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Effect of integrated weed management in rainfed upland rice of Odisha

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ABSTRACT

A field experiment was conducted during wet seasons of three consecutive years, viz. 2013-15 under typical rainfed upland situation to evaluate the performance of different weed management techniques for improving the overall productivity and to work out the economics of different weed management practices in Vandana variety of rice. The highest grain yield (3.18 t ha^{-1}) was observed in weed free condition where three hand weeding at 15, 30 and 45 DAS has been done followed by two hand weedings (2.97 t ha^{-1}) at 15 and 35 DAS, which was at par with the stale seed bed + post emergence application of Azimsulfuron 35 g a.i. (2.86 t ha^{-1}) with weed control efficiency (WCE) of 90.8 per cent. Yield reduction due to weed competition in weedy plot was 58% over weed free check. Use of Azimsulfuron at 35 g a.i. per ha at 20 DAS proved to be more cost effective over the other treatments (BC ratio 1.21). Thus, use of Azimsulfuron at 35 g a.i. per ha 20 DAS was found to be the most cost-effective practice in upland conditions simulating the conditions prevalent in the present study.

Key words: Economics, upland rice, weed management, yield attributes

INTRODUCTION

Direct seeded rice crop in upland situation face great weed competition in *kharif* season which limits its productivity. Weeds cause substantial yield losses (50-100%) and are considered the most important constraints in realizing the targeted high yields (Saha and Rao, 2007; Ogwuike et al., 2014; Rao et al., 2015). Aerobic soil condition, favourable temperatures and dry tillage practice encourage the germination and growth of diverse and highly competitive weed flora (Moorthy and Manna, 1993; Rao et al., 2007, 2015). The weeds compete with rice crop for nutrients, sun light and other necessary factors thereby causing the yield loss drastically and different rice varieties also respond differently to weed population (Garrity et al., 1992). Traditional method of weeding is very labour intensive, costly and time-consuming practice along with drudgery. Now-a-days, labour availability and that again at time of need is not very easy, which adds up the weed problem as weeding at critical times saves labour and improves yield both in quality and quantity (Prasad and Rafey, 1995; Juraimi et al., 2013; Chauhan et al., 2015).

To overcome this barrier various weed management practices (application of different herbicides and other management practices) are being followed, but most of the single practice are not fully effective and also economic (Tiwari and Singh, 1989; Chauhan, 2012; Juraimi et al., 2013). This strongly reiterates the demand for combining different weed management techniques to minimize the overall weed competition and reduce the total cost involved in weeding operation (Bhurer et al., 2013; Singh et al., 2016; Thakur et al., 2018). Thus, this experiment was conducted in a typical upland

situation to evaluate the efficiency of different weed management techniques and their economic viability.

MATERIALS AND METHODS

A field experiment was conducted at Krishi Vigyan Kendra Cuttack, Santhapur during *kharif* of three consecutive years viz. 2013-2015 under typical rainfed upland having soil type of red lateritic, light in texture with acidic in reaction (pH 5.2 to 5.4) having organic carbon content (0.43 to 0.45%) total nitrogen (0.058 to 0.069 %), available phosphorous (10.8 to 15.1 kg ha^{-1}) and potassium (111.08 to 130.5 kg ha^{-1}).

The experiment was conducted in randomized block design with ten weed management practices (treatments) in four replications with upland rice variety "Vandana". The treatments consisted of T_1: Stale seed bed + post emergence application of Azimsulfuron (30 g a.i. ha^{-1}) at 20 day of sowing (DAS), T_2: Pretilachlor (750 g a.i. ha^{-1}) + 1 hand weeding (HW; 35 DAS), T_3: Pretilachlor (750 g a.i. ha^{-1}) + 1 mechanical weeding (MW; 30 DAS), T_4: PSE (Pyrazosulfuronethyl (PSE; 20 g a.i. ha^{-1}) + 1 HW 30 DAS, T_5: PSE (20 g a.i. ha^{-1}) +1 MW 30 DAS, T_6: MW twice (15 and 30 DAS), T_7: Azimsulfuron (35 g a.i. ha^{-1}) at 20 DAS, T_8: Hand weeding twice (15 and 35 DAS), T_9: Weed free (HW at 15, 30 and 45 DAS) and T_{10}: Weed infested plot. Mechanical weeding was done with finger weeder. Rice variety "Vandana" was sown in rows behind the country plough at spacing of 20 cm during third week of July using a seed rate of 80 kg ha^{-1}. A fertilizer dose of 40:20:20 kg N: P_2O_5 and K_2O was applied as basal in the seed furrows in the form of single super phosphate and muirate of potash. Half of the N was applied to the crop at 20 DAS and rest two equal halves at 45 DAS and at panicle initiation (PI) stage. The weed density and dry wt. of weeds were recorded at 60 DAS with the help of 0.25 m^2 quadrants and converted per m^2 basis. Plant height (cm), number of panicles (m^{-2}), number of grains ($panicle^{-1}$), grain weight (n=1000), grain yield, straw yield, weed density (45 DAS), weed dry matter (60 DAS) and weed control efficiency (WCE; 60 DAS) were recorded for all the treatments. Weed control efficiency (WCE) denotes the magnitude of weed reduction due to weed control treatment. It was worked out by using the formula suggested by Mani et al. (1973) and expressed in percentage.

