagers and PAU Centre. Most of the centres made efforts to keep the Parthenium free campus of their universities besides doing general awareness about the weed. The PAW activities conducted by the centres in association with KVKs, Schools, Colleges and municipalities attracted the digital and print mea to cover the events in their TVs and newspapers.

जैवविविधता के लिए गाजर घास घातक

WP 2.2 Taxonomic and phyto-geographic assessment of invasive and other problem weeds

AAU, Jorhat

AAU, Jorhat also studied the taxonomic and phyto-geographic assessment of knot-weeds *Polygonum* and *Persicaria* belonging to family Polygonaceae. Most of the members of *Polygonum* and *Persicaria* possessed vegetative mimicry to each other. Hence, recognition of species at their vegetative state is often considered as a difficult task. To solve these difficulties of distinguishing the species at vegetative state, the Ochrea (stipule of *Polygonum* and *Persicaria*) could be an important taxonomic tool, either alone or in combination of petiolar and laminar characteristics. All together eleven species, 6 belonging to *Persicaria* and 5 to *Polygonum*, were found to be of common occurrence as weed in different land situations in Assam. All the species, despite of their weedy nature, have more or less utility in the society either as vegetable or for medicinal purposes. *Polygonum microcephalum* was the only species which escaped from

cultivation and appeared as weed in orchards, gardens and similar upland cropland situations, while rest of the species were wild and facultative weeds of variety of crops. Key based on the characteristics of *Ochrea* and its relevant internode and foliaceous petiolar wing were developed for species identification.

WP 2.3. Identification of new herbicides and to study their effect on cutting and spray time for the management of *Lantana*

CSKHPKV, Palampur

Least regrowth of *Lantana* after April cuttingwas recorded while more regrowth after May cutting. Among time of spray, after 2 months of cutting recorded more regrowth of *Lantana* over spray after 1 month cutting. Herbicide application of glyphosate (1.5 kg/ ha) had the least regrowth of *Lantana* bushes in comparison to no herbicide application. The effect of time of cutting and time of spray on number of shoots per plant were found to be non-significant. With herbicide application, number of shoots per plant was found to be lower with glyphosate (1.5 kg/ha) which was statistically at par with glyphosate + surfactant (1.5 kg/ha + 1000 g/ha). The lowest number of leaves per plant was found to be in April cutting of *Lantana* as compared to May and August cutting. The number of leaves per plant was not significantly affected by time of spray and herbicide application **(Table 2.3.1)**.

Table 2.3.1: Growth parameters of *Lantana* at the time of spray.

Treatment	Shoot height (cm)	Number of shoots per plant	Number of leaves per plant
Time of cutting			
1st week of April	44.80	3.25	320.31
1st week of May	59.71	3.45	357.40
1st week of August	50.97	3.19	367.96
CD (P=0.05)	2.54	NS	5.71
Time of spray			
1 month after cutting	47.77	3.21	346.39
2 months after cutting	55.88	3.39	350.72
CD (P=0.05)	1.20	NS	NS
Herbicide application			
Glyphosate (1.5 kg ha^{-1})	49.08	2.79	346.07
Glyphosate + Surfactant (1.5 kg ha^{-1} + 1000 g ha^{-1})	50.08	3.03	353.18
Glyphosate + Metsulfuron-methyl (1.5 kg ha^{-1} + 4 g ha^{-1})	52.50	3.25	346.17
Glyphosate + Metsulfuron-methyl + Surfactant (1.5 kg ha^{-1} + 4 g ha^{-1} + 1000 g ha^{-1})	52.91	3.49	348.25
Unsprayed	54.56	3.93	349.12
LSD (P=0.05)	1.67	0.33	NS

Management of aquatic weeds

WP 2.4. Management of *Salvinia molesta* in rice fields

Cooperating centers: BCKV, Kalyani, KAU, Thrissur

BCKV, Kalyani surveyed the *Salvinia molesta* for its infestation in in Nadia, Murshidabad, N & S 24 PGS, Howrah and Hooghly districts but did not find its presence. KAU, Thrissur conducted experiment with 15 treatments in pots for its chemical control. The effectiveness of various treatments was assessed in the tank based on phytotoxicity scoring, per cent of control, fresh weight and regrowth of *Salvinia* molesta. Effective control of *S. molesta* was

observed when sprayed with herbicides glufosinate ammonium, (florpyrauxifen-benzyl + cyhalofop-butyl), (cyhalofop butyl + penoxsulam) and (butachlor + penoxsulam). Among the various chemicals, 90% control was observed in salicylic acid, copper sulphate and acetic acid. However, new sprouts were observed by 40 days after spraying. Spraying of 2,4 -D amine resulted in only 17% control whereas for lime 32% control was observed. The pre-mix herbicide (butachlor + penoxsulam) was found to be most effective in terms of rapid action as well as complete drying (98%) of salvinia. By ten days, the entire salvinia mat decayed without any regrowth. Another effective herbicide was cyhalofop butyl + penoxsulam in which complete control (98%) was registered at 40 DAT with a phytotoxicity score 5 with no traces of regrowth. In the case of pre-mix herbicide (florpyrauxifen-benzyl + cyhalofop butyl), the action was slow and symptoms of phytotoxicity appeared only after one week as in the case with carfentrazone ethyl. A phytotoxicity score of 5 with 98% efficiency was registered in (florpyrauxifen-benzyl + cyhalofop butyl) at 40 DAT. Spraying broad-spectrum contact herbicide glufosinate ammonium at the rate of 0.3 kg/ha was sufficient for managing the weed. Glufosinate ammonium can be recommended in paddy fields for preparatory cultivation. Carfentrazone ethyl at 0.02 and 0.04 kg/ha was slow in action, as the symptoms of phytotoxicity were observed only after one week of spraying. In the case of the application of salicylic acid, acetic acid and copper sulphate, quick control was observed within 24 hours, however, by 40 DAT regrowth was registered, indicating the short-term activity of the chemicals. Use of lime resulted in slight control. Gypsum application had no inhibitory effect on salvinia. On the contrary, it enhanced the growth.

WP 2.5 Managment of aquatic weed *Vallisneria* in wetland rice

KAU, Thrissur

Vallisneria also known as eel grass or tape grass is a common submerged aquatic plant in Kerala. KAU, Thrissur conducted an experiment in rice variety ' infested with the weed. Remarkable reduction in weed dry weight was observed in 2,4-D (1.0 kg/ha) applied plots at all stages of observation followed by pre-mix herbicide florpyrauxifen-benzyl + cyhalofop butyl @ 0.15 kg/ha, florpyrauxifen-benzyl @ 31.5 g/ha and hand weeding at 20 and 40 days after transplanting. At 20 DAS (days after spray), in the remaining treatments, weed dry weight increased from the initial observation due to increased growth of the weed and these were almost on par with each other. Weed control efficiency (WCE) was 100% in 2,4-D applied plot on 20th DAS. Florpyrauxifen-benzyl + cyhalofop butyl@ 0.15 kg/ha and Florpyrauxifen-benzyl @ 31.5 g/ha were the next best alternative with 98% WCE. All other treatments were with less than 25% WCE. At 50 DAS and harvest, a similar trend was followed, but with reduced weed control efficiencies.

WP 2.6 Management of aquatic weeds in farm ponds by pond liming

KAU, Thrissur

KAU, Thrissur conducted an study during July - August 2022, using cement tanks of 40 L capacity to standardize the quantity of liming materials like burnt lime (CaO) for the management of aquatic weeds in pond. The cement tanks were filled with pond water of pH 7.01 and uniform quantity of fresh aquatic weed najas (1 kg each) collected from the infested pond was put into the water and kept for acclimatization under partially shaded condition for one week. Then treatments were imposed. The change in pH and EC of the water was monitored 2 hours after application of treatments. There was a sudden increase in pH from 7.01 to 9.76 which further increased to 10.29 by 2 days. The EC increased from 104 to 189 µS/cm with the application of lime. It was found that the lower doses of lime from 50 to 400 mg/L were not effective. However,

the lime application at 600 mg/L could completely control the weed. Based on the above results field trials were done at three locations in Thrissur and Palakkad districts. The ponds selected were severely infested with mixed flora of submerged aquatic weeds najas and hydrilla. After lime application, the aquatic weeds were successfully managed in thee pond.

Management of aquatic weed *Limnocharis flava* in rice

KAU, Thrissur

Experiment was conducted for the management of *Limnocharis flava* in rice variety Jyothi, a short duration HYV of KAU, raised as a transplanted crop at a spacing of 15 cm x 10 cm. Post-emergent application of 2,4-D Na salt, 1.0 kg/ha, 18-20 DAS and florpyrauxifen benzyl 31.5 g/ha, 15-20 DAS proved best herbicides to control the weed **(Table 2.6.1)**

Table 2.6.1: Effect of treatments on weed control efficiency (%), grain and straw yield of rice, and BC ratio.

Treatment	30 DATP	60 DATP	Harvest	Grain yield (kg/ha)	Straw yield (kg/ha)	BC ratio
Post emergent application of 2,4-D Na salt, 1.0 kg/ha, 18-20 DAS	100	88	83	4523[a]	5326[a]	2.52
Penoxsulam + butachlor 820 g/ha, 0-7 DAT	93	87	80	3424[b]	4291[b]	1.88
Penoxsulam +pendimethalin, 625 g/ha, 0-7 DAT	93	85	86	3369[b]	4136[b]	1.81
Metsulfuron ethyl + chlorimuron ethyl4 g/ha 15-20 DAS	91	86	85	3614[b]	4262[b]	2.01
Florpyrauxifen benzyl + cyhalofop butyl 150 g/ha 15-20 DAS	100	88	82	4498[a]	5498[a]	2.44
Florpyrauxifen benzyl 31.5 g/ha, 15-20 DAS	100	89	84	4476[a]	5416[a]	2.42
Bispyribac sodium 25 g/ha, 15-20 DAS	88	86	82	3528[b]	4294[b]	1.92
Cyhalofop butyl + penoxsulam 150 g/ha	95	85	85	3629[b]	4128[b]	1.93
Carfentrazone ethyl 25 g/ha	92	84	83	3516[b]	4261[b]	1.96
HW at 20 and 40 DAT	100	98	91	4529[a]	5392[a]	1.70
UWC	0	0	0	2061[c]	2981[c]	0.45
SD				346.60	413.33	
Sem±				245.08	292.27	
LSD (P=0.05)				723.00	862.18	

WP 2.8 Biological control of water hyacinth by *Neochetina* spp.

Cooperating centers: AAU, Anand, BCKV, Kalyani, SKUAST, Jammu, MPUAT, Udaipur, PJTSAU, Hyderabad, OUAT, Bhubaneswar, PAU, Ludhiana, TNAU, Coimbatore, RVSKVV, Gwalior

AAU, Anand observed good population of adult weevils from the pond of Sadanapura village, however no complete control of the weed was observed. Adults weevils from Sadanapura village pond were collected and further released on 25-08-2022 at Tundel village but pond is given on lease for fish farming and cleaned by the owner. BCKV, Kalyani could

not find any perennial pond infested with water hyacinth so experiment was not conducted. SKUAST, Jammu observed only average 19-27 feeding scars/leaf with few die back symptoms (5-10%) at Tanda village. MPUAT, Udaipur conducted study in cemented tank. The observation showed that there were not significant built up in the population of the weevil. Complete defoliation and plant mortality was not observed; however, it suppressed the growth of water hyacinth. PJTSAU, Hyderabad conducted a survey to determine the *Neochetina* spp. infestation levels in various tanks around Rajendrnagar. However, the population was very low (1.0 to 1.8 weevils/10 plants). Hence to augment the existing populations, centre initiated rearing of weevils in water tanks constructed at AICRP on Weed Management. The weevils are being reared for further release in the infested ponds.

OUAT, Bhubaneswar released 200 number of weevils in the perennial pond of Delang (Puri district) and study is under progress. PAU, Ludhiana released the weevils in village Boparai Kalan and Galib Kalan but did not observe good control hence the ponds were cleaned manually. TNAU, Coimbatore released *Neochetina* spp. weevils collected from various sources on 31.10.2022 and 18.11.2022 in the newly emerged water hyacinth patches at Krishnampathy tank near Wetland farm of TNAU. Number of weevils survived at the time of release was around 650. Observation on the population build-up of beetles, dieback symptoms on water hyacinth plants and clear water appearance will be recorded. RVSKVV, Gwalior after successful biological control of water hyacinth in one of the big water bodies selected another perennial pond infested with the water hyacinth in the village Hanumangarh of District Gwalior and release the weevils in 2019. The population of bio-agents were found increased (average 5.7 adult/plant) in the month of September, 2022 after 2 years. The feeding scars were also increased and get 25.6/ leaf and found 0-10 on an average. The population of bio-agents increasing as compare to last six months. Dieback symptoms on leaves had also been increased **(Table 2.8.1)**.

Table-2.8.1: Population of the bio-agent, feeding scars and dieback symptoms of weevils on water hyacinth plant 2020-21.

Time period	Adult s	Feeding scarce on leaves	Dry weight (g/m^2)	Damage (0-5 scale)	Clear water surface (10 to 100%)
March, 2020	2.4	3.8	300	0	-
September, 2020	3.2	7.2	280	1	-
March, 2021	5.6	7.2	280	2	10
September, 2021	6.2	9.8	250	1	10
February, 2022	10.4	18.5	200	3	20
September, 2022	12.5	25.6	150	3	20
Av ±SD	3.98	8.31	57.50		

WP 2.9 Efficacy of *Alternanthera philoxeroides* (AP) aqueous extracts on growth and development of *Eichhornia crassipes*: A Green Approach

UAS, Bengaluru

UAS, Bengaluru conducted an experiment to the allelopathic potential of *Alternanthera philoxeroides* (Mart.) Griseb. against water hyacinth and also bioassay study on black gram. Aqueous extract of AP was determined by GCMS. About 53 phytoconstituents were identified in different plant parts. Among the 53 phytochemical constituents, nine

compounds were present in all the plant parts. The whole plant of aqueous extract showed the highest phyto-constituents than other plant parts of *A. philoxeroides.* A pot culture experiment with 21 treatments was conducted to see the influence of allelochemicals of *A. philoxeroides* on water hyacinth. The treatments showed highly significant difference compared to control after 30 and 45 days after imposition of treatments. The treatments showed greater reduction in fresh weight at higher doses of plant aqueous extracts compared to control. The increase in growth of 40.32% in *E. crassipes* under control while in whole plant extract at 80 g/l, fresh weight reduced from 160 g to 35 g (78.13 %) and it showed the highest significant reduction compared to other treatments followed by leaf extract 80 g/l and stem extract 80 g/L. The allelopathic effects of extracts of each plant part of *A. philoxeroides* on the growth and development of water hyacinth ranged overall as growth stimulatory effect at lower concentration and inhibitory and suppressive effect at higher concentration.

In the lake experiment, significant reduction of plant biomass observed in water hyacinth treated with aqueous extracts of *A. philoxeroides.* The fresh weight was increasing in all the stages of the plant under control and whereas the fresh weight was decreasing in all other treatments imposed with aqueous extracts of *A. philoxeroides.* Highest fresh weight, stem length and no of leaves and number of branches reduction was observed in whole plant extract at 120 g/L.

The effects of allelochemicals of *A. philoxeroides* on germination and growth of black gram was also studied. The aqueous extracts of higher concentration in all plant parts (stem, leaf, root, whole plant) reduced the germination percentage of black gram crop. The most effective aqueous extract in suppressing the germination of black gram was stem at 120 g L^{-1} (4%) followed by leaf (18%), root and whole plant (30 %) . Higher concentration of aqueous extracts of different plant parts of *A. philoxeroides* showed significantly lower SVI (seedling vigor index) . The same trend was observed within the plant part of *A. philoxeroides* at different concentrations. The allelopathic potential will be high at higher concentrations hence it affects the germination percentage of black gram

An experiment was conducted to evaluate the efficacy of allelochemicals *of A. philoxeroides* as pre- and post-emergent application on control of weeds in black gram under field condition. The per cent germination was low in whole plant >root>stem>leaf treatments sprayed at higher concentrations at 160 g/L compared to lower concentration at 120 g/L. Highest inhibition in germination was observed in whole plant followed by root, leaf and stem aqueous extract. Germination was not affected in black gram control plot. Aqueous extracts of *A. philoxeroides* significantly influenced the lower weed density and weed dry weight in blackgram field experiment. Highest reduction of weed density and weed dry weight was observed in whole plant extract at 160 g/L in grasses.

At all the stages of crop growth, significantly lower plant height was recorded from the treatments, however among the aqueous extracts, application of leaf extract showed the lower reduction of crop growth followed whole plant and root extract. This is because the allelopathic effects played important role for reduction of plant height and number of branches in all the treatments

The yield parameters as influenced by different aqueous extracts of *A. philoxeroides* in black gram crop differed significantly due to allelochemicals potential. These allelochemicals as pre-emergent spray inhibited the germination percentage of black gram and directly reduced the plant population of the black gram crop.

