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RESEARCH ARTICLE

Weed growth and productivity of direct-seeded rice under different weed management practices

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ABSTRACT

A field experiment was conducted during *Kharif* (rainy season), 2021 and 2022 at Agricultural Research station, Chatabar, Faculty of Agricultural Sciences, SOADU, Bhubaneswar. The soil of the experimental field was sandy loam in texture. The experiment comprising of seven treatments *viz.* pendimethalin 30 EC at 1000 g /ha, oxadiargyl 80WP at 100 g/ ha, pendimethalin PE *fb* bispyribac-sodium (1000 + 25 g/ha), oxadiargyl 80 WP PE *fb* bispyribac-sodium (100+ 25 g/ ha), bispyribac-sodium 25 g/ha, weedy check and weed free were laid out in a randomized block design with three replications. Results revealed that oxadiargyl at 100 g/ha *fb* bispyribac-sodium 25 g/ha recorded the lowest values of total weed density and weed dry weight at 45 DAS during both the years and was at par with combination of pendimethalin PE followed by bispyribac-sodium (1000+25 g/ha) PoE. The highest grain yield of direct-seeded rice along with higher yield attributing characters like number of filled grains/panicle, panicle/m^2 and test weight were recorded under weed free treatment and it was at par with oxadiargyl at 100 g/ha *fb* bispyribac-sodium 25 g/ha.

Keywords: DSR, Pendimethalin, Oxadiargyl, Weed, Grain yield

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important food crops of the world and is the major staple food for more than half of the world's population. Weeds are most severe and widespread biological constraints to crop production in India and alone cause 33% of losses out of total losses due to pests (Verma *et al.*, 2015). Weeds population is in general in direct-seeded rice than transplanted rice. Weed infestation is one of the major constraints for low productivity and causes 50-60% yield loss due to simultaneous germination of both crop and weed seeds (Pinjari *et al*. 2016). Manual weeding is considered to be the best, but it is very much costly. That is the reason why herbicides have been considered to be better alternative to hand weeding in DSR (Singh *et al*. 2006). According to Sahu and Singh (2011), chemical weed management is a good option to control weeds in direct-seeded rice. Most of the herbicides preferred for DSR are applied as pre-emergence to control weeds during initial period; however, a combination of herbicides may be more effective to control various flushes of weed. Keeping the above things in view, a field experiment was carried out to study the effect of herbicide on weed dynamics and yield of direct-seeded rice.

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MATERIALS AND METHODS

A field experiment was conducted during *Kharif* (rainy season) 2021 and 2022 at Agricultural Research station, Faculty of Agricultural Sciences, Siksha 'O' Anusandhan Deemed University (SOADU), Bhubaneswar. The soil of the experimental field was sandy loam in texture. The experiment comprising of seven treatments *viz*. pendimethalin at 1000 g/ha, Oxadiargyl 80 WP at 100 g/ha, pendimethalin PE *fb* bispyribac-sodium (1000 + 25 g/ ha) PoE, oxadiargyl (PE *fb* bispyribac-sodium (100 + 25 g/ha) PoE, bispyribac-sodium 25 g/ha PoE, weedy check and weed free, was laid out in a randomized block design with three replications. Rice variety '*MTU 1010*' was sown on 15th June 2021 and 2022 at a spacing of 20 x 15 cm. Recommended nutrient dose 80-40-40 kg/ha was aapplied. Nitrogen 80 kg/ha through urea was applied in 3 splits (one third N as basal, remaining 2/3rd in two equal split doses at active tillering and panicle initiation) and full dose of phosphorus through SSP and full dose of potash through MOP; both 40 kg/ha were applied as basal during final land preparation. In addition, zinc sulphate 25 kg/ha was applied as basal. Herbicides were applied with the help of hand operated knapsack

sprayer fitted with a flat fan nozzle. All other recommended agronomic practices were followed and plant protection measures were adopted as per need. Weed counts was recorded by placing 50 x 50 cm quadrat from the marked sampling area of 1.0 m^2 in each plot and after drying them in hot air oven at 70 ^oC, weed dry weight was recorded. The data were subjected to a square root transformation to normalize their distribution. The yield components like number of panicles/m^2, grains per panicle, 1000 grain weight and yield of rice were also recorded and statistically analyzed at 5% level of significance. Weed control efficiency was calculated by using standard formula.

RESULTS AND DISCUSSION

Effect on weeds

Digitaria sanguinalis, *Echinochloa colona* among grasses, *Ludwigia parviflora*, *Hedyotis corymbosa*, *Lindernia ciliata*, *Cleome viscosa* among broad-leaved and *Cyperus iria* among sedges were predominant in the experimental field. Teja and Duary (2018) observed that *Echinochloa colona, Digitaria sanguinalis, Ludwigia parviflora* and *Sphenoclea zeylanica* were the most predominant weeds in direct-seeded rice (DSR) field. Similar types of weed flora under DSR were also reported by Chakraborti *et al*. (2018), Dhanapal *et al.* (2018), Banjara *et al.* (2019), Yadav *et al.* (2019) and Malik *et al.* (2021).

The highest density and dry weight of broad-leaved, grasses, sedges and total weed was recorded in weedy plots, whereas lowest density and dry weight was recorded in weed free plot at 45 DAS (**Table 1**). It was found that combination of oxadiargyl PE *fb* bispyribac-sodium (100+25 g/ha) PoE registered lowest density and dry weight of broad-leaved, grasses, sedges and total weed at 45 DAS and was at par with combination of pendimethalin PE *fb* bispyribac-sodium (1000+25 g/ ha) PoE (**Table 1**). The density and dry weight of total weed was reduced by 89.04 and 85.18% under oxadiargyl PE followed by bispyribac-sodium (100+25 g/ha) PoE as compared to weedy check plot.