WCE (%) = 100 × (Dry weight of weeds in unweeded control-dry weight of treatment plot) / (Dry weight of weeds in unweeded control)

The cost of cultivation, gross return, net return were calculated in rupees per ha and the benefit: cost was also calculated.

RESULTS AND DISCUSSION

In the experimental fields, grasses viz. *Cynadon dactylon*, *Eragrostis gangetium*, *Setaria glauca*, *Dactyloctenium aegyptium*, sedges viz. *Cyperus rotundus*, *Cyperus iria*, *Cyperus compressus*, *Fimbristylis miliacea* and broad leaf weeds viz. *Celocia argentea*, *Ludwigia perennis*, *Lindernia ciliata*, *Sida rhombifolia* were present as the major weeds. The broad-leaved weeds were the most predominant comprising 50-60% of total weed population in each year followed by sedges (30-40%) and grasses (10-15%).

The results revealed that the weed density (m^{-2}) in chemical weeding when integrated with cultural management practices, i.e. stale seed bed (T_1) resulted in similar weed density and also weed control efficiency (Table 1) as observed in triple and double hand weeding treatments (T_8, T_9). In these groups, the weed count and dry matter accumulation by weeds were significantly reduced over weedy check. The data on weed dry matter at 60 DAS when expressed as gram per square meter followed similar pattern. However, weeding with Pretilachlor and Pyrazosulfuron ethyl along with hand weeding or mechanical weeding had lower weed control efficiency in our field conditions. Similar to our findings, Behera et al. (1997) also got similar results while evaluating the efficiency of Butachlor + one HW or MW with finger weeder in controlling weed population in upland rice fields. Thus, timely weed control is considered to be the most critical for enhancing the productivity of rainfed upland rice (Saha et al.,1999). Among the various weed management techniques, the lowest

weed density and dry matter of weeds were recorded in weed free check having the highest WCE where three weedings were done. The treatment where two hand weedings were done recorded the second lowest weed density, dry matter of weeds and higher weed control efficiency closely followed by the treatment stale seed bed + post emergence application of Azimsulfuron. On application of different combinations of herbicides and cultural practices, Singh et al. (2016) recommended the use of good tillage practice along with herbicide chosen based on the dominant weeds in the system. This may be the reason Azimsulfuron acted as the best herbicide in the present study (Table 1).

Table 1. Performance of rice crop under different weed management techniques (pooled data)

Treatment	Plant height (cm)	Panicles (no. $m^{-2)}$	Grains $panicle^{-1}$	1000 grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Weed density (no. m^{-2})	Weed dry matter at 60 DAS (g m^{-2})	WCE (%)
T_1	109.1	220	72.4	24.08	2.86	5.44	74.5	8.2	90.8
T_2	102.5	202	68.8	23.41	2.19	4.09	90.8	24.8	72.2
T_3	101.2	198	68.0	23.32	2.06	3.84	94.2	27.7	68.8
T_4	107.1	215	70.4	23.75	2.58	4.48	80.8	17.1	80.7
T_5	103.4	210	70.0	23.48	2.36	4.43	86.7	21.4	75.9
T_6	108.8	218	71.7	23.98	2.72	5.16	76.5	11.6	86.9
T_7	107.6	216	70.8	23.93	2.70	5.10	78.2	12.4	86.0
T_8	110.1	226	73.0	24.21	2.97	5.60	68.7	7.2	91.9
T_9	110.5	228	73.4	25.37	3.18	5.38	65.5	0	100.0
T_{10}	94.9	140	57.2	23.28	1.34	2.62	148.9	88.7	-
CD (P= 0.05)	8.0	7.2	5.4	0.46	0.17	0.21	10.2	7.08	5.64