Interaction between different plant parts and different concentration of aqueous extracts

of *A. philoxeroides* significantly varied in the experiment. As the concentration of the aqueous extract increased, there was decrease in weed count observed. However, when the effect of different plant parts on weed dry weight was noticed, whole plant extract recorded lowest weed density and weed dry weight followed by root, leaf and stem extracts. The results from this study showed that the isolated compound from *Alternanthera* philoxeroides (Mart.) Griseb. had remarkable allelopathic potential. The aqueous extract at different concentration in different plant part significantly inhibited the seedling growth of water hyacinth. The aqueous extract also reduced the germination of black gram.

WP 2.10: Identification of weeds of national importance (WoNI)

Cooperating centers: AAU, Jorhat, SKUAST, Jammu, OUAT, Bhubaneswar, PAU, Ludhiana, CSKHPKV, Palampur, TNAU, Coimbatore, KAU, Thrissur, UAS, Bengaluru, IGKV, Raipur

All the centres started the identification of weeds of national importance by physical and literature survey based on the questionnaire developed by DWR, Jabalpur. AAU, Jorhat identified *Ludwigia peruviana, Mikania micrantha, Chromolaena odorata, Mimosa diplotricha, Panicum repens*. SKUAST, Jammu sent the questionnaire for identification of weeds of national importance in Jammu and Kashmir. OUAT, Bhubaneswar also sent questionnaire to identify WoNI in 10 districts of Odisha. Work is in progress.

PAU, Ludhiana did random survey of 15 farmers from district Barnala, having rice-wheat as the dominant system. The survey revealed seven major weeds concerning farmers in the region. *Phalaris minor* was the most dominant present at all locations, *Chenopodium album* and *Leptochloa chinensis* each present at 12 locations, *Echinochloa colona* present at 6 locations and *Rumex dentatus*, *Dactyloctenum aegyptium* and *Portulaca oleracea* each present at 5 location each. The farmers reported *P. minor* as the most invasive and having long term impacts on vegetation and ecosystem. All other weeds vary in their categorization in term of invasiveness and impacts. For example, *L. chinensis* had higher ability to establish, seedling tolerance to weed control practices and is highly competitive once established. Same was the case with *R. dentatus* and *E. colona*.

Based on the invasiveness characteristics, general impacts, potential for spread and social impacts, CSKHPKV, Palampur ranked *Lantana camara* as the number one weed of the state followed by *Parthenium hysterophorus, Ageratum conyzoides*, *Bidens pilosa*, *Avena fatua*, *Sorghum halepense, Phalaris minor, Oxalis latifolia, Syndrella vialis, Alternanthera philoxeroides, Persicria hydropiper, Galinsoga parviflora, Chromolaena adenophorum, Imperata cylindrica, Echinochloa colona*, *Cyperus iria*, *Commelina* sp, *Digitaria sanguinalis*, *Polygonum alatum* and *Spergula arvensis* in that order.

TNAU, Coimbatore conducted the survey from the sources in 18 districts of of Tamil Nadu . From the data collected in questionnaire, Major weeds present in the surveyed districts were *Cyperus rotundus, Parthenium hysterophorus, Cyanodon dactylon and Prosopis juliflora* under non-cropped areas. KAU surveyed Thrissur and Alappuzha for WoNI. The major weeds of Kerala were *Hydrilla, Salvinia, Eichhornia.* UAS, Bengaluru identified *Chromolaena odorata, Eichhornia crassipes* Mart Solms. IGKV, Raipur initiated study in 28 villages and work is in progress.

WP-3 Fate of herbicide residues in different agroecosystems

WP 3.1 Assessment of herbicide residues under program WP-1.1 Weed management in major crops and cropping systems and station trials specific to the state

PJTSAU, Hyderabad

Herbicide residues in cotton based inter cropping systems

Diuron and quizalofop analysis was carried out on HPLC with UV/DAD detector. Pendimethalin residues in soil were determined by GC. Initial residues of diuron, pendimethalin, quizalofop at 4 hours after herbicide application varied from 0.298 to 0.322 µg/g, 0.432 to 0.458 µg/g and 0.022 to 0.031 µg/g in the soil samples. Diuron residues persisted up to 60 days after herbicide application in the soil. At the time of harvest, the diuron residues were below the detection limit of 0.05 µg/g in all the soil. Persistence of pendimethalin and quizalofop soil could be noticed up to 60 days after pre-emergence application in soil. At the time of harvest, the pendimethalin residues were below the detection limit of 0.05 µg/g in all the soil samples. Persistence of quizalofop in soil could be noticed up to 15 days after herbicide application. At the time of harvest, the pendimethalin residues were below the detection limit of 0.012 µg/g in all the soil samples. **(Table 3.1.1)**

Table 3.1.1: Pendimethalin residues in soil samples (*Kharif* 2022).

Treatment	Days after herbicide application				
	0	15	30	60	Harvest (125 DAS)
Cotton+soybean-IWM	0.432	0.312	0.145	0.074	BDL
Cotton+soybean-Chemical	0.462	0.298	0.142	0.081	BDL
Cotton+Sesame-IWM	0.468	0.285	0.136	0.065	BDL
Cotton+Sesame-Chemical	0.452	0.308	0.145	0.071	BDL
Cotton+*Dhaincha*-IWM	0.441	0.311	0.122	0.071	BDL
Cotton+*Dhaincha*-Chemical	0.458	0.302	0.118	0.055	BDL

Residues of atrazine, tembotrione and topramezone in soil and maize samples in maize-chick-pea cropping system

For residue analysis, soil samples were collected at 4 hours after herbicide application and at harvest. Grain, and straw samples (rice and maize), were collected randomly from all the treatment plots at harvest time. Atrazine residue were determined on GC-FTD. Topramezone and tembotrione residues in soil were analysed by HPLC-UV. Initial residues of atrazine at 3 hours after herbicide application varied from 0.344 to 0.362 µg/g in the soil samples. The persistence of atrazine in soil could be noticed up to 60 days after application of the herbicide. In the soil, grain and plant samples , the atrazine residues were below the detection limit of 0.05 µg/g at the time of harvest. The initial residues of the topramezone in soil was 0.014 to 0.017 µg/g and tembotrione residues in soil varied from 0.022 to 0.031 µg/g. Topramezone residues in soil could be assessed in soil at 60 days after application of the herbicide and at harvest stage of the crop. At the time of harvest the tembotrione and topramezone resiues in soil, grain and plant were below the detection limits (0.01 µg/g).

PAU, Ludhiana

Samples were collected from field experiment to estimate the residues of metribuzin and pendimethalin applied to pea. The experiment was conducted in triplicate with three treatments: T1: Pendimethalin 750 g/ha, T2: Pendimethalin 750 g/ha followed by paddy straw mulch 7.5 t/ha and T3: Metribuzin 210 g/ha. Metribuzin and pendimethalin residues were quantified using HPLC. The LOD and LOQ of metribuzin and pendimethalin were 0.02 and 0.05 µg/g, respectively. The initial residues of pendimethalin were 0.309 and 0.321 µg/g in T1 and T2 treatments, respectively while for metribuzin residue were 0.100 µg/g.

TNAU, Coimbatore

Soil samples were collected at 0, 1, 3, 5, 10, 15, 30, 45 and 60 from the herbicides applied and hand weeding plots and were subjected to respective residue analysis to find out the persistence and residue in soil. Similarly plant straw and grain were also collected for its residue analysis. Pyrazosulfuron ethyl, bispyribac-sodium, bensulfuron-methyl penoxsulam, pretilachlor, cyhalofop-p-butyl residues were analysed by HPLC–DAD.

Persistence of herbicides (*Rabi* 2021-22)

Residues of bensulfuron- methyl and cyhalofop-butyl persisted up to 30 DAHA, pretilachlor persisted up to 45 DAHA, pyrazosulfuron-ethyl bispyribac-sodium and penoxsulam persisted up to 15 DAHA. The dissipation of all the herbicides was found to follow first order reaction kinetics (R^2>0.90) with the half-life ranging from 9.06 to 13.02 days. The residues of all the herbicides in soil, grain and straw from different plots were below 0.01 mg/kg. **(Table 3.1.1)**

Persistence of herbicides (*Kharif* 2022)

The dissipation of all the molecules was found to follow first order reaction kinetics (R^2>0.90) with the half-life of 10.3 to 11.8 days for pyrazosulfuron ethyl, 12.5 days for bispyribac-sodium,13.4 days for cyhalofop-butyl, 11.3 days for penoxulum and 12.6–14.1 for bensulfuron-methyl. The residues of all the herbicides in grain and straw from different plots were below 0.01 mg/kg **(Table 3.1.2)**.

Table 3.1.1: Persistence of different herbicides in rice soil (*Rabi* 2021-22) in rice-rice cropping system

Treatments	Herbicide	Residue (mg/kg)/ days									
		0 (2hr)	1	3	5	10	15	30	45	60	90
PE pyrasosulfuron-ethyl *fb* HW	PSE	0.038	0.032	0.025	0.018	0.014	0.012	BDL	BDL	NA	NA
PE bensulfuron-methyl + pretilachlor *fb* HW	BSM	0.071	0.062	0.054	0.041	0.028	0.018	0.014	BDL	BDL	NA
	Pretilachlor	0.416	0.384	0.372	0.298	0.216	0.128	0.092	0.036	BDL	BDL
PE pyrasosulfuron-ethyl (10% WP) *fb* penoxsulam+ cyhalofop butyl (RM)	PSE	0.041	0.036	0.031	0.027	0.018	0.013	BDL	BDL	NA	NA
	Penoxsulam	0.034	0.029	0.021	0.017	0.014	0.010	BDL	BDL	NA	NA
	Cyhalofop butyl	0.060	0.055	0.049	0.041	0.030	0.018	0.013	BDL	NA	NA
PE bensulfuron-methyl + *fb* POE bispyribac-sodium	BSM	0.074	0.068	0.059	0.049	0.031	0.024	0.014	BDL	BDL	NA
	BPS	0.032	0.026	0.019	0.017	0.012	0.010	BDL	BDL	NA	NA

Table 3.1.2: Dissipation equation, correlation coefficient and half-lives of different herbicides in soil

Treatments	Herbicide	R^2	$t^{1/2}$
PE pyrasosulfuron-ethyl *fb* HW	PSE	0.903	9.13
PE bensulfuron- methyl + pretilachlor *fb* HW	BSM	0.884	12.42
	Pretilachlor	0.972	13.02
PE pyrasosulfuron-ethyl penoxsulam+ cyhalofop butyl	PSE	0.996	9.13
	Penoxsulam	0.981	9.06
	Cyhalofop- butyl	0.971	12.97
PE bensulfuron-methyl + bispyribac-sodium	BSM	0.952	12.20
	BPS	0.922	9.39

WP 3.2 Assessment of herbicide residues in the long-term experiments under program WP-1.2 Weed Management under conservation tillage-based cropping

PJTSAU, Hyderabad

Herbicide residues in cotton- maize-green manure conservation agriculture experiment

A field study was initiated on conservation agriculture in cotton (*Kharif, 2022*) – maize (*Rabi 2021-22*) – *Sesbania* green manure (summer) cropping system to study the influence of herbicides on soil properties and also to assess the carryover of the herbicide residues. Diuron, pyrithiobac sodium, quizalofop-p-ethyl herbicides were applied to the cotton crop. Atrazine was applied 1000g/ha as pre-emergence. Atrazine residues were determined by GC-FTD. Diuron residue in soil was determined by HPLC with UV detector. The LOD and LOQ reported for diuron was 0.0165 µg/g and 0.05 µg/g respectively.

Atrazine residues in soils

At 4 hours after herbicide application, initial residues of atrazine varied from 0.394 to 0.422 µg/g in the soil samples. In the final soil sample, and maize grain/ plant samples collected at the time of harvest, the atrazine residues were below the detection limit of 0.05 µg/g.

Kharif 2022

Initial residues of diuron and quizalofop-ethyl at 4 hours after herbicide application varied from 0.198 to 0.316 µg/g and 0.038 to 0.050 µg/g in the soil samples. In the soil sample at the time of harvest, the diuron and quizalofop-ethyl residues were below the detection limit of 0.05 µg/g and 0.01 µg/g in all the soil samples.

PAU, Ludhiana

Wheat 2021-2022

Metribuzin and clodinafop-propargyl were analysed in wheat. The LOD and LOQ of metribuzin and clodinafop-propargyl were 0.02 and 0.05 µg/g, respectively. Initial residues of metribuzin in soil ranged from 0.033 to 0.148 µg/g in different treatments and the residues were below the detectable limit (<0.01 µg/g) in soil and wheat grain at the harvest of crop. The residues of clodinafop-propargyl in soil and wheat grain at harvest under recommended herbicide and IWM treatments were below detectable limit (<0.05 µg/g).

Maize 2022 (Maize-mustard cropping system)

Topramezone from soil samples was extracted by ultrasound assisted extraction (UAE) method. The residues were quantified using HPLC. The LOD and LOQ of topramezone were 0.003 and 0.01 µg/g, respectively. The initial residues of topramezone were 0.021 µg/g and residues decreased significantly with time. Degradation

followed first order kinetics with $R^2 > 0.99$ and DT_{50} of topramezone was 14.53 days. The residues were below the detectable limit (<0.01 µg/g) in soil, stover and grain at the harvest of crop.

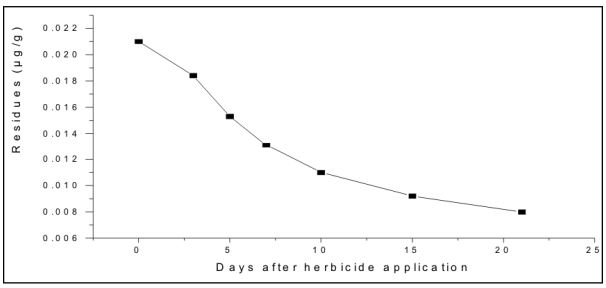


Figure 3.2.10 Degradation of topramezone in soil

TNAU, Coimbatore

During *Rabi* 2021-22 baby corn was grown as test crop which received atrazine as pre-emergence herbicide, tembotrione and topramezone and 2,4-D as early post emergence herbicide as per the treatment to control weeds. Soil samples were collected from the PE herbicide applied plots on 0, 3, 7, 15, 30, 45 and at harvest and analysed for residues. Zero tillage with and without residue plots recorded lower residues when compared to conventional tillage. The dissipation of all the herbicides was found to follow first order reaction kinetics (R2 > 0.90) with the half-life of 14.4 -17.6 days for atrazine, 8.6 to 10.0 days for tembotrione, 9.2 to 12.0 days for topramezone and 5.3 to 7.5 days for 2, 4-D irrespective of tillage practices and weed management methods.

Table 3.2.1: Influence of conservation tillage and weed management practices on herbicide (mg/kg) residues in soil with baby corn (Late *Rabi* 21) in Cotton- baby corn cropping system

Treatments	**Days after herbicide application**						
	0	3	7	15	30	45	Harvest
	PE Atrazine 0.5 kg/ha						
(CT)	0.330	0.304	0.269	0.214	0.114	0.056	0.018
(ZT)	0.324	0.298	0.266	0.198	0.108	0.048	0.012
(ZT+R)	0.318	0.292	0.254	0.184	0.108	0.042	0.011
Treatments	**PE Atrazine 1.0 kg/ha + BC on 45 DAS**						
	0 day	3 day	7 day	15 day	30 day	45 day	Harvest
(CT)	0.718	0.664	0.604	0.492	0.328	0.168	0.041
(ZT)	0.694	0.648	0.593	0.471	0.314	0.142	0.034
(ZT+R)	0.682	0.641	0.581	0.468	0.306	0.133	0.030
Treatments	**EPOE Tembotrione 120 g/ha**						
	0 day	3 day	7 day	15 day	30 day	45 day	Harvest
(CT)	0.091	0.079	0.046	0.024	0.012	BDL	BDL
(ZT)	0.082	0.071	0.041	0.019	0.010	BDL	BDL
(ZT+R)	0.081	0.068	0.039	0.016	0.014	BDL	BDL
Treatments	**EPOE Topramezone 12.5 g/ha**						
	0 day	3 day	7 day	15 day	30 day	45 day	Harvest
(CT)	0.035	0.024	0.018	0.014	BDL	BDL	NA
(ZT)	0.024	0.021	0.012	0.010	BDL	BDL	NA
(ZT+R)	0.028	0.020	0.011	0.009	BDL	BDL	NA
Treatments	**2,4 D 500 g/ha**						
	0 day	3 day	7 day	15 day	30 day	45 day	Harvest
(CT)	0.368	0.296	0.214	0.074	BDL	BDL	NA
(ZT)	0.334	0.281	0.198	0.060	BDL	BDL	NA
(ZT+R)	0.324	0.027	0.178	0.048	BDL	BDL	NA

Analysis showed that the residues of 2,4-D, tembotrione and topramezone in soil, baby corn cob and straw from different plots were below 0.01 mg/kg irrespective of the tillage management practices followed for weed control. Whereas, application of atrazine at 0.5 and 1.0 kg/ha recorded residues of 0.011 to 0.041 mg/kg **(Table 3.2.1)**.

WP 3.3 Assessment of herbicide residues in high value crops

AAU, Anand

There was no any herbicide residue of atrazine, pendimethalin or metribuzin observed in fresh rhizome of turmeric

PJTSAU, Hyderabad

a. Oxyfluorfen residues in cabbage in babycorn-cabbage cropping system (*Rabi* 2021-22)

Oxyfluorfen applied 150 g/ha as pre-planting spray 48 hours before planting of the cabbage seedlings. LOQ of oxyfluorfen in soil and in onion bulb was 0.05 mg/kg, Residues of oxyfluorfen in soil and cabbage samples and soil at the time of harvest were below the detection limit of 0.05 mg/kg.

B. Metribuzin residues in soil and tomato fruits in tomato-beetroot and water melon cropping system. (*Kharif* 2022)

Metribuzin was used as a post-emergence herbicide at 500 g/ha. At the time of first picking tomato fruits were also collected from the experimental field. Freshly harvested tomato fruit samples were collected from 4 different spots in the field. Metribuzin residues were analysed by GC. The soil samples collected at harvest of the tomato fruits, residues of metribuzin were below the detection limit (0.05 mg/kg). In all tomato samples collected from the farmers' fields, metribuzin residues were BDL (0.05 mg/kg)

PAU, Ludhiana

Potato 2022

Field experiment was conducted at farmers' field at village *Akalgarh* (75°38'50.80'' 30°45'8.28'') to estimate the residues of metribuzin applied to potato. Two sequential applications of metribuzin were done at 1st of November, 2022 and 15th of November, 2022, respectively at 250 mL/acre. Soil samples were collected from the field at 3 hrs after second spray for determination of residues of metribuzin and analyzed for residues by HPLC. The initial residue of metribuzin was 0.521 µg/g in soil sample.

WP 3.4 Assessment of herbicide residues under program

PAU, Ludhiana

Soil, water and crop samples were collected randomly at harvest from farmer's fields from Ludhiana, Moga, Kapurthala, Fazilka and Sangrur districts of Punjab in rice-wheat cropping system. Pretilachlor, butachlor, anilofos, bispyribac sodium, pendimethalin, penoxsulam, sulfosulfuron, metsulfuron-methyl, pinoxaden, clodinafop, mesosulfuron methyl + iodosulfuron methyl sodium were commonly used herbicide in these districts. Residues of these herbicides and some of their transformation products viz. viz 2-amino-4,6-dimethoxypyrimidine (ADMP), 4,6-dimethoxypyrimidine-2-yl-urea (DMPU), methyl 2-(aminosulfonyl) benzoate (MASB) and 2-amino-4-methoxy-6-methyl-1,3,5-triazine (AMMT) were estimated by optimized salting-out assisted liquid-liquid extraction (SALLE) technique from water and analysed by HPLC conditions.The residue of these herbicides in soil, water and crop produce were below detectable limit (<0.01-0.05 µg/g). The residues pyroxasulfone, pendimethalin, clodinafop + metribuzin and penoxsulam in samples of soil, water and crop produce collected from OFR and FLD trials at harvest were below detectable limit (<0.01 µg/g). The soil and crop produce samples were collected from ten farmer's field with known

history of herbicide application in different districts of Punjab. Herbicide used by the farmer and their residues and their effect on DHA activity is given in **Table 3.4.1.**

Table 3.4.1: Residues of herbicides and dehydrogenase activity of soil in samples from farmers' field

Farmers's name	Village and district	History of herbicide spray	Residues (µg/g)	Dehydrogenase activity (µg of TPF g^{-1} day^{-1})
Chamkaur Singh	Bhari Mansa, Sangrur	Butachlor	<0.01	14.123 ± 0.22
Gurdeep Singh	Deon, Bathinda	Bispyribac Sodium	<0.02	19.231 ± 0.13
Harchand Singh	Khirkian wala, Sri Muktsar Sahib	Bispyribac Sodium	<0.02	13.112 ± 0.65
Iqbal Singh	Thandewala, Sri Muktsar Sahib	Bispyribac Sodium	<0.02	12.321 ± 0.51
Anmol Singh	Barkandi, Sri Muktsar Sahib	Bispyribac Sodium	<0.02	20.119 ± 0.21
Lakhwinder Singh	Kandhargarh, Sangrur	Butachlor	<0.01	16.544 ± 0.43
Jashanpreet Singh	Sarainaga, Sri Muktsar Sahib	Bispyribac Sodium	<0.02	14.777 ± 0.59
Shukwinder Singh	Akalgarh, Ludhiana	Pretilachlor	<0.01	16.111 ± 0.67
Shubampreet Singh	Akalgarh, Ludhiana	Pretilachlor	<0.01	11.006 ± 0.41
Sukhdev Singh	Cheema, Sangrur	Butachlor	<0.01	12.564 ± 0.71

In collaboration with department of soil science ground water samples were collected from Muktsar Sahib and Fazilka districts for Punjab. The groundwater of study area was alkaline in nature with pH value varying from 7.01 to 8.64 and from 7.07 to 8.44 in Muktsar and Fazilka districts, respectively. Butachlor, bispyribac sodium, sulfosulfuron, clodinafop, pinoxaden, metsulfuron methyl, mesosulfuron methyl and iodosulfuron methyl were commonly used herbicides in these districts and residues of these herbicides in water samples collected from farmer fields were below detectable limit.

TNAU, Coimbatore

Soil and plant samples were collected at the time of harvest from the maize, tomato, brinjal, rice and black gram grown fields of different farmers from mathuvarayapuram, Devarayapuram, thondamuthur and sennanur village of coimbatore district which received atrazine, quizalofop ethyl, pendimethalin, butachlor and pyrazosulfuron ethyl. The collected soils are clay loam sandy loam, sandy clay loam in texture and the organic carbon content ranged from 0.46 to 0.74%, pH and EC ranged from 7.82 to 8.32 and 0.25 to 0.37dS/m respectively. NPK were supplied as per the state recommendation to the particular crop. Herbicides were analysed by HPLC-DAD for residues at the time of harvest in soil, water and plant produce **(Table 3.4.2)**

Table 3.4.2: Herbicides residue in soil and crop produce from farmers' field

Name of the farmer	Crop	Herbicide	Herbicide dose	Soil (µg/g)	Water (µg/ml)	Grain/ fruit (µg/g)	Straw / Haulm (µg/g)
Mr. N. S. Nanjappan PattiarkovilpathiThottam Narasipuram	Black gram	Pendimethalin	1 kg ai /ha	BDL	BDL	0.018	0.012
Mr. Kuppusamy Booluvampatti	Rice	Pyrazosulfuron ethyl	25g ai /ha	BDL	BDL	BDL	BDL
Mr. Moorthi Paramesampalayam IkkaraiBooluvampatti	Rice	Pretilachlor	0.6 kg ai/ha	BDL	BDL	BDL	BDL
Mr. Palanisamy Devarayapuram,	Maize	Atrazine	0.5 kg ai/ha	BDL	BDL	BDL	BDL
Mr.Nanjukutti VadakkuThottam Devarayapuram	Brinjal	Quizalofop ethyl	50g ai /ha	BDL	BDL	BDL	BDL
Mr.Ravi Irrutu pallam	Greengram	Imazethapyr	75g ai /ha	BDL	BDL	0.031	BDL

The pendimethalin residue of 0.018 and 0.012 µg/g was found in blackgram grain and haulmn. Imazethapyr residues of 0.031 µg/g were found in greengram grain. Other applied herbicides were not detected in the different plant matrices, water and soil except pendimethalin and imazethapyr. This showed that they have been degraded from the soil before the harvest of the crop.

Herbicides residue in soil and ground water sample from farmers' field

Soil and ground water samples were collected between July to September 2022 from various field of tirupur and coimbatore district where herbicides are being continuously used more than 10 years for weed control. The data on herbicides residue level in the soils and ground water collected from different farmer's field. Residues of applied herbicides were not detected in the soil and water of all the locations except Andigoundanur, where 0.037 µg/g atrazine residues were detected in maize grain at harvest.

WP- 4 Demonstration and impact assessment of weed management technologies & SCSP

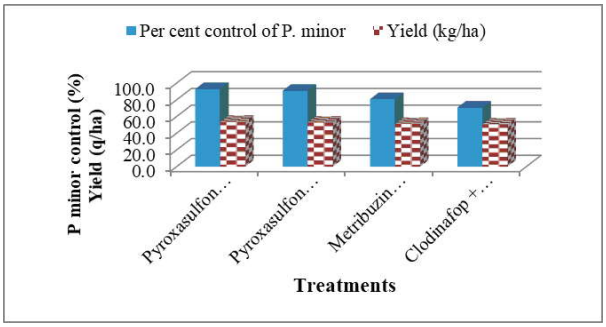
WP 4.1 On-farm research trials

At Coimbatore, five OFTs were conducted with the aim of demonstrating integrated weed management practices in groundnut at the farmers' fields with local varieties of groundnut in Zamin Kalathur Village, Puravipalayam Block, Pollachi Taluk, Coimbatore District during the *Kharif* 2022. The major weeds present in the groundnut fields were *Boerhaavia erecta*, *Borreria hispida*, *Cleome viscosa*, *Cyperus rotundus*, *Digitaria longiflora*, *Euphorbia hirta and Tridax procumben*s etc. Total weed density and weed dry weight were considerably lower with application of EPOE imazethapyr + quizalofop-ethyl (50+50 g/ha) *fb* hand weeding 30 - 35 DAP in all five locations. Among the treatments, higher pod yield was recorded with EPOE imazethapyr + quizalafop-ethyl (50+50 g/ha) *fb* hand weeding 30 - 35 DAP which in turn increased the net returns. Higher percentage of yield increase was also recorded under the EPOE imazethapyr + quizalafop-ethyl (50+50 g/ha) *fb* hand weeding 30 - 35 DAP.

S.No.	Name of the Farmer	Name of the Village
1.	P. Velusamy s/o Palanikounder	Zamin kalathur Village, Puravipalayam block, Pollachi Taluk, Coimbatore District.
2.	S.Kaleeswari w/o Sivasakthi	
3.	S.Eswaran s/o Subbegounder	
4.	M.Bakkiyalakshmi w/o Madhavamanikandan	
5.	P.Velusamy s/o Periya kavundar	

At Ludhiana, five OFTs on weed management in direct seeded rice were conducted with pendimethalin 24% + penoxsulam 1% (RM) at 2500 g/ha in comparison with pendimethalin 30EC at 2500 g/ha (standard). Pendimethalin + penoxsulam (RM) at 2500 ml/ha provided effective control of broad-spectrum weeds and an early weed yield free environment to DSR at early stages. The new ready-mix provided rice grain yield similar to pendimethalin 2500 ml/ha however, both had significantly higher grain yield than unsprayed check at all locations. Similarly four OFTs on weed management in wheat were conducted with tank-mix of pyroxasulfone at 127.5 g + pendimethalin 750 g/ha which was compared with pyroxasulfone at 127.5 g/ha (standard). Tank-mixture of pyroxasulfone at 127.5g/ha + pendimethalin 750 g/ha as pre-emergence recorded effective control of *P. minor* and provided higher weed control and wheat grain yield than pyroxasulfone alone at 1.28 q/ha at two locations.

At Hisar, the efficacy of different herbicides against resistant populations of *P. minor* was assessed at farmers' fields. The pre-emergence uses of pyroxasulfone + pendimethalin (TM) at (127.5 + 1500 g/ha) followed by PoE application of meso + iodosulfuron 14.4 g/ha and pinoxaden 50 g/ha demonstrated at eight sites in rice –wheat growing areas of Haryana provided 93.0 and 91% control of multiple herbicide resistant *P. minor* whereas application of metribuzin (urea mix) after first irrigation followed by meso + iodosulfuron 14.4 g/ha resulted in 80.9 % control of *P. minor*. Application of pyroxasulfone + pendimethalin (TM) at (127.5 + 1500 g/ha) followed by PoE application of meso + iodosulfuron 14.4 g/ha resulted in higher grain yield (53.6 q/ha) followed by pyroxasulfone + pendimethalin (TM) at (127.5 + 1500 g/ha) *fb* pinoxaden 50 g/ha (52.7 q/ha).



At Thrissur, on-farm research trials on management of *Limnocharis flava* in rice was conducted at three locations. The three treatments were post-emergent application of 2,4-D Na salt, 1 kg/ha, 18-20 DAS (T1), Penoxsulam +pendimethalin, 625g/ha, 0-7 DAS (T2) and (Farmer's practice)-hand weeding (T3). It was found that the post-emergent application of 2,4-D Na salt, 1 kg/ha at 18-20 DAS resulted in, the highest grain yield of 47.6 q/ha and the lowest average weed dry matter of 7.63 g/m^2 at harvest.

At Jammu, two on-farm research trials on weed management in transplanted rice were conducted in *Kharif* 2022 at farmer's fields in Jammu region under irrigated conditions. The two test treatments *viz.*, triafamone + ethoxysulfuron 66.5 g/ha at 25 DAT and cyhalofop-butyl + penoxsulam 135 g/ha post at 25 DAT were evaluated and compared with bspyribac-sodium 25 g/ha at 25 DAT as Farmer's practice in two locations. All the herbicides were applied at 25 DAT using 500 L water/ha. Lower weed density, higher grain yield and B:C ratio were recorded test treatments (triafamone + ethoxysulfuron 66.5 g/ha at 25 DAT and cyhalofop-butyl + penoxsulam 135 g/ha post at 25 DAT) as compared to farmer's practice. The new herbicidal interventions i.e triafamone + ethoxysulfuron 66.5 g/ha at 25 DAT and cyhalofop-butyl + penoxsulam 135 g/ha post at 25 DAT recorded 6.25% and 7.33% higher mean yield as compared to farmer's practice (bispyribac-sodium 25 g/ha at 25 DAT), respectively.

At Raipur, twenty-five on-farm research trials were conducted on weed management in direct seeded rice with pre-emergence application of pyrazosulfuron 20 g/ha at 0-7 DAS *fb* bispyibac- Na 25 g/ha at 20 DAS (T1) and pyrazosulfuron 20 g/ha *fb* penoxsulam +cyhalofop-butyl 135 g/ha (T2) as Improved weed management technology and use of bispyribac-Na 25g/ha at 20 DAS as farmers' practice (T3). Percent increase of grain yield under recommended practice (T1 and T2) over farmers' practice was 16.88 and 22.18%, respectively. The average benefit-cost ratio was significantly higher (3.02 and 3.07) as compared to the farmers' practice (2.62).

At Anand, two OFTs were conducted in soybean with treatments viz. propaquizafop 2.5% + imazethapyr 3.75% w/w ME (premix) *fb* IC + HW at 40 DAS (T_1), quizalofop ethyl 7.5% + imazethapyr 15% w/w EC (premix) fb IC + HW at 40 DAS (T_2) and Farmers' practice (IC *fb* two HW at 20 and 40 DAS) (T_3). The result indicated that T_1 was more effective in controlling the weeds and it has a net returns of Rs. 61.318/ ha and benefit-cost ratio of 2.78.

At Gwalior, two OFTs were conducted on sorghum at farmer's fields in two villages of Gwalior district in *Kharif* 2022. Herbicides atrazine 750 g/ha (PE) *fb* 2,4-D dimethylamine salt 750 g/ha and ready-mix atrazine + mesotrione (438 g/ha) (PoE) were tested on sorghum and compared with farmer's practices where farmer was not applied any herbicide. The dominant weeds on farmer's field were *Cyperus rotundus, Phyllanthus niruri, Echinocloa crus-galli, Commelina benghalensis, Digera arvensis* and *Sateria glauca*. The results revealed that the application of atrazine 750 g/ha (PE) + 2,4-D dimethylamine salt 750 g/ha at 20 DAS gave 48% more yield and the application of post-emergence ready mix atrazine + mesotrione (438 g/ha) at 20 DAS provided 35% more yield

over farmer's practice. The centre also conducted two OFRs in wheat crop during *Rabi* 2021-22. Combinations of post emergence herbicides sulfosulfuron + metsulfuron (30+2) g/ha, and clodinafop+ metsulfuron (60+4) g/ha were tested for chemical weed control and compared with farmer's practice. The dominant weeds on farmer's fields were *Cyperus rotundus, Anagallis arvensis, Phalaris minor, Convolvulus arvensis, Chenopodium album* and *Spergula arvensis* etc. The results showed that both the combinations of weed management practices suppress the weed flora and resulted higher seed yield over farmer's practices. The maximum yield of 46 q/ha was obtained with the application of sulfosulfuron + metsulfuron (30+2) g/ha PoE *fb* clodinafop + metsulfuron (60+4) g/ha PoE (45.4 q/ha) which were around 53% higher over farmer's practice (3.00 t/ha). Two OFRs on the management of problematic weed *Cuscuta* in berseem also carried out during *Rabi* 2021-22. Pendimethalin 0.5 kg/ha at 10 DAS and imazethapyr 40 g/ha after 1st cut was applied in berseem fodder crop and tested to control the problematic weed *Cuscuta.* It was compared with farmer's practices in two locations of Gwalior district. The results indicated that the application of imazethapyr 40 g/ha after 1st cut resulted 15% higher yield of fodder berseem over farmer's practice (no herbicide applied).