The data on plant height differed significantly among treatments, where the weed population had a negative effect on plant height as T_8, T_9 and T_1 had higher plant height when compared to the weedy control or groups with less WCE (Table 1). Similar trend was also observed in case of other yield contributing parameters like panicle number, grains per panicle and grain weight, indicating weeds affect these parameters and the effect was significantly different than that of the control. Pooled data of three years revealed that the highest grain yield (3.18 t ha^{-1}) was observed in weed free condition where three hand weedings at 15, 30 and 45 DAS has been done followed by two hand weedings (2.97 t ha^{-1}) at 15 and 35 DAS, which was at par with the stale seed bed + post emergence application of Azimsulfuron 35 g a.i. (2.86 t ha^{-1}) with a weed control efficiency (WCE) of 90.8 per cent. The yields obtained in the treatments; T_6 Mechanical weeding twice and T_7 (Azimsulfuron @ 35 g a.i. ha^{-1} at 20 DAS) were comparable to each other. Higher grain yields in these treatments was attributed to better control of weeds as observed from lower weed density and dry matter accumulation by weeds and increased yield attributing characters like higher number of panicle $m^{-2,}$ grains $panicle^{-1}$ and grain weight. Tiwari and Singh (1989) also recorded similar results in rainfed upland rice. Similar result was reported by Bhurer et al. (2013) who observed that weed free plot had the highest yield followed by pendimethalin 30 EC followed by two hand weeding and pendimethalin followed by 2, 4-D then one hand weeding. The maximum yield reduction due to weed competition was recorded 58% in weedy plots. Plant height and straw yield were also increased where weeds were controlled either by twice hand weeding or integrating chemicals or mechanical method (Table 1). Bhurer et al. (2013) also recorded similar

findings in direct seeded rice on grain yield and yield attributing characters.

The cost of cultivation varied among the treatments due to involvement of mechanical weeder, labour and chemicals as inputs in different weed management techniques (Table 2). Hand weeding thrice (T_9) or twice (T_8) were the costliest input wise, whereas T_3, T_5 and T_7 had lower input costs. The negative values in terms of net returns (₹5350 and ₹1320) were observed in case of T_2 and T_3 treatments due to lesser gross return and higher cost of cultivation due to labour requirement in hand weeding and mechanical weeding, respectively. Thus, it is imperative that weed management through chemical at right time will be most economical in rainfed upland rice production system (Table 2).

Table 2. Economics of different weed management techniques

Treatment	Cost of cultivation (₹ ha^{-1})	Gross return (₹ ha^{-1})	Net return (₹ ha^{-1})	B: C
T_1	27050	31180	5130	1.20
T_2	30150	23800	-5350	0.82
T_3	24700	22380	-1320	0.94
T_4	28150	28060	910	1.03
T_5	24550	25670	2120	1.09
T_6	26200	29640	4440	1.18
T_7	25350	29400	5050	1.21
T_8	29650	32330	3680	1.13
T9	32650	34450	2800	1.09
T10	19250	14680	-3570	0.80

In similar studies, weed free treatments resulted in the highest yield, but not economical due to high cost of cultivation (Bhurer et al., 2013). The highest benefit: cost (BC ratio: 1.21) was observed with T_7 (Azimsulfuron 35 g a.i. ha^{-1} at 20 DAS) closely followed by T_1 (stale seed bed + post emergence application of Azimsulfuron 30 g a.i. ha^{-1}), whereas a negative BC ratio was obtained in T_2 and T_3 due to higher input cost (T_2), low weed control efficiency (T_2 , T_3) and lower rice yield (T_2 ,T_3) in these treatments. In terms of return, the highest net return (₹5130.00) was observed with T_1, but due to higher cost of cultivation than T_7, the BC ratio was reduced in the former treatment. Mechanical weeding with finger weeder at 15 and 30 DAS also had similar BC ratio as T_1 and T_2due to its effectiveness in weed control (Table 1).