At Bengaluru, six on-farm research trials were conducted on weed management in kodo millet during *Kharif* 2022. The three treatments were; metsulfuron methyl + chlorimuron ethyl WP-20 WP (2+2) 4 g/ha (T1), 2,4 D sodium salt 80 WP 750 g/ha (T2) and one inter cultivation and hand weeding at 20 and 40 DAS (T3). The results showed that T1 recorded the lowest weed dry weight where as, T3 recorded highest yield. The centre also carried out five OFTs on weed management in foxtail millet. The treatment were; metsulfuron methyl + chlorimuron ethyl WP-20 WP (2+2) 4 g/ha (T1), 2, 4 D sodium salt 80 WP 750 g/ha (T2) and One inter cultivation and hand weeding at 20 and 40 DAS (T3). The results indicated that the T3 provided the highest seed yield and lowest weed dry weight. However, T1 recorded seed yield and weed dry weight figures very much close to that of T3.

At Palampur, during 2021-22, ten OFTs on rice, eight on wheat, eight on maize, seven on peas, seven on soybean and five on turmeric were undertaken. The results were encouraging and the results showed that the treatment pyrazosulfuron –20 g/ha (PE) *fb* bispyribac sodium 25 g/ha (30 DAS) provided the highest grain yield (4.5 t/ha) in rice and clodinafop 60 g/ha + metsulfuron methyl 4 g/ha gave highest yield (40.4 q/ha) in wheat. In maize, tembotrione – 120 g/ha + atrazine-0.5g/ha (20-30 DAS) gave the highest yield being 20% higher over the farmers' practice of hoeing and hand weeding 20 and 45 days after sowing. In peas, imazethapyr 100 g/ha + HW increased peas yield by 10.5% over the farmers' practice of hand weeding thrice whereas pendimethalin

1.50 kg/ha + HW increased peas pod yield by 6.6% over the farmer's practice. Treatment quizalofop ethyl 60 g/ha + chlorimuron ethyl 4 g/ha (25-30 DAS) gave highest yield (18 q/ha) in soybean and treatment atrazine 1 kg (PE) *fb* mulch fb HW 75 DAP provided highest yield (91 q/ha) in turmeric.

At Udaipur, two OFTs on different herbicide combinations in soybean were conducted at village Vallabhnagar (Udaipur). The farmer's field was infested with *Ecinochloa-colona, Commelina bengalensis* and *Cyperus rotundus* among the monocots, *Trianthema pertulacastrum* and *Digera arvensis* were observed among dicots. Application of imazethapyar + propaquizafop (RM-shaked) 125 g/ha at 15-20 was found effective over farmers' practice. Farmers appreciated the response of imazethapyar + propaquizafop instead of imazethapyar for weed control in soybean. Five OFTs on weed management in maize was conducted at Madar, Udaipur. Application of Atrazine *fb* tembotrione 500 g/ha as PE + 120 g/ha at 3-4 leaf stage (15 DAS) was found effective against weed flora in maize at farmers' field.

At Banda, seven OFTs on rice were carried out in farmer's fields located in Banda district during the *Kharif* season of 2022 with three different treatments viz. Penoxsulam 20 g/ha at 20-25 DAS (T1), Bispyribac sodium 25 g/ha as PoE (20 -25 DAS) (T2) and Farmer's practice (two hand weeding) (T3). Rice variety Pant-24 widely grown by farmers of the region used for the study. Herbicides applied as per treatments by using Knap-sac sprayer fitted with flat fan nozzle. The major weeds that infested the plots were *Echinochloa crusgalli, Braccharia reptans, Digera arvensis, Commelina diffusa, Cyperus species*, etc. Maximum weed population recorded under farmer's practice (two hand weeding), while minimum under Penoxsulam

20 g/ha at 20-25 DAS. Mean grain yield was recorded highest (40.6 q/ha) when penoxsulam 20 g/ha applied 20-25 DAS followed by bispyribac sodium 25 g/ha as PoE (3.92 t/ha) which was 17.0 % and 12.9 % higher over farmer's practice (34.7 q/ha).

At Bhubaneswar, four OFTs on transplanted rice were conducted during *Rabi* 2021-22 at Nayagarh and Kendrapara districts. Maximum yield of 36.5 q/ha was recorded in the plot applied with pretilachlor 0.75 kg/ha followed by oxadiargyl 75 g/ha (3470 kg/ha). A net saving of Rs. 2450 - 2550/ ha was obtained in the plots treated with herbicides. Further, during *Kharif*-2022, four OFTs in rice were conducted in Bhubasuni patna, Baghamari, Khurda area. The highest yield was obtained in the plots applied Bispyribac- Na(20 g/ha) (4.5 t/ha) followed by Penoxsulam (23.5 g/ha) (43 q/ha). The saving in weeding cost over farmers practice was to the tune of Rs. 2600 to Rs 2950 / ha.

Sl. No.	Name of the farmer	Village
1	Smt. Prabhati Sahoo	Gajamara,Dhenkanal
2	Sri Santosh Ku: Swain	Gajamara,Dhenkanal
3	Sri Bhagwan Barik	Anlamada, Khandapada,Nayagarh
4	Sri Gobind Nayak	Anlamada,Khandapada,Nayagarh

At Akola, two OFTs on soybean were conducted at farmer's fields in which two weed management technologies were compared with farmer's practice (hand weeding). Higher yield and weed control were recorded with the application of propaquizafop 2.5% + imazethapyr 3.75% (RM) in comparison with the farmer's practice. Further, two OFTs on cotton were conducted with three treatments *viz.* pendimethalin 30 EC as PE @ 1.00 kg/ha *fb* directed spray (by using protective shield) of paraquat 24 SL / 0.60 kg/ha at 45 days after sowing (T_1), pyrithiobac sodium 10% EC (T_2) and farmer's practice (2 Hoeing 10 days interval and 2 hand weeding) (T_3). The results indicated that application of pre-emergence herbicdes pendimethalin *fb* directed spray of paraquat out yielded over alone application of pyrithiobac as post-emergence herbicides. This might be due to management of wider weed spectrum with sequential application of pre-emrgence pendimethalin *fb* directed application of paraquat dichloride. Higher gross moentary return was reported in farmers practice, however, higher net monetary return and B:C were reported by application of pre-emrgence pendimethalin *fb* directed application of paraquat dichloride.

At Hyderabad, on-farm research trials were conducted on the management of *Orobanche* in tomato. The five treatments include; T_1: neem cake 200 kg/ha at transplanting *fb* glyphosate at 10 and 10 g/ha at 30 DAP & 55 DAP, T_2: neem cake 200 kg/ha at transplanting *fb* glyphosate at 20 and 20 g/ha at 30 DAP & 55 DAP, T_3: neem cake 200 kg/ha at transplanting *fb* pendimethalin 1.0 kg/ha as PE, 3 DAP, T_4: neem cake 200 kg/ha at transplanting *b* halosulfuron methyl 67.5 g/ha at 30 DAP and T_5: Control. The results of the trials indicated that there were phytotoxic symptoms due to the application of glyphosate @ 20 g/ha whereas no phytotoxicity observed with glyphosate at 10 g/ha. Neem cake 200 kg/ha at transplanting *fb* halosulfuron methyl 67.5 g/ha at 30 DAP and Neem cake 200 kg/ha at transplanting *fb* glyphosate at 10 and 10 g/ha at 30 DAP & 55 DAP recorded lower Orobanche infestation.

WP 4.2 Front-line demonstrations

At Coimbatore, five front-line demonstrations (FLDs) were carried out in onion at Pollikalipalayam village, Pongalur block, Tiruppur district during December 2022 so as to demonstrate the herbicidal weed management practices to control early emerging weeds in onion. Two treatments were taken up *viz.* T_1- PE oxyfluorfen 0.25 kg/ha + hand weeding on 30-35 DAP and T_2- farmers practice (2 Hand weeding). The crop is at vegetative stage.

At Gwalior**,** two FLDs were conducted on pearlmillet in two farmer's fields in the village of Ganpatpura, District Gwalior during *Kharif* 2022 to demonstrate the benefit of the application of atrazine 500 g/ha + 2,4-D 500 g/ha. The dominant weeds on farmer's field were *Cyperus rotundus, Cynodon dactylon, Phyllanthus niruri, Commelina benghalensis, Digera arvensis* and *Echinocloa crus-galli.* Results showed that around 64% higher yield was obtained with BC ratio 2.40 over farmer's practice with the application of atrazine 500g/ha + 2,4-D 500g/ha. The centre also carried out two FLDs in wheat crop during *Rabi* 2021-

22. post emergence herbicidessulfosulfuron + metsulfuron (30+2) g/ha, and clodinafop+ metsulfuron (60+4) g/ha were applied to control the weeds and compared with farmer's practices at two locations of Gwalior district where farmer was not applied any herbicide. The dominant weeds on farmer's fields consisted of *Cyperus rotundus*, *Anagallis arvensis*, *Phalaris minor*, *Convolvulus arvensis*, *Chenopodium album* and*Spergula arvensis*, etc. The findings indicated that the combination of sulfosulfuron + metsulfuron (30+2) g/ha PoE gave maximum yield (48.4 q/ha) *fb* clodinafop+ metsulfuron (60+4) g/ha PoE (47.2 q/ha) in the farmers field, which was 62%, and 51% higher than farmers practice (no herbicide applied) respectively. However, the maximum BC ratio was found (2.72) with the application of sulfosulfuron + metsulfuron (30+2) g/ha PoE.

At Palampur, sixty-eight demonstrations were conducted during 2021-22 in different crops. In wheat clodinafop propargyl 60 g/ha + metsulfuron-methyl v/s farmer's practice and in peas imazethapyr 100 g/ha v/s farmers practice were evaluated. In rice butachlor 0.6 kg/ha/ *fb* bispyribac sodium 20 g/ha, in soybean, quazalofop-ethyl 60 g/ha+ chlorimuron ethyl 4 g/ha/imazethapyr 100 g/ha, in maize tembotrione 120 g/ha + atrazine 0.5 kg/ha and in turmeric metribuzin 0.75 kg/ha fb mulch fb HW were evaluated against the farmers practice. The results revealed that 22.9% increase in grain yield of wheat, 25.6% increase in the peas pod yield, 18.4% grain yield of rice, 18.6% grain yield of maize, 28.8% in yield of soybean and 40.2% rhizome yield of turmeric over the respective famers practice being undertaken in a particular crop.

At Ludhiana, four front line demonstrations were conducted in *Kharif* 2022. Uniform spreading of paddy straw mulch at 7.5 t/ha just after sowing of maize provided effective control of annual weeds and provided similar maize grain yield to farmer's practice (atrazine

as pre- or tembotrione as post-emergence). Paddy straw mulch provided similar weed control and maize grain yield as of farmer's practice. Further, eight FLDs on control of *P. minor* with ready-mix of clodinafop 9% + metribuzin 20% at 174 g/ha were conducted in wheat. New herbicide pre-mix gave 28% higher control of *P. minor* and 18% higher wheat grain yield than clodinafop, sulfosulfuron and pinoxaden.

At Hisar, demonstrations on use of glyphosate for *Orobanche* control in mustard were carried out at 21 locations in Mahendergarh, and 10 locations in Bhiwani and Hisar districts. The average yield of mustard with use of glyphosate was 10-12% higher than the control in Mahendergarh district.

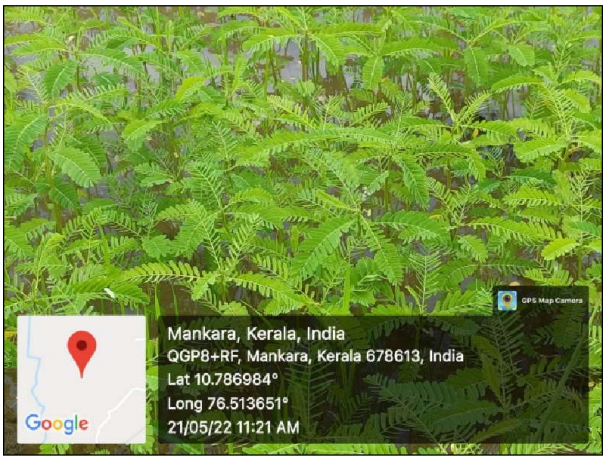
At Hyderabad, five Front Line Demonstrations were conducted in rice during *Kharif* 2022 to popularize the integrated weed management technology at Palem, Kahanapur and Venkatapur villages, Palem Mandal in Nagarkurnool district respectively. The results from FLDs showed that IWM involving post-emergence application of Triafamone 20% (44 g/ha) + ethoxysulfuron 10% WG (22.5 g/ha) at 225 g/ha as POE *fb* hand weeding at 40 DAT resulted in efficient weed control in early crop growth stages compared to the farmers method. Further the manuall abour requirement was less when the improved practice was adopted by the famer compared to the traditional

method. This resulted in higher BC ratio in the range of 2.28 to 2.35 compared to farmers' method where BC ratio was in the range of 1.99 to 2.17.

At Thrissur, six FLDs were conducted at different locations in farmers' fields to popularize the organic weed management technology-green manuring (*in-situ*), transplanting of rice *fb* one hand weeding at 40 DAT. It was found from the demonstrations that the technology provided efficient weed control and better grain yield as compared to farmers' practice-Direct seeding, two hand weeding at 25-45 DAT. The average grain yield obtained from the technology was 31.7 q/ha with a BC ratio of 2.05, whereas farmers' practice gave an average yield of 30.2 q/ha with a BC ratio of 1.78.

At Jammu, two front line demonstrations on weed management in direct-seeded rice were conducted in *Kharif* 2022 at farmer's fields in Jammu region under irrigated conditions. The one test treatments viz., pendimethalin 1 kg/ha as PE *fb* triafamone + ethoxysulfuron 66.5 g/ha at 25 DAS was evaluated and compared with pendimethalin 1 kg/ha *fb* bispyribac-sodium 25 g/ha at 25 DAS as Farmer's practice in two locations. All the herbicides were applied using 500 L water/ha. The results indicated that the lower weed density, higher grain yield and BC ratio were recorded in test treatment (pendimethalin 1 kg/ha as PE *fb* triafamone + ethoxysulfuron 66.5 g/ha at 25 DAS) as compared to farmer's practice (pendimethalin 1 kg/ha *fb* bispyribac-sodium 25 g/ha at 25 DAS). The new herbicidal intervention i.e pendimethalin 1 kg/ha as PE *fb* triafamone + ethoxysulfuron 66.5 g/ha at 25 DAS recorded 8.45% higher mean yield as compared to farmer's practice (pendimethalin 1 kg/ha *fb* bispyribac-sodium 25 g/ha at 25 DAS). The centre also carried out five front-line demonstrations on weed management in maize during *Kharif* 2022 at farmer's fields in Jammu region under rainfed conditions. The one test treatments viz., topramezone + atrazine 25.2 + 500 g/ha at 15-20 DAS was evaluated and compared with atrazine 1 kg/ha as Farmer's practice in five locations. All the herbicides were applied using 500 L water/ha. The results of this demonstration indicated that the lower weed density, higher grain yield and BC ratio were recorded in test treatment (topramezone + atrazine 25.2 + 500 g/ha at 15-20 DAS) as compared to farmer's practice (atrazine 1 kg/ha as PE). The new herbicidal intervention i.e. topramezone + atrazine 25.2 + 500 g/ha at 15-20 DAS recorded 11.18 to 17.13% higher mean yield as compared to farmer's practice (atrazine 1 kg/ha).

At Udaipur, Fifteen FLDs on broad spectrum weed control in wheat with premix application of sulfosulfuron + metsulfuron (30 + 2 g/ha) at 30 DAS; mesosulfuron+idosulfuron



methyl sodium -14.4 g/ha at 30 DAS were conducted at kyara ka bhilwada, mata ka bhilwada and Kesar khedi Kumbhalgarh, dist. –Rajsamand. The farmer's field was infested with *Phalaris minor* among the monocots *Chenopodium album, Malwa parviflora, Melilotus indica, Chenopodium murale and Convolvulus arvensis* were observed among dicots. Application of ready-mix herbicide mesosulfuron + idosulfuron methyl sodium - 14.4 g/ha at 35 DAS recorded minimum weed density and weed dry matter as compared to farmers practice with increased the wheat grain yield by 9.26% over farmers practice wheat yield.

At Raipur, twenty-five demonstrations were conducted on weed management in direct seeded rice with treatment application of pre-emergence application of pyrazosulfuron 20 g/ha at 0-7 DAS *fb* bispyibac- Na g/ha at 20 DAS as technology transfer and other treatment i.e. farmer's practice was application use of bispyribac-Na 25 g/ha at 20 DAS. The average yield of farmers' practice was 46 q/ha whereas the average grain yield obtained under improved technology treatments were 56.1 q/ha and 55.7 q/ha in two locations, i.e., Bemetara and Balod districts, respectively. However, percent increase under recommended practice over farmers' practice was 21.66 and 21.18%. The average benefit-cost ratio was appreciably higher (3.12) as compared to the farmers' practice (2.68).

At Anand, five FLDs were conducted in wheat during *Rabi* 2021-22 with application of sulfosulfuron 75% + metsulfuron 5% WG (30 + 2 g/ha) at 30 DAS as technology transfer and metsulfuron 20% WP (4 g/ha) as farmers' practice at 30 DAS. The results of the demonstration revealed that the application of sulfosulfuron 75% + metsulfuron 5% WG (premix) 32 g/ha PoE recorded higher WCE and gave higher yield, net return and BC ratio (2.32) as compared to farmers practice metsulfuron 20% WP 4 g/ha (2.20). Farmers were fully satisfied with the performance of the technology.

At Kalyani, demonstration on improved crop production technology on jute was conducted during the jute season of the year 2022 in two villages. Adjacent check plot (with farmers' practice) was maintained for each demonstration plot in order to differentiate the practice of improved technology from the traditional one. Improved production practice viz line sowing, chemical weed control with quizalofop ethyl 5% 1.5ml/L at 20 DAS plus one hand weeding after 20 days of herbicide application, plant protection measures against damage by insect pests were taken in practice all together. The use of improved technology led to a respective increase in net returns by 27.29% and 34.61% in both villages, when compared to traditional farmers' practices. In order to improve the socio-economic status of farmers in the ongoing villages in a system-based approach, the centre conducted demonstrations for the adoption of advanced production technology in succeeding crops of jute. The treatments included; T_1- New variety (Pratiksha) + 100% RDF (80:40:40 kg/ha N-P_2O_5-K_2O) pretilachlor 750 g/ha PE *fb* bispyribac-Na 25 g/ha at 25 DAT and T_2- farmers' practice: existing old variety (MTU7029) + 80:40:40 kg/ha N-P_2O_5-K_2O + one hand weeding at 25DAT. The demonstration results showed that in both villages, the use of improved technology resulted in a respective increase in net returns of 24.51% and 38.6%

compared to farmers' practice.

At Akola, twenty FLDs were conducted on weed management in soybean with the pre-emergence application of diclosulam 84% WDG as improved technology and 1 hoeing and 2 hand weeding as farmers' practice. Farmers' practice recorded higher grain yield and gross monetary return over pre-emergence application of diclosulam, however, benefit-cost ratio was higher with the application of pre-emergence herbicides diclosulam.

Table 4.2.1: Extension Activities undertaken by coordinating centres.

Sl no.	Centre Name	Training imparted	Radio talks	TV Programmes	Kisan Mela/ Kishan Day	Handout/ folders/pamphlets	Bulletins/booklet	Trainings participated	On farms trials	Frontline demonstrations	Parthenium awarness week
1	PAU, Ludhiana	3	-	2	2	-	2	12	9	4	√
2	UAS, Bengaluru	16	-	6	2	-	-	5	-	-	√
3	RVSKVV, Gwalior	-	-	-	-	-	-	9	4	4	√
4	GBPUAT, Pantnagar	-	7	-	2	-	-	-	12	4	√
5	CSKHPKV, Palampur	6	4	-	-	-	1	32	14	68	√
6	AAU, Jorhat	19	2	1	-	-	1	3	5	5	√
7	AAU, Anand	3	2	-	-	-	-	21	2	15	√
8	TNAU, Coimbatore	1	-	-	-	-	6	4	1	5	√
9	KAU, Thrissur	11	-	-	-	-	3	9	4	6	√
10	OUAT, Bhubaneshwar	-	-	-	-	-	-	-	8	-	√
11	PJTSAU, Hyderabad	-	-	6	-	-	8	13	1	2	√
12	CCSHAU, Hisar	3	2	-	-	-	-	16	-	-	√
13	IGKV, Raipur	2	-	-	3	-	-	-	25	-	√
14	PDKV, Akola	14	-	2	-	-	-	-	6	1	√
15	BCKV, Kalyani	-	-	-	-	-	-	5	-	-	√
16	MPUAT, Udaipur	21	-	-	-	-	2	6	22	9	√
17	SKUAST, Jammu	2	-	-	-	-	-	-	2	7	√
	Total	**101**	**17**	**17**	**9**	**-**	**23**	**135**	**115**	**130**	**-**

WP 4.3. Impact assessment of weed management technologies

At Anand, the technologies developed during last five years on weed management are demonstrated on the farmers' field. Awareness during training programme on weed management have positive impact on the adoption of weed management technologies in the different crops. District level survey indicated that the weed management technology clodinafop propargyl 15% + metsulfuron methyl 1% WP in wheat has covered 18000 ha in Anand district which has provided an yield increase of 3.6 q/ha and an average cost saving of Rs. 4882 per ha. Similarly, propaquizafop 2.5% + imazethapyr 3.75% w/ w ME in soybean crop have been adopted by 20% of farmers in the Dahod district which

had given a yield increment of 2.6 q/ha and cost saving of Rs. 10, 980 per ha. Early post-emergence (10-15 DAS) application of imazethapyr 100 g/ha *fb* IC + HW at 40 DAS in summer groundnut has adopted by 25% of farmers in Chotaudepur district with an area coverage of 600 ha. In the same district, pendimethalin 900 g/ha *fb* IC+HW at 30 and 60 DAS in cotton have been adopted by 35% of farmers with an area coverage of 30000 ha.

At Bhubaneswar, Impact assessment of weed management' technologies was carried out in Puri district by surveying 250 farmers. The farmers have mostly marginal holding size with medium family size. The dominant cropping systems practiced are rice - pulses / groundnut, rice - vegetables and rice - rice (irrigated patch - 20%). The major production constraints are lack of exposures, unavailability of inputs in time, weed menace and uncertainty of monsoon. The yields of the crops are low in 60% of the areas and the farmers are spending Rs 1500 - 2150 /ha more in manual weeding. Most of the farmers are not satisfied with the traditional method of weed management. Whereas the technology post emergence herbicide bispyribac Na 0.02 kg/ ha 25 DAS provided 13-18% increase in yield with an average cost savings of Rs. 2500 per ha. The approximate area coverage of the technology in the district was 16650 ha and around 9% farmers were adopted the technology to control the weeds in rice.

At Ludhiana, production technology and weed management for brinjal-pea system under organic farming resulted a cost saving of Rs. 2266 per ha as compared to the existing practice and provided a yield increment of 8.4 q/ha. Surface seeding of wheat in a combine harvested paddy field gave a yield increase of 1.3 q/ha and cost saving of Rs. 2500/ha. The technology named "Early post-emergence weed management with ready mix of triafamone + ethoxysulfuron" resulted 0.3 q/ha increase in yield with a cost saving in weed management equal to Rs. 500 per ha.

At Palampur, impact assessment of weed management technologies was carried out in Hamirpur and Kinnaur districts of Himachal Pradesh. The technology "Atrazine 1.0 -1.25 kg/ha *fb* HW" in maize have been adopted by 57% of the farmers with an area coverage of 4735 ha. The technology provided 9 q/ha yield increment and Rs. 1000/ha cost saving in comparison with the existing practices of weed management in the crop. Further, clodinafop 60 g/ha + metsulfuron methyl 4 g/ha in wheat have been adopted in an area of 2124 ha and average yield increase reported was 4.3q/ha and cost saving in weed management equal to Rs. 6500 per ha. Similarly, the technology bispyribac -Na at 25 g/ha in rice was adopted by 37% of farmers with an area coverage of 700 ha. The average yield increment recorded was 6.1q/ha and cost saving in weed management was Rs. 10,400 per ha as compared to the existing farmer's practice.

At Thrissur**,** a study was conducted to assess the impact of weed management technologies adopted by farmers of Kerala. For the study, information was collected from the farmers of Thrissur and Palakkad districts using a pre-tested questionnaire. The study aimed to observe the changes in farmers' living standards and livelihood security after adopting weed management technologies. Among the respondents, 52.77% of the farmers were marginal farmers with less than 1 ha of land; 25% of the farmers were small farmers, 13.88% were medium farmers, and 8.33% were large farmers. Most of the respondent farmers (56%) practiced direct-seeded rice cultivation, and 44.44% adopted transplanting. The adoption of weed management technologies resulted rice yield increased by 300 kg/acre in the *Kharif* season and 200 kg/acre in *Rabi*. The effect was seen in the net income too, which increased by Rs. 13,400/acre in the *Kharif* season and Rs. 10,600/acre in *Rabi*. Farmers gained access to weed management technologies

primarily through training and newspaper articles. 80.55% of the farmer respondents were accessing these sources. Exhibitions are another type of source that 61.11% of farmers use. 50% of the farmers depend on the radio and TV for information. Lack of equipment availability was the major constraint faced by the farmer respondents (70%) when adopting herbicide technology. About 52% of the farmers are constrained by high labour costs for herbicide application.

At Coimbatore, impact of weed management technology PE oxyfluorfen 200 g/ha + hand weeding on 25-30 DAP was assessed in onion crop by conducting survey and discussion with the farmers. The impact study was carried out with OFR and FLD farmers at Coimbatore district and nearby farmers. Weeds pose serious problem in the cultivation of aggregatum onion as it competes with the crop and reduces the bulb yield. The conventional method of weed management viz., hand weeding is laborious and expensive. Moreover, closer spacing of the onion transplants and the shallow root system of the seedling make the hand weeding operation quite difficult as it damages the onion leaves and uprooting of the plants while uprooting the weeds. Hence, the use of pre-emergence herbicide becomes inevitable in the cultivation of aggregatum onion. The farmers expressed that the adoption of weed management technology PE oxyfluorfen 200 g/ha + hand weeding on 25-30 DAP in onion efficiently controlled the weeds during the early stage of the crop and require less labour for subsequent hand weeding. The farmers expressed that there is saving in cost of labour which in turn increased the net return and this is a viable technology for onion cultivation. The yield of onion increased by 3 t/ha after the adoption of weed management technology and yield increase was upto 30% over farmers practice of two hand weeding.

At Bengaluru, impact assessment study was conducted in different districts extending from South to Northern part of Karnataka. In Chickballapur district, adoption of Metolachlor (PE) in beetroot resulted yield increment of 7q/ha with a cost saving in weed management equal to Rs. 5494 per ha. Tembotrione in maize were adopted by 90% of farmers in the district and the technology provided a yield increment of 4.5q/ha with cost saving of Rs. 4179 per ha. Similarly, metribuzin (PoE) in potato were adopted by 90% 0f the farmers in the district and reported an average yield increment of 15q/ha with a cost saving of Rs. 6000/ha. In Hassan district, propaquizafop (50-100 g/ha) + diuron -WP in ginger were adopted by 82% of the farmers and the technology gave a yield increment of 26q/ha. In Bellary district, imazethapyr herbicide were adopted by 63% of groundnut farmers and it has an average cost saving of Rs. 6720 per ha and yield increment of 5q/ha. In Chitradurga district, application of oxyfluorfen - EC-PE + propaquizafop in onion crop were adopted by 98% of the farmers and which resulted a yield increment of 12q/ha and cost saving of Rs. 8566 per ha. In Mandya district, 98% of rice farmers used pretilachlor herbicide for weed management and they did realize an average yield increment of 4 q/ha with a cost saving equal to Rs. 4700 per ha.

Survey on aquatic weed infestation

TNAU, Coimbatore

Centre has conducted surveys of aquatic weeds in different districts of Tamil Nadu *viz* Coimbatore, Dindigul, Erode, Madurai, Namakkal, Salem, Sivagangai, Tiruppur, Tiruvannamalai and Virudhunagar. In Tiruvannamalai district, 6 waterbodies (tanks) were surveyed. The major aquatic weeds present were *Eichhornia crassipes, Prosopis juliflora, Cyperus distans* and *Ipomoea carnea.* Infestation of weeds was ranging from 10-30% in different tanks. However, infestation was not found in Kommuteri tank. In Dindigul

district, 5 waterbodies were surveyed where major aquatic weeds such as *Eichhornia crassipes, Hydrilla verticillata, Ipomoea aquatica, Nymphaea nauchali*, *Cyperus distans* and *Ipomea aquatica* were observed at varying intensity (10-80%). In Salem district, 8 waterbodies (tanks) were surveyed in which major aquatic weeds present were *Typha* sp., *Cyperus distans*, *Ipomea carnea*, *Prosopis juliflora* infecting 10% of the water bodies. However, in Kumaragiri tank, weed infestation was not found and in Mookaneri tank, 40% of water was infested with *Eicchornia crassipes*. In Namakkal district, 7 waterbodies were surveyed and found to be infested with *Typha* sp., *Prosopis juliflora*, *Eicchornia crassipes* and Wild luffa with varying intensity level (5-95%). In Vennandur Tank, the major aquatic weeds present was *Prosopis juliflora* (25%). Among surveyed tanks in Namakkal district, 3 tanks were free from weeds. In Erode district, 6 waterbodies were surveyed. Out of 6 waterbodies, 4 were infested with different weeds such as *Typha* sp., *Ipomoea carnea*, *Prosopis juliflora* at 5% infestation level. However, no weed infestation was observed in remaining 3 lakes. In Coimbatore district, 8 waterbodies were surveyed where *Eichhornia crassipes* was the major weed present in different intensity (5-40%). Other weeds such as *Prosopis juliflora*, *Cyperus distans* and *Nelumbo nucifera* were also found in few lakes, however, no weeds were present in Kumaraswamy Lake.

In Sivagangai district, 8 waterbodies were surveyed. One of the major weed *Prosopis juliflora* was found in all surveyed waterbodies in varying intensity (10-50%). Whereas, *Ipomoea carnea* (5%), *Nelumbo nucifera* (20%), *Typha sp.* (20%) were among the other observed weeds in the waterbodies. In Virudhunagar district, 6 waterbodies were surveyed. In the waterbodies, *Prosopis juliflora* was the dominated weed with varying intensity (60%-90%). Other weeds such as *Eicchornia crassipes*, *Cyperus distans* and *Ipomoea carnea* (10%) were also present. In the 9 surveyed waterbodies of Madurai district, major dominated aquatic weed was *Prosopis juliflora* which was present in almost all waterbodies with varying intensity (6-80%). Other weeds present were *Eicchornia crassipes* (70%), *Nelumbo nucifera* (50%), *Ipomoea carnea* (5%), *Typha sp.* (20%) and *Cyperus distans* (30%). Further, 6 waterbodies were surveyed in Tiruppur district. Surveys revealed the dominance of *Nymphaea nouchali* (30%), *Potamogeton natans* (20%) *Ipomoea carnea* (10%) and *Prosopis juliflora* (5%) in the waterbodies.

UAS, Bengaluru

Centre surveyed different aquatic bodies for observing the weed infestation **(Tabal 5.1)**.

Table 5.1. Aquatic weed Infestation in Karnataka

Name of the water body	Place, District & State	Weeds present in the aquatic body with infestation	
		Name of weed	Water body Area infested with weed (%)
Chornurukere Lake	Chornur, Bellary, Karnataka	*Ipomoea carnea* sub spfistulosa	2-4 %
		Prosopis juliflora (Bellary jail)	16-18%
Chitradurga canal	Babbur farm, Chitradurga, Karnataka	*Alternanthera philoxeroides*	2-3%
Koppal Lake	Koppal, Koppal, Karnataka	*Alternanthera philoxeroides*	2-3%
Belgaum Lake	Bailhongal, Belgaum, Karnataka	*Alternanthera philoxeroides*	1-2 % (Near the banks)

Davangere Lake	Hangode, Davangere, Karnataka	*Alternanthera philoxeroides*	0.5-1 %
Haveri Lake	Haveri, Haveri District & Karnataka state	*Ipomoea carnea* sub sp. *fistulosa*	3-4 %
Vasuvallikere Lake	Malvalli, Mandya, Karnataka	*Typha* sp.	2-3 % (patches)
		Eicchornia crassipes	-
Dibburhalli Lake	Chintamani, Chickballapur, Karnataka	*Hygrophila auriculata*	4-5% (near banks of lake)
		Typha angusta	4-5 % (in patches)
Tejure pond	Hassan, Hassan, Karnataka	*Typha angustifolia* (lesserbul grass)	5-6%
		Eichhornia crassipes	6-7%
Tarak Dharwad Lake	Dharwad, Karnataka	*Ipomoea obscura*	0.5-1 % (all along banks)
Kumta Lake	Shivmogga Karnataka	*Alternanthera philoxeroides*	0.5-1 %
		Hygrophila auriculata	5-6%

AAU, Anand

Centre surveyed 36 water bodies including pond, canal and river around Anand district for observing aquatic weed infestation in Gujarat state. These ponds are mainly infested with *Eichhornia crassipes* and infestation was ranging from 30-80% in the aquatic bodies.