CONCLUSION

The present study indicated that weed free condition (three hand weedings at 15, 30 and 45 DAS) and two hand weedings (15 and 35 DAS) were superior in weed control, but the stale seed bed + post emergence application of Azimsulfuron 35 g a.i. and use of Azimsulfuron at 35 g a.i. per ha at 20 DAS were proved to be more cost effective over all the other treatments in upland conditions used in the study. However, the weed characteristic and their population should be targeted when selecting the herbicide.

REFERENCES

Behera, U.K., Jha, K.P. and Mahapatra, I.C. 1997. On farm evaluation of different weed management practices in early rice (*Oryza sativa*) in the rainfed uplands in eastern India. *Indian. J. Agron*. **42**: 446-451.

Bhurer, K.P., Yadav, D.N., Ladha, J.K., Thapa, R.B. and Pandey, K.R. 2013. Influence of integrated weed management practices on dynamics and weed control efficiency in dry direct seeded rice. *Nepal J. Sci. Technol.* **14**(2): 33-42.

Chauhan, B.S. 2012. Weed ecology and weed management strategies for dry-seeded rice in Asia. *Weed Technol*. **26**:1-3.

Chauhan, B.S., Ahmed, S., Awan, T.H., Jabran, K. and Manalil, S. 2015. Integrated weed management approach to improve weed control efficiencies for sustainable rice production in dry-seeded systems. *Crop Protect.* **71**: 19-24.

Garrity, D.P., Movillon, M. and Moody, K. 1992. Differential weed suppression ability in upland rice cultivars. *Agron. J*. **84**: 586-591.

Juraimi, A.S., Uddin, M.K., Anwar, M.P., Mohamed, M.T.M., Ismail, M.R. and Man, A. 2013. Sustainable weed management in direct seeded rice culture: A review. *Austr. J. Crop Sci*. **7**: 989.

Mani, V.S., Malla, M.L., Gautam, K.C. and Bhagwndas. 1973. Weed killing chemicals in potato cultivation. *Indian Farm*. **VXXII**: 17-18.

Moorthy, B.T.S. and Manna, G.B. 1993. Studies on weed control in direct seeded rainfed upland rice. *Indian J. Agric. Res*. **27**: 175-180

Ogwuike, P., Rodenburg, J., Diagne, A., Agboh-Noameshie, A.R. and Amovin-Assagba, E. 2014. Weed management in upland rice in sub-Saharan Africa: impact on labor and crop productivity. *Food Secur.* **6**: 327-337.

Prasad, K. and Rafey, A. 1995. Effect of integrated weed management on weed growth, nutrient uptake, economics and energetics in rainfed upland rice (*Oryza sativa*). *Indian J. Agric. Sci*. **65**: 260-264.

Rao, A.N., Johnson, D.E., Sivaprasad, B., Ladha, J.K. and Mortimer, A.M. 2007. Weed management in direct-seeded rice. *Adv. Agron.* **93**: 153-255.

Rao, A.N., Wani, S.P., Ramesha, M. and Ladha, J.K. 2015. Weeds and weed management of rice in Karnataka State, India. *Weed Technol*. **29**: 1-7.

Saha, S., Moorthy, B. and Jha, K.P. 1999. Influence of different production factors on the performance of rainfed upland rice (*Oryza sativa*). *Indian J. Agric. Sci.* **69**: 449-450.

Saha, S. and Rao, K.S. 2007. *Weed management in rice*. CRRI Research Bulletin No. 2. Central Rice Research Institute, Cuttack, India.

Singh, V.P., Dhyani, V.C., Singh, S.P., Kumar, A., Manalil, S. and Chauhan, B.S. 2016. Effect of herbicides on weed management in dry-seeded rice sown under different tillage systems. *Crop Protect*. **80**: 118-126.

Tiwari, A.N. and Singh, K.K. 1989. Effect of removal of types of weed flora in upland direct seeded rainfed rice. *Indian J. Weed Sci*. **21**: 72-74.

Thakur, C.L., Shrivastava, G.K., Sreedevi, B. and Thakur, A.K. 2018. Realising aerobic rice potential in India-An integrated weed management perspective. *Int. J. Curr. Microbiol. Appl. Sci.* **7**(2): 575-589.