4. RECOMMENDATION FOR PACKAGE OF PRACTICES

AAU, Anand

- In soybean, application of propaquizafop 2.5% + imazethapyr 3.75 w/w ME (premix) 125 g/ha EPoE *fb* IC + HW at 40 DAS and quizalofop ethyl 7.5% + imazethapyr 15% w/w EC 112.5 (premix) EPoE *fb* IC + HW at 40 DAS produced 9.80% higher yield, net return and B:C as compared farmers practice (IC + HW at 20 and 40 DAS).
- Fluazifop-p-butyl 11.1% w/w + fomesafen 11.1% (premix) 250 g/ha EPoE *fb* IC+HW at 40 DAS and imazethapyr 35% + imazamox 35% WG 70 g/ha EPoE *fb* IC+HW at 40 DAS were found equally effective for weed control as Inter Culture *fb* HW at 20 & 40 DAS (farmers practice) with higher B:C (2.77, 2.68, respectively) compared to farmer's practice (2.57) in summer groundnut.
- Atrazine 50% WP + topramezone 336 g/l SC 500+25.2 g/ha PoE (tank mix) and atrazine 50% WP + tembotrione 34.4% SC 500+120 g/ha PoE (tank mix) were found equally effective for weed control as IC *fb* HW at 25 DAS (farmer's practice) with higher B:C (2.86 and 2.75, respectively) compared to FP (2.55) in *Rabi* maize.
- Sulfosulfuron 75% + metsulfuron 5% WG (PM) 32 g/ha PoE recorded higher weed control efficiency with higher B:C (2.32) as compared to metsulfuron methyl 20% WP 4 g/ha PoE (farmer's practice) in wheat.
- Good quality compost can be obtained from weed biomass *viz.*, *Trianthema monogyna* (Carpet weed), *Digera arvensis* (False amaranth), *Amaranthus spinosus* (Spiny pig weed) and *Parthenium hysterophorus* (Carrot grass), by mixing Anubhav Microbial Bio-decomposer Consortium I (AMBC I) 1.0 L/t and 200 kg cow dung slurry/t (cow dung and water in 1:2) with maintaining optimum moisture (~ 60%) in the pit.

BCKV, Kalyani

- Pretilachlor 750 g/ha as pre-emergence *fb* bispyribac-Na 25 g/ha as post emergence at 25 DAT for weed management in rice.

MPUAT, Udaipur

- Application of atrazine 0.5 kg/ha as PE with tembotrione 120 g /ha PoE at either 20 to 25 DAS for weed management in maize.
- Stale seedbed technique + plastic mulch (25 micron) at sowing for effective organic weed management in fennel.
- In sweet corn, crop sown with treatment of soil solarization with plastic mulch was found more effective in reduction of weed population and gave maximum green cob yield.

IGKV, Raipur

- Motorized weeder twice (single row type) in rice and black polythene (25µ) mulch in sweet corn generated the highest system yield and net return from organic scented rice – sweet corn cropping system.
- In rice-wheat-cowpea cropping system, IWM of oxadiargyl 80g/ha PE *fb* hand weeding at 25 DAT/S in rice, integrated (clodinofop 0.06 kg/ha + metsulfuron 0.004 kg/ha PoE *fb* HW 40 DAS) in wheat

and PE of pendimethalin 1.0 kg/ha *fb* 1 HW at 20 DAS in cowpea.

- Topramezone 25.28 g/ha as post-emergence at 18-20 DAS found to be very effective with highest WCE and produced the highest seed yield and net return of chickpea.

CCSHAU, Hisar

- Sulfentrazone 28%+ clomazone 30% (Authority NXT 58% WP) 1.0 kg in 200 liter of water per acre as pre-emergence at proper soil moisture for control of complex weed flora in sole sugarcane.

PJTSAU, Hyderabad

- In baby corn-cabbage organic cropping system inter-row poly-film mulching (30 micro-metres thickness) *fb* intra-row hand weeding (HW) at 30 DAS (3071 kg/ha) or stale seed bed *fb* HW at 20 & 40 DAS (2796 kg/ha) or inter-row rice straw mulch 5 tons/ha *fb* intra row HW at 30 DAS (2779 kg/ha) provided efficient weed control and higher yield in *Kharif* baby corn. During *Rabi* season, mulching with groundnut shells 2 t/ha resulted in higher cabbage yield (37160 kg/ha) followed by poly film mulch + intra row HW at 30 DAT (30075 kg/ha) and rice straw mulch 5 t/ha + intra-row weeding at 30 DAT (28470 kg/ha) apart from effective weed suppression.
- The cropping system productivity in terms of baby corn equivalent yield was highest (16916 kg/ha) in live mulching with *dhaincha* upto 30 DAS in baby corn and groundnut shell mulching 2 t/ha in cabbage followed by poly mulch+ intra row HW at 30 DAS/T in both the crops (15101 kg/ha) or rice straw mulch 5 t/ ha + intra row HW at 30 DAS/T in both the crops (14167 kg/ ha).

OUAT, Bhubaneswar

- Ready mix herbicide bensulfuron methyl + pretilachlor (RM) 0.660 kg/ha at 2 days after transplanting (DAT) *fb* 2, 4 D ethyl ester 0.50 kg/ha at 30 DAT was found to be the best combination of herbicides in controlling the mixed weed populations in the transplanted finger millet.

UAS, Bengaluru

- Metsulfuron methyl + chlorimuron ethyl 20 WP at 4 g/ha and 2, 4 D sodium salt 80 WP 750 g/ha controls weeds effectively in kodo millet if applied when the weeds are at 2-4 leaf stage.
- Metsulfuron methyl + chlorimuron ethyl WP-20 WP (2+2) 4 g/ha and 2, 4 D sodium salt 80 WP 750 g/ha were found to be controlling complex weed flora in Fox tail millet, if sprayed at 2-4 leaf stage.
- In organically grown *Kharif* – Kodo milletstale seedbed technique + inter cultivation at 25 DAS and 45 DAS and inter cultivation at 25 DAS + 1 hand weeding at 45 DAS were found to be effective in controlling weeds.
- In organically grown *Rabi* blackgram stale seedbed technique + inter cultivation at 25 DAS and 45 DAS and inter cultivation at 25 DAS + 1 hand weeding at 45 DAS were found to be effective in controlling weeds.
- Pendimethalin 38.7 EC at two dosage (677 g/ha and 580 g/ha) were effective in controlling weeds and also herbicide residue in coriander leaf sample was below the detection limit.

PAU, Ludhiana

- Sow wheat using combine harvester fitted with seeding attachment, at the time of paddy harvest. It should be followed by single operation of cutter-cum spreader and irrigation. Alternatively, seed and basal fertilizer can be broadcast manually, after paddy harvest, followed by cutter cum spreader and irrigation. Use 112.5 kg seed/ha (fungicide and insecticide treated seed) and recommended dose of basal

fertilizer. The new technique has many added benefits over the conventional methods of paddy residue management like 1) It costs three to four times lesser than conventional methods, for straw management and wheat sowing, 2) It makes paddy residue management and wheat sowing much easier, 3) It does not require costly machines and high HP tractor for residue management, 4) It encourages in-situ paddy residue management which is environment friendly and builds up soil health, 5) It provides complete mulching which save the crop from terminal heat stress, 6) It reduces herbicide use, as weed infestation is lesser in a mulched field, 7) It will halt paddy straw burning. (Collaboration: Deptt of FMPE; Wheat Section, Deptt of Plant Breeding & Genetics; KVKs at Moga, Patiala, Fatehgarh Sahib and Ludhiana).

- In brinjal-paddy system, to brinjal, apply 12.5 t FYM/ha (1.0 % N on dry weight basis) at time of its transplanting and to pea, apply 5.0 t FYM/ha (1.0% N on dry weight basis) at sowing. For weed management, apply 12 t/ha paddy straw mulch in brinjal immediately after its transplanting, and10 t/ha paddy straw mulch in pea immediately after its sowing; the escaped weeds, if any, may be removed by hand weeding (Collaboration: School of Organic Farming, PAU Ludhiana).
- .Two mechanical weeding in furrow and on bed, at 30 & 45 days after sowing wheat on 67.5 cm raised bed, gave weed control efficiency (92.4%). This method gave 38.0 q/ha wheat grain yield in comparison to 45.4 and 20.1 q/ha in two hand weeding and weedy check, respectively. The proposal on organic wheat production on bed (67.5 cm) with two rows and managing the weeds by two mechanical weeding in furrows and on the bed after attaching one tyne in the middle of two sweep type furrow openers of existing ridger (Collaboration: School of Organic Farming, PAU Ludhiana).
- In direct-seeding of rice on raised-beds under *tar-wattar* condition bed planter fitted with bed compacter (for reshaping beds/ ridges) was used and simultaneous sowing of 2-rows of hydro-primed and treated seed was done. First irrigation was applied at 21 days after sowing. Raised bed DSR recorded 1.6 q/ha higher paddy yield and 8.3% higher saving of irrigation water than flat-bed DSR (Collaboration: Rice Section, Deptt of Plant Breeding & Genetics, Deptt of Soil & Water Engineering and Deptt of Farm Machinery & Power Engineering (FMPE), PAU Ludhiana).
- Attachment of press wheels with Lucky Seed Drill enhances pre-emergence herbicide efficacy, enhance profile moisture retention and tackling hard crust (krand formation) in DSR (Collaboration: Deptt of FMPE).
- In direct-seeded rice early-post emergence application of ready-mix of triafamone 10% + ethoxysulfuron 20% at 225 g/ha provides effective control of *Echinochloa* sp., *Leptochloa chinensis*, *Cyperus rotundus*, annual sedges and broadleaf weeds when applied at l-2 leaf stage of weeds; proper moisture must be maintained in the field for one week after spray.

CSKHPKV, Palampur

- Imazethapyr 75 g/ha + hand weeding was most effective weed management treatment in garden peas under mid hill conditions of Himachal Pradesh.
- Application of glyphosate 1000 g/ha and metsulfuron methyl 4 g/ha were most effective in controlling *Alternanthera philoxeroides* and *Synedrella vialis* in non-crop conditions.

KAU, Thrissur

- In coconut plantations which are not

intercropped, *in-situ* green manuring by growing leguminous crops like *dhaincha*, cowpea or horse gram and ploughing-in by two months after sowing can help in effective weed control. Another option is use of low-cost organic residues (like byproduct of Ayurvedic industry). These practices can help in building up soil health and ultimately yield and can be adopted in organic management systems.

- *Salvinia* infestation in rice field can be controlled with pre-mix herbicides [cyhalofop butyl + penoxsulam (0.15 kg/ha)], [butachlor + penoxsulam (0.82 kg/ha)], flourpyroxifen benzyl (31.5 g/ha), florpyrauxifen benzyl + cyphalofop butyl (0.15 kg/ha). Another effective herbicide glufosinate ammonium (0.30 kg/ha) can be used in case of non-cropped paddy field before planting of rice at the time of preparatory cultivation as it is not selective to rice.
- 2,4-D sodium salt, florpyrauxifen-benzyl as well as pre-mix combination of florpyrauxifen-benzyl+ cyhalofop butyl were effective in controlling aquatic weed *Vallisneria* in rice field, which is a weed reported recently from Kerala.
- Growing *dhaincha in-situ* and incorporating it before transplanting in the first crop season is a method for organic weed management in rice. Through this technology, the cost of one hand weeding can be saved as there is considerable reduction in weed density and green manure addition to the crop can enhance productivity.
- *Limnocharis flava* in rice, which is a problem weed reported recently by many farmers that post emergent application (18-20 days after sowing rice) of 2,4 – D sodium salt 1 kg/ha or penoxsulam + pendimethalin 625 g/ha along with an adjuvant/ sticker 2ml/L of spray fluid can effectively control the weed.
- For alien weed *Syngonium podophyllum* in the rubber plantations, the formulations of 2,4– D (Na salt and amine) 1 kg/ha was found to be effective in controlling the weed for a short period of up to 4-6 months. As the vines are very hardy, the regrowth could be observed and hence integrated strategy of herbicide spray followed by removal and disposing in pits only can help in long term control

TNAU, Coimbatore

- In blackgram and greengram pre-emergence application of pendimethalin 0.75 kg on 3 DAS followed by early post-emergence application of imazethapyr 60 g /ha on 15 DAE of weeds (2 - 3 leaves stage of weeds) and quizalofop ethyl 50 g/ha on 20 DAE of weeds (2 - 3 leaves of weeds) are recommended for controlling broad-leaved and grassy weeds, respectively.
- Post-emergence application of glyphosate 1.5 kg/ha + 2,4-D Na salt 1.25 kg/ha + wetting agent 2 ml litre of water was found to be effective in reducing density and dry weight of *Solanum elagaenifolium* and with no regeneration even after 60 days after herbicide application in non-crop conditions.

PDKV, Akola

- Post-emergence application of imazethapyr + imazamox 0.070 kg/ha PoE 15 DAS was the most remunerative and effective herbicide for controlling the weed flora and getting higher yield and economic returns in soybean.
- In cotton, pre-emergence pendimethalin 1.00 kg /ha followed by directed spray (by using protective shield) of non-selective herbicide paraquat 0.60 kg/ha at 45 days after sowing is recommended for controlling weeds with higher yield and monetary returns.
- In maize, pre-emergence atrazine 0.50 kg/

ha followed by post emergence application of tembotrione 0.120 kg/ha at 20DAS were the most remunerative and effective herbicides for controlling the weed flora and getting higher yield and economic returns.

- Post-emergence application of imazethapyr + imazomox 0.07 kg/ha 20 DAS was the most remunerative and effective herbicide for controlling the weed flora and getting higher yield and economic returns in groundnut.
- In turmeric, pre-emergence pendimethalin 1 kg/ha or by metribuzin 0.7 kg/ ha or atrazine 0.75 kg/ha (0-5 DAP) *fb* straw mulch 10 t/ha (10 DAP) *fb* one HW (75 DAP) is recommended for controlling weeds with higher yield and monetary returns.
- Post-emergence application of clodinafop propargyl+ metsulfuron methyl 0.06 + 0.004 kg/ha or sulfosulfuron + metsulfuron methyl 0.03 + 0.002 kg/ha at 35 DAS were the most remunerative and effective herbicides for controlling the weed flora and getting higher yield and economic returns in wheat.
- In sole soybean, post-emergence application of propaquizafop 0.050 kg + imazethapyr 0.075 kg/ha at 21 DAS (2.0 L/ha ready mix commercial formulationin 500 L water) or pre-emergence application of diclosulam 84% WDG 0.026 kg/ha (30 g/ha commercial formulation in 500 L water) is recommended for higher seed yield and economic returns.

5. SCHEDULED CASTE SUB-PLAN PROGRAMME

SKUAST, Jammu

Under Scheduled Caste Sub Plan, training on 'Application techniques of herbicide use' was provided to the farmers of SC community. Some agricultural inputs such as knapsack sprayer and fertilizer (DAP) were also distributed to 100 SC farmers of Upper Chakroi village of Jammu district at SKUAST-J, Chatha on 10 March, 2022.

Distribution of agricultural inputs to SC farmers

CCSHAU, Hisar

Training on 'Herbicide spray techniques' was conducted for SC farmers. In addition to this, they were also provided with sprayers and herbicides for use in wheat crop. Distribution of agricultural inputs was also organized at village Nangla during April, 2022 where summer mungbean seed, pheromones traps and mineral mixture were provided to SC farmers. These farmers were also trained through training programme on 'Weed management in *Kharif* crops' organized at KVK, Fatehabad during April, 2022.

Distribution of agricultural inputs to SC farmers

KAU, Thrissur

Under the scheme, agricultural inputs such as sprayers and herbicides were distributed to the SC farmers of Palakkad and Thrissur districts for weed management in their fields.

TNAU, Coimbatore

A capacity building programme on "Integrated Weed Management" was conducted

for the Scheduled Caste farmers under Scheduled Caste Sub Plan at Chikkadhasampalayam village, Mettupalayam taluk, Coimbatore during December, 2022. This programme was attended by 30 Scheduled Caste farmers and benefited through the training on Integrated Weed Management. They were also given inputs *viz.*, herbicide, farm tools, and training kit consisting of leaflets and pamphlets about the weed management technologies. Herbicide application techniques were demonstrated to the farmers at cropped and non-cropped areas and with different herbicides. An exhibition was also organized to explain about the weed management technologies.

GBPUAT, Pantnagar

Centre organized one day training programme on weed management in *Kharif* and *Rabi* crops, spraying technology and precautions adopted during spraying. The training programme was organized on 11 Oct, 2022 in Udham Singh Nagar District. A meeting with farmers of Pratappur and Inderpur (Block-Rudarpur) villages was organized under SCSP scheme, in which 115 farmers participated. During the meeting, 5 farmers were also provided sprayers under the Plan. Centre also organized one day training programme on 'Weed management in major crops" during January, 2023 in the hamlet of Indrapur where about 100 farmers participated. The farmers in the training programme received N:P:K (19:19:19) and Biovita crop growth promoters for improving crop yield.

SCSP training on Weed Management

Distribution of inputs to SC farmers

RVSKVV, Gwalior

Under SCSP scheme, centre distributed different agricultural inputs such as seed (wheat and mustard), fertilizers (urea, SSP) and herbicides (oxyfluorfen and sulfosulfuron+ metsulfuron) for one-acre area to 39 farmers. Sprayers (battery operated) were also provided to 9 farmers of different villages. One *Krishak Sangoshthi* was also organized at University Campus to create awareness about the SCSP programme among the farmers which can help in lifting the socio-economic condition of the farmers of SC community.

UAS, Bengaluru

Weed management hand tools like Sprayer, sickle, Varavari, Kolu Guddali and Cycle weeder were distributed to the SC beneficiaries.

Centre organized awareness programme on various methods of weed management and their integration to reduce the human dependency on manual hand weeding and also educated SC farmers about the effective use of herbicides for different crops. In addition to this, weed management tools / equipments such as Cycle weeders (4), Sprayers (4) and local hand weeding tools like Small Sickles (40), Kol Guddali (4) and Varari (40) were also

distributed to the SC farmers of Chokkapura village of Kolar District on 10th November 2022.

MPUAT, Udaipur

Centre organized different activities under Scheduled Caste Sub-Plan (SCSP) during *Kharif*, 2022 and *Rabi*, 2022-23 at Ghasa, Kharbadon ka gida and Baper villages of Mavli (Udaipur) and Rajsamand districts in which demonstrations, trainings and human resources development activities were undertaken. Improved crop production technologies have been introduced to the farmers as per package of practices through five training camps during *Rabi*. To promote small scale mechanization, implements and tools like hood, sprayer and drum (for herbicide solution preparation) were provided to the SC farmers. During *Kharif*, 2022, centre demonstrated weed management technologies on wheat, mustard, fenugreek and chickpea for the SC beneficiaries and conducted 25 demonstrations with support of inputs like improved herbicides, knapsack sprayers, sprayer nozzles, bio-fertilizers etc. in selected villages of this community.

6. LINKAGES AND COLLABORATION

Name of the centre	Linkages and collaboration Name of the Institute	Nature of linkages and collaboration
KAU, Thrissur	Department of Agriculture, Kerala	-
	Government Engineering College	A mini project on development of laser based robotic weed control is being undertaken with the collaboration
CCSHAU, Hisar	IRRI and State Department of Agriculture, Haryana	All the recommendations are tested at farmers' fields by extension officers of KVK's and Department of Agriculture, Haryana.
AAU, Jorhat	Rain Forest Research Institute, Jorhat	External Expert in the Ph.D.
	Department of Pharmacology & Toxicology, College of Veterinary Science, AAU, Guwahati	Taxonomic guidance & Utilization of weeds for medicinal uses and drug making
	North East centre for Technology Application and Reach (NECTAR), Guwahati	Mapping of MAP farming in Assam on
	SHGs, Govt organizations, Tea Industries etc.	Weed biomass utilization for vermicomposting
	North East Institute of Science & Technology, Jorhat	Weed Utilisation & Management
	World Bank aided Assam Agribusiness and Rural Transformation Project (APART)	To raise productivity, profitability & resource-use efficiencies of rice-based cropping systems in Assam
	DBT Centre (Jorhat); NEIST (Jorhat); IICT (Hyderabad); etc. Schools and Colleges of various places of Assam, various NGOs, National Highway Authority, etc.	Chemical and genetical evaluation of selected weeds Invasive weed management
	ICAR, IRRI	Effective management strategies to increase the use efficiency of water and nutrients and GHG mitigation through Alternate Wetting & Drying (AWD) and Urea Deep Placement (UDP) in transplanted and Direct-seeded rice in Summer and *Kharif* season
	ICAR, IRRI	*Climate Smart Management Practices for Rice* under Direct Seeded Rice Consortium (DSRC)
MPUAT, Udaipur	Rajasthan college of Agriculture	The staff members are associated with the teaching and other students activities of the college.
	All India Network Project on Organic Farming, MPUAT, Udaipur AICRP on IFS, MPUAT, Udaipur	The scientists of the project are associating with the training programmes of Directorate of Extension Education.
	State Department of Agriculture and ATMA	Trainings, Group meetings, Field visit, Diagnostic field visits, Conference- Technology dissemination.
		ICAR Network project on organic farming and AICRP on Integrated farming system.
	UPL Pvt. Ltd. Mumbai	Field visit and Research on New molecule evaluation on cotton, Soybean, sugarcane and funding source.

Name of the centre	Linkages and collaboration Name of the Institute	Nature of linkages and collaboration
	Dhanuka Agritech Ltd. New Delhi	Field visit and Research on New molecule evaluation on cotton and funding source.
	Gharda Chemicals Pvt. Ltd.,	Dombivali, Dist Thane, (Mh) A New Herbicide molecule evaluation on maize.
	I.S.K. Biosciences India Pvt. Ltd., New Delhi.	A New Herbicide molecule evaluation on maize.
	BAYER Crop Science Limited, Thane, Maharashtra,	A New Herbicide molecule evaluation on wheat.
	Excel crop care company, Mumbai.	A New Herbicide molecule evaluation on soybean and wheat.
	GFSC,	Gujarat to evaluate bio herbal on Mustard
GBPUAT, Pantnagar	State Agriculture Universities Member of advisory committee, Plant protection of district of U.S. Nagar /Industries	Advisement on weed management
	Member of Agromet advisory Services, GBPUA&T Pantnagar	
	Bayer crop science, Mumbai	Research on weed management in different crop and cropping system
	Dow Agro science	
	M/s Syngenta India Limited, Pune, Maharashta	
	M/s PI Industries Limited, Gurgaon , Haryana, India	
	M/s Jivagro Limited, Mumbai, Maharashtra	
	FMC	
	UPL Pvt. Limited	
	ADAA India Private Ltd.	
	Siris Minerals Anglo American India Pvt. Ltd.	
UAS, Bengaluru	National Bureau of Agriculturally	-
	ICAR, Bengaluru in getting bio-control agents	Release to control Parthenium and water *hyacinth*
	AICRP for Dry Land Agriculture	UAS, Bengaluru to conduct large scale demonstrations of weed technologies on farmers field and also for the implementation of SCSP program.
	Department of Plant and Environment Sciences, UAS, GKVK, Bengaluru	*Water Hyacinth* experiments.
	Project Co-ordinating Unit, AICRP on Small Millets	-
	Research Institute of Organic farming, UAS, GKVK, Bengaluru	Conduct organic trials
	AICRP on IFS	ZBNF experiments.
	KVK Hadonahalli, UAS, Bengaluru	The implementation of farm trials.
	Department of Agriculture, GOK, Chikkaballapur	The implementation of farm trials
OUAT, Bhubaneswar	Department of Agriculture, Govt. of Orissa	-

Name of the centre	Linkages and collaboration Name of the Institute	Nature of linkages and collaboration
	Department of Horticulture, Govt. of Orissa	
	Public sectors like SAIL, HAL, NTPS, Indian RareEarth Ltd, Chilka Development Authority	
	ICAR Institutes operating in the state (CIFA, CRRI, Tuber Research)	
	Other State Agricultural Universities	
	Herbicide manufacturers	
	NGOs and farmers of different district of our state	
	Irrigated Upland, Coimbatore centre	
TNAU, Coimbatore	State Department of Agriculture and ATMA	An investigation was carried out to study the weed dynamics in the on station Integrated Farming System (IFS) Research
PDKV, Akola	ZP and Panchayat Samiti	Trainings, Group meetings, Field visit, Diagnostic Field Visits, Conference- Technology dissemination.
	Akola Municipal Corporation	Trainings, Group meetings, Field visit & technical knowhow
	Central Salt and Marine Chemicals Research Institute, Bhavnagar, Gujarat	*Parthenium* awareness programme in all schools and colleges and control of *water hyacinth* and other perennial weeds.
	Centre of Organic Agriculture and Research Training	Evaluation of seaweed sap against pulses and funding source.
	Dr. PDKV, Akola Organic Weed Management.	-
	M/s. Godrej Agrovet Pvt. Ltd., Mumbai	-
	M/s. Makhteshim-Agan India Pvt. Ltd., Hyderabad	Field visit and Research on New molecule evaluation on cotton, Soybean, onion and funding source.
	M/s.Bayer India Ltd	Field visit and Research on New molecule evaluation on sunflower and funding source.
	Monsanto India Ltd., Mumbai	Field visit and Research on New molecule evaluation Product testing
	Arasta Life Sciences, Pune	Field visit and Research on New molecule evaluation Product testing on Cotton
	M/S Dhanuka Pesticides Ltd	Field visit and Research on New molecule evaluation Product testing on Cotton
	M/S UPL Pesticides Ltd.,	Field visit and Research on New molecule evaluation Product testing on Cotton, Soybean and other crops
	M/S Insecticides India Ltd., New Delhi	Field visit and Research on New molecule evaluation Product testing on Cotton, Soybean and other crops
	Godrej Agrovet Ltd., Mumbai	Field visit and Research on New molecule evaluation Product testing on Cotton, Soybean and other crops
	Acadian Seaplants India Pvt.Ltd	Field visit and Research on New molecule evaluation Product testing on Cotton, Soybean and other crops
		Mumbai for product testing of growth stimulents in cotton.

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Publications and students guided by the coordinating centres during 2022-23

Sl no.	Centre Name	Research paper	Popular article	Paper presented inseminars/ conferences	Book	Book Chapter	Lecture delivered	Students guided M.sc.	Ph.D
1	PAU, Ludhiana	11	10	7	-	4	9	4	5
2	UAS, Bengaluru	7	-	17	-	-	-	11	5
3	RVSKVV, Gwalior	8	14	10	-	2	-	5	8
4	GBPUAT, Pantnagar	9	7	5	-	1	-	5	4
5	CSKHPKV, Palampur	16	-	11	-	4	32	-	-
6	AAU, Jorhat	-	1	9	-	-	-	2	4
7	AAU, Anand	4	2	9	-	4	6	16	-
8	TNAU, Coimbatore	5	2	5	2	5	-	3	9
9	KAU, Thrissur	11	2	-	-	-	-	3	2
10	OUAT, Bhubaneshwar	-	-	-	-	-	-	-	1
11	PJTSAU, Hyderabad	17	5	19	-	3	13	2	4
12	CCSHAU, Hisar	14	6	6	2	-	-	4	-
13	IGKV, Raipur	-	8	3	-	-	-	1	2
14	PDKV, Akola	-	2	4	-	-	-	6	1
15	BCKV, Kalyani	4	-	-	-	-	-	5	4
16	MPUAT, Udaipur	15	7	12	1	-	-	3	-
17	SKUAST, Jammu	-	8	-	-	-	5	2	-
	Total	**121**	**74**	**117**	**5**	**23**	**65**	**72**	**49**

8. AWARD AND RECOGNITIONS

Centre Name	Award and Recognitions	Venue and Date	Name of the Scientist
SKUAST, Jamm	Bharat Gaurav Puraskar-2022	Education Foundation, New Delhi in the field of Weed Science in Agriculture.	Dr. B. R. Bazaya
MPUAT, Udaipur	Appreciation Award	Hon'ble Vice Chancellor, MPUAT, Udaipur on Independence Day, 2022	Dr. Arvind Verma
	Appreciation Award	Hon'ble Vice Chancellor, MPUAT, Udaipur on Independence Day, 2022	Dr. Roshan Choudhary
	Best poster presentation	National Conference on maize for resource sustainability, Industrial Growth and Farmers Prosperity Maize Technologists Association of India in collaboration of MPUAT, Udaipur from 23-25 Feb., 2022.	S. K. Sharma, Roshan Choudhary, S. K. Yadav, R. K. Jain & Gajanand Jat
IGKV, Raipur	ISWS Prof. B.S Chauhan Best Paper Award	3rd International weed Conference of Indian society of weed science on their research paper Long-term weed management effect on weed dynamics, weed shift and productivity of direct-seeded rice- chickpea cropping system published in Indian journal of weed Science 52(2): 107–115, 2020during 3rd International weed Confenece on "Weed problems and management challenges: Future perspectives held at Anand, Gujarat, December 20-23, 2022.	Nitish Tiwari, Shrikant Chitale and Tapas Choudhary
CCSHAU, Hisar	Travel Grant to attend	8th International Weed Science congress held at Bangkok, Thailand from 4-9 December, 2022.	Dr. Todar Mal
	ISWS Young Scientist Award 2020-21	during the 3rd International Weed Conference held at AAU, Anand from 20-23 December, 2022.	Dr. Todar Mal
GBPUAT, Pantnagar	Best Centre Award	AII India Coordinated Research Project on Weed Control get the for the year 2022 in the Annual Review Meeting of ICAR-Directorate of Weed Research held at TNAU, Coimbatore during 25-27 May, 2022.	**Team**
	Faculty Excellence Award	In recognition to the exemplary and significant contribution in the field of research and extension during the year 2022	Dr. V.P. Singh
	Faculty Excellence Award	In recognition to the exemplary and significant contribution in the field of research and extension during the year 2022.	Dr. Tej Pratap
	Faculty Excellence Award	In recognition to the exemplary and significant contribution in the field of research and extension during the year 2022.	Dr. S. P. Singh
RVSKVV, Gwalior	Appreciation certificate	the occasion of teacher's day by "Lions Club Gwalior Excellency and Lions club Gwalior Prerna" on 5th September, 2021.	
UAS, Bengaluru	Principle Investigator Incentive award	11th October 2022 UAS, GKVK, Bangalore	Dr. K.N. Geetha Prof. and Scheme Head
	Co-Principal Investigator Incentive award	11th October 2022 UAS, GKVK, Bangalore	Dr.S. Kamala Bai Jr. Agronomist

9. RECOMMENDATION OF AICRP-WM ANNUAL REVIEW MEETING

Recommendation of XXIX Annual Review Meeting of All India Coordinated Research Project on Weed Management during 25-27 May, 2022 at Tamil Nadu Agricultural University, Coimbatore are given below:

- The technical programme should be formulated keeping in view the farmer's practical needs on weed management.
- Close collaboration with other disciplines is required to ensure good and quality output and avoid repetitions.
- All the centres should carry out studies on weed management under organic farming/ natural farming in high value crops.
- The impact assessment of weed management technologies should be conducted by all the centres, starting with few districts of the state.
- Greater emphasis needs to be given by all the coordinating centres on studying the weeds of national importance (WoNI) following the proforma developed. Information should be collected from persons in the SAU, KVK, state department having basic knowledge of weeds.
- The regular activity of organizing Parthenium Awareness Week shall continue at all the centres.
- Training and awareness on safe use of herbicide and adoption of advanced techniques for application of herbicide like drone-based application technique need to be strengthened at each centre.
- All the centres shall submit success stories of the promising weed management technologies developed at their place.
- The centres should submit the AUC in the format provided to them. The next release of funds will be made only after getting the AUC.

10. STATUS OF EXPERIMENTS CONDUCTED

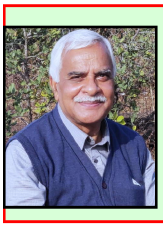
Sl. No	Centres	**WP-1** Development of location-specific sustainable weed management practices	**WP-2** Management of weeds in non-cropped and aquatic areas	**WP-3** Fate of herbicide residues in different agroecosystems	**WP-4** Demonstration and impact assessment of weed management technologies & SCSP	**ST** Station trials on weed management	**Total no. of expirement**
1	PAU, Ludhiana	WP1.2.3, WP 1.3.13, WP-1.5.1	WP 2.8 WP 2.10	WP 3.1, WP 3.2, WP 3.3, WP 3.4	WP 4.1, WP 4.2, WP 4.3	ST-1.1.14*, ST-1.1.15*	14
2	UAS, Bengaluru	WP-1.1.2, WP-1.1.4, WP-1.1.5, WP1.2.3, WP 1.3.1, WP-1.4.4*	WP 2.4 WP 2.9 WP 2.10	WP 3.1* WP 3.2* WP 3.3*	WP 4.1, WP 4.3	ST-1.1.9	15
3	RVSKVV, Gwalior	WP-1.1.3, WP-1.1.7, WP1.2.3, WP 1.3.14, WP-1.4.5	WP 2.8 WP 2.10	-	WP 4.1, WP 4.1, WP 4.2, WP 4.3* WP 4.4*	-	12
4	GBPUAT, Pantnagar	WP-1.1.1, WP1.2.1, WP 1.3.4, WP-1.5.1	WP 2.8 WP 2.10	-	WP 4.1* WP 4.2* WP 4.*, WP 4.3*	-	10
5	CSKHPKV, Palampur	WP-1.1.2, WP-1.1.5, WP 1.2.4, WP 1.3.3	WP 2.3, WP 2.8* WP 2.10	WP 3.1, WP 3.2, WP 3.3, WP 3.4	WP 4.1, WP 4.2, WP 4.3, WP 4.4	ST-1.1.6, ST-1.1.7	17
6	AAU, Jorhat	WP 1.3.11* WP-1.4.7*	WP 2.1, WP 2.2, WP 2.10	-	WP 4.1* WP 4.3* WP 4.4*	ST-1.1.2*, ST-1.1.3* ST-1.1.20*	11
7	AAU, Anand	WP 1.2.5, WP 1.3.2, WP 1.4.6	WP 2.8 WP 2.10	WP 3.1 WP 3.2, WP 3.3	WP 4.1, WP 4.2, WP 4.3	ST-1.1.12* ST-1.1.13	13
8	TNAU, Coimbatore	WP 1.2.5, WP 1.3.9, WP 1.4.3	WP 2.8 WP 2.10*	WP 3.1, WP 3.2, WP 3.3* WP 3.4	WP 4.1, WP 4.2, WP 4.3, WP 4.4	ST-1.1.1	14
9	KAU, Thrissur	WP 1.3.6, WP-1.4.8, WP-1.5.3*	WP 2.4, WP 2.5, WP 2.6, WP 2.10	WP 3.1*	WP 4.1, WP 4.2, WP 4.3, WP 4.4	ST-1.1.4a, ST-1.1.4b, ST-1.1.5	15
10	OUAT, Bhubaneshwar	WP-1.1.2, WP-1.1.6, WP1.2.2, WP 1.3.1, WP 1.4.1	WP 2.4* WP 2.8 WP 2.10	-	WP 4.1, WP 4.2* WP 4.3* WP 4.4	-	12
11	PJTSAU, Hyderabad	WP-1.1.3* WP-1.1.7* WP 1.2.5 WP 1.3.8	WP 2.8* WP 2.10*	WP 3.1WP 3.2, WP 3.3, WP 3.4*	WP 4.1, WP 4.2, WP 4.3*	ST-1.1.11	14
12	CCSHAU, Hisar	WP-1.1.1, WP1.2.1, WP1.2.3, WP1.4.2, WP1.5.1	WP 2.7* WP 2.8* WP 2.10*	WP 3.1* WP 3.2* WP 3.3*	WP 4.1, WP 4.2, WP 4.3* WP 4.4*	ST-1.1.19	16
13	IGKV, Raipur	WP-1.1.2, WP-1.1.4, WP-1.2.2, WP-1.3.5, WP-1.5.2	WP 2.7* WP 2.8 WP 2.10*	-	WP 4.1, WP 4.2 WP 4.3*	-	11

14	PDKV, Akola	WP-1.1.5, WP-1.1.6* WP-1.3.7	WP 2.7* WP 2.8* WP 2.10*	-	WP 4.1, WP 4.2, WP 4.3*	ST-1.1.10	10
15	BCKV, Kalyani	WP-1.1.2, WP-1.1.5, WP-1.1.6, WP-1.1.7, WP-1.2.2	WP 2.4, WP 2.8 WP 2.10*	WP 3.1, WP 3.3	WP 4.1, WP 4.3* WP 4.4	-	14
16	MPUAT, Udaipur	WP-1.1.3, WP-1.1.5, WP-1.1.7, WP-1.2.4, WP-1.3.10, WP-1.4.1*	WP 2.8 WP 2.10*	-	WP 4.1, WP 4.2, WP 4.3* WP 4.4	ST-1.1.8	13
17	SKUAST, Jammu	WP-1.1.1, WP1.2.1, WP1.3.12, WP1.5.1, WP1.5.4	WP 2.8, WP 2.10	-	WP 4.1, WP 4.2, WP4.3* WP 4.4*	-	11

* Not reported.

11. SCIENTIFIC STAFF

ICAR-DWR, Jabalpur



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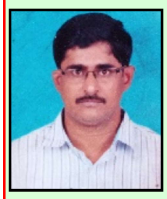

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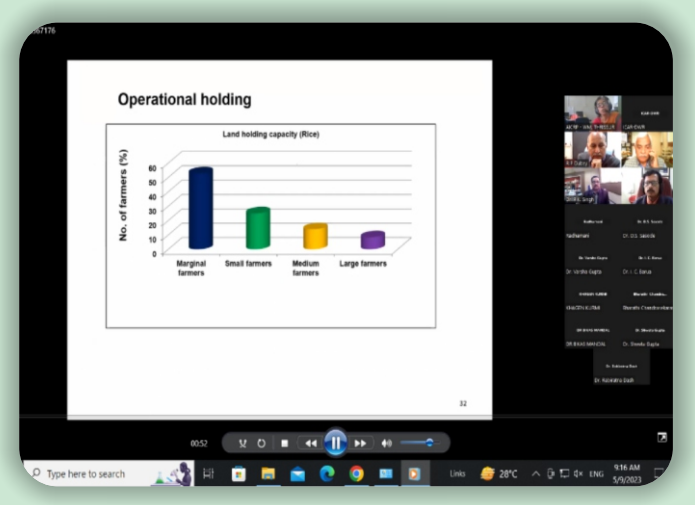
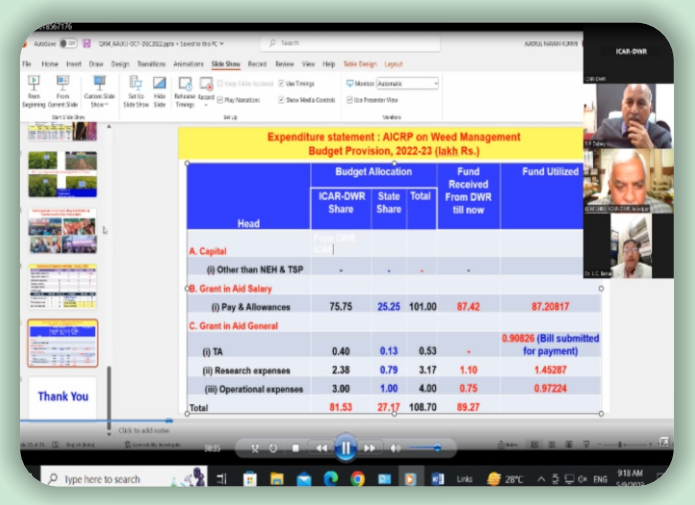
12. Status of Submission of Annual Report-2022

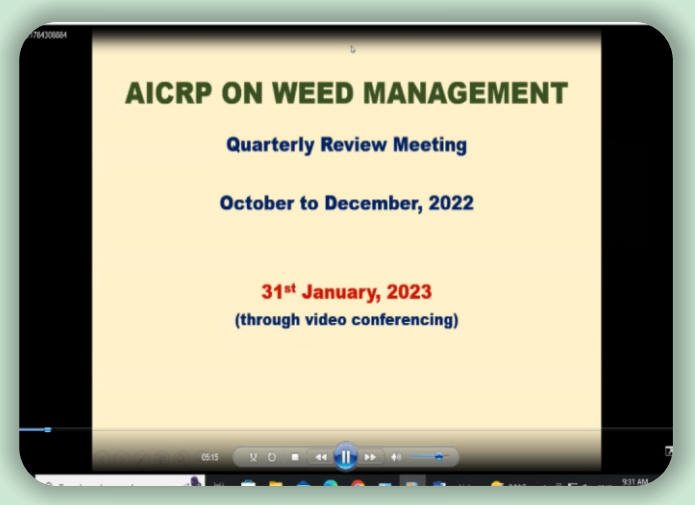
Sl. No.	Centre's Name	Received	
		On or before due date (20.01.2023)	After due date
Regular Centres			
1.	PAU, Ludhiana	20.01.2023	-
2.	UAS, Bengaluru	16.01.2023	-
3.	RVSKVV, Gwalior	20.01.2023	27.02.2023 (updated)
4.	GBPUAT, Pantnagar	-	23.01.2023
5.	CSKHPKV, Palampur	04.01.2023	-
6.	AAU, Jorhat	-	01.03.2023
7.	AAU, Anand	-	04.03.2023
8.	TNAU, Coimbatore	09.01.2023	-
9.	KAU, Thrissur	10.01.2023	-
10.	OUAT, Bhubaneshwar	-	29.01.2023
11.	PJTSAU, Hyderabad	20.01.2023	-
12.	CCSHAU, Hisar	-	04.02.2023
13.	IGKV, Raipur	18.01.2023	-
14.	PDKV, Akola	13.01.2023	-
15.	BCKV, Kalyani	-	23.02.2023
16.	MPUAT, Udaipur	-	23.01.2023
17.	SKUAST, Jammu	-	29.01.2023
Volunteer Centres			
1.	SKUAST, Kashmir	-	25.01.2023
2.	BAU, Sabour	-	28.01.2023
3.	PAJNCOA&RI Puducherry	-	30.01.2023
4.	UAS, Dharwad	-	18.02.2023
5.	BUAT, Banda	20.01.2023	-
6.	ANGRAU, Guntur	-	26.02.2023
7.	SKNAU, Jobner	20.01.2023	-

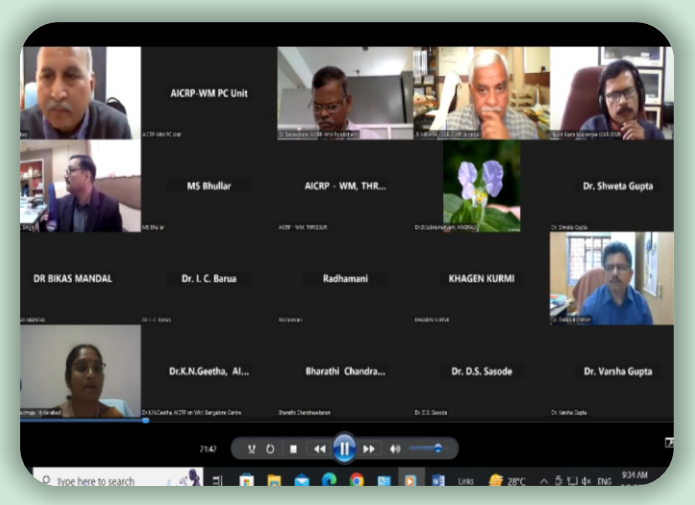
ACRONYMS

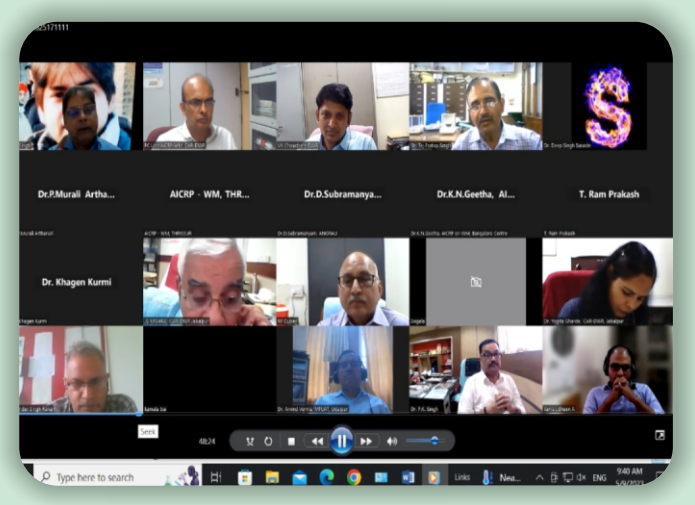
B:C	Benefit cost ratio
BD	Bulk density
BDL	Below detectable limit
BLW	Broad leaf weeds
CT	Conventional tillage
CT-DSR	Conventional tilled direct seeded rice
CT-TPR	Conventional tillage after transplanted rice
DAD	Days after disappearance
DAP	Days after planting
DAS	Days after sowing/spraying
DAT	Days after transplanting
DB	Development blocks
DHA	De-hydrogenese activity
DSR	Direct-seeded rice
DSR+R	Direct seeded rice+Residue
EPoE	Early post emergence
FYM	Farm yard manure
GA	Gibberellic acid
HHW	Hand hoeing weeding
HW	Hand weeding
IC	Inter cultivation/culture
IM	Indian mustard
IWM	Integrated weed management
K	Potassium
LPoE	Late post emergence
MBC	Microbial biomass carbon
MRL	Maximum residue limit
MT	Minimum tillage
MW	Mechanical weeding
N	Nitrogen
Na	Sodium
P	Phosphorus
PE	Pre-emergence
PM	Poultry manure
PSB	Phosphorus solubilizing bacteria
PTR	Puddled transplanted rice
RD	Recommended dose
RM	Ready mix
SMBC	Soil microbial biomass carbon
SSB	Sulfer solubilizing bacteria
SVI	Seedling vigour index
TM	Tank mixed
TPR	Transplanted rice
TPR	Transplanted residue
TPR	Transplanted puddled rice
VSD	Variable speed drive
ZT	Zero tillage
ZT+R	Zero tillage + Residue

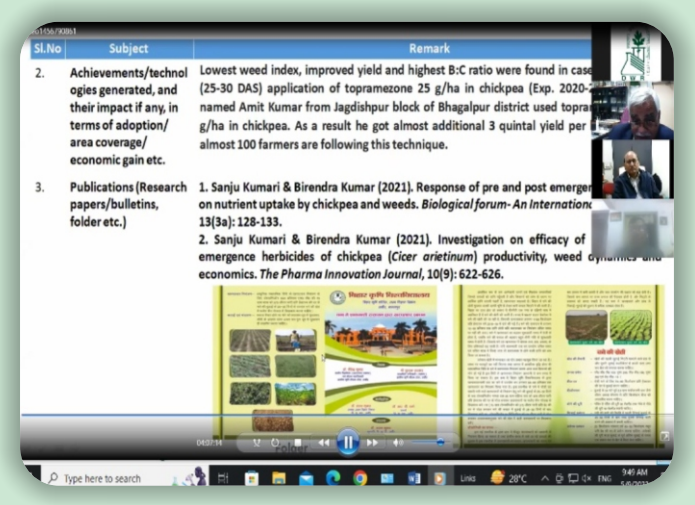

Operational holding
Land holding capacity (Rice)
No. of farmers (%)
Marginal farmers
Small farmers
Medium farmers
Large farmers


Expenditure statement : AICRP on Weed Management
Budget Provision, 2022-23 (lakh Rs.)
Budget Allocation
ICAR-DWR Share
State Share
Total
Fund Received From DWR till now
Fund Utilized
Head
A. Capital
(i) Other than NEH & TSP
B. Grant in Aid Salary
(i) Pay & Allowances 75.75 25.25 101.00 87.42 87.20817
C. Grant in Aid General
(i) TA 0.40 0.13 0.53 - 0.90826 (Bill submitted for payment)
(ii) Research expenses 2.38 0.79 3.17 1.10 1.45287
(iii) Operational expenses 3.00 1.00 4.00 0.75 0.97224
Total 81.53 27.17 108.70 89.27
Thank You


AICRP ON WEED MANAGEMENT
Quarterly Review Meeting
October to December, 2022
31st January, 2023
(through video conferencing)


AICRP-WM PC Unit
MS Bhullar
AICRP - WM, THR...
Dr. Shweta Gupta
DR BIKAS MANDAL
Dr. I. C. Barua
Radhamani
KHAGEN KURMI
Dr.K.N.Geetha, Al...
Bharathi Chandra...
Dr. D.S. Sasode
Dr. Varsha Gupta


Dr.P.Murali Artha...
AICRP - WM, THR...
Dr.D.Subramanya...
Dr.K.N.Geetha, Al...
T. Ram Prakash
Dr. Khagen Kurmi


Sl.No
Subject
Remark
2. Achievements/technologies generated, and their impact if any, in terms of adoption/ area coverage/ economic gain etc.
Lowest weed index, improved yield and highest B:C ratio were found in case
(25-30 DAS) application of topramezone 25 g/ha in chickpea (Exp. 2020-
named Amit Kumar from Jagdishpur block of Bhagalpur district used topra
g/ha in chickpea. As a result he got almost additional 3 quintal yield per
almost 100 farmers are following this technique.
3. Publications (Research papers/bulletins, folder etc.)
1. Sanju Kumari & Birendra Kumar (2021). Response of pre and post emerge
on nutrient uptake by chickpea and weeds. Biological forum- An Internationa
13(3a): 128-133.
2. Sanju Kumari & Birendra Kumar (2021). Investigation on efficacy of
emergence herbicides of chickpea (Cicer arietinum) productivity, weed
economics. The Pharma Innovation Journal, 10(9): 622-626.

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Agrisearch with a human touch

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