Application of herbicide alone also performed well to control broad-leaved, grasses and sedges. Among the lonely applied herbicide bispyribac-sodium at 25 g/ha PoE was more effective in controlling weed density and dry weight of broad-leaved at 45 DAS followed by oxadiargyl at 100 g/ha PE (**Table 1**). Bispyribac-sodium at 25 g/ha PoE alone could reduce density and dry weight of BLW by 79.99 and 75.43 %, respectively as compared to weedy check plots. But pendimethalin are less effective to control broad-leaved weed. Pendimethalin was more effective in controlling grassy weeds than bispyribac-sodium. However, bispyribac-sodium was effective against grasses, sedges and broad-leaved weeds in rice fields (Walia *et al.* 2006, Yadav *et al.* 2009). The higher WCE (weed control efficiency) at 45 days was recorded in oxadiargyl PE *fb* bispyribac-sodium (100+25 g/ha) PoE treatment **(Figure 1**)

Effect on crop

Highest number of filled grains/panicle, panicles/ m^2, test weight, panicle length and grain yield were recorded under weed free treatment and it was at par with oxadiargyl at 100 g/ha PE *fb* bispyribac-sodium at 25 g/ha PoE (**Table 2**). All the weed management treatments significantly increased grain yield over unweeded control. Oxadiargyl at 100 g/ha PE *fb* bispyribac-sodium at 25 g/ha PoE and pendimethalin at 1000 g/ha PE *fb* bispyribac-sodium at 25 g/ha PoE recorded at par value of number for filled grains/ panicle, panicles/m^2, test weight and panicle length during both the years.

Among the weed management treatments, oxadiargyl at 100 g/ha PE *fb* bispyribac-sodium at 25 g/ha PoE registered significantly highest grain yield of 3.21 t/ha over other treatments and was at par with pendimethalin at 1000g/ha PE *fb* bispyribac-sodium at

Table 1. Density and dry weight of weeds in DSR under different weed management practices at 45 DAS (pooled mean)

Treatment	Weed density (no./m^2)				Weed dry weight (g/m^2)			
	BLW	Grass	Sedge	Total	BLW	Grass	Sedge	Total
Pendimethalin at 1000 g/ha	6.81(46.0)	4.54(20.3)	3.18(9.7)	8.74(76.0)	5.66(31.6)	3.83(14.4)	2.55(6.1)	7.24(52.0)
Oxadiargyl at 100 g/ha	5.23(27.0)	6.15(37.7)	2.48(5.7)	8.39(70.3)	4.62(21.1)	4.63(21.1)	2.37(5.1)	6.89(47.4)
Pendimethalin PE *fb* bispyribac-sodium (1000 + 25 g/ ha)	4.77(22.0)	4.05(16.0)	1.68(2.3)	6.38(40.3)	4.08(16.2)	3.11(9.2)	1.69(2.4)	5.33(27.9)
Oxadiargyl PE *fb* bispyribac-sodium (100+ 25 g/ ha)	4.24(17.7)	3.20(10.0)	1.87(3.0)	5.58(30.7)	3.62(12.7)	2.82(7.5)	1.66(2.3)	4.78(22.5)
Bispyribac-sodium at 25 g/ha	5.09(25.7)	6.35(40.0)	2.04(3.7)	8.34(69.3)	3.90(15.0)	5.50(29.9)	1.57(2.0)	6.87(46.9)
Weedy check	11.34(128.3)	11.65(135.3)	4.14(16.7)	16.36(280.0)	7.84(61.0)	8.87(78.6)	3.56(12.2)	12.33(151.8)
Weed free	0.71(0.0)	0.71(0.0)	0.71(0.0)	0.71(0.0)	0.71(0.0)	0.71(0.0)	0.71(0.0)	0.71(0.0)
LSD (p=0.05)	0.70	1.05	0.32	0.87	0.71	0.90	0.45	0.98

Figures in parentheses are the original values. The data was transformed to SQRT (“x+0.5) before analysis

Table 2. Yield attributes and grain yield of DSR as influenced by weed management practices (pooled mean)

Treatment	Panicle length (cm)	Panicles/ m^2	1000-seed weight (g)	Filled grains/ panicle	Yield (t/ha)			Weed index (%)
					2021	2022	Pooled	
Pendimethalin at 1000 g/ha	24.83	176.63	19.37	93.53	2.04	2.25	2.15	37.89
Oxadiargyl at 100 g/ha	25.00	188.77	22.13	100.20	2.31	2.62	2.46	28.85
Pendimethalin PE *fb* bispyribac-sodium (1000 + 25 g/ha)	25.27	201.43	22.13	111.20	2.85	3.21	3.03	12.53
Oxadiargyl PE *fb* bispyribac-sodium (100+ 25 g/ha)	26.07	227.23	23.30	117.93	3.01	3.42	3.21	7.10
Bispyribac-sodium at 25 g/ha	25.12	192.00	22.30	107.20	2.46	2.81	2.63	23.88
Weedy check	21.33	155.37	18.33	79.47	1.30	1.59	1.44	58.26
Weed free	27.80	243.97	23.77	127.53	3.26	3.67	3.46	0.00
LSD (p=0.05)	2.77	33.55	2.58	16.12	0.34	0.43	0.39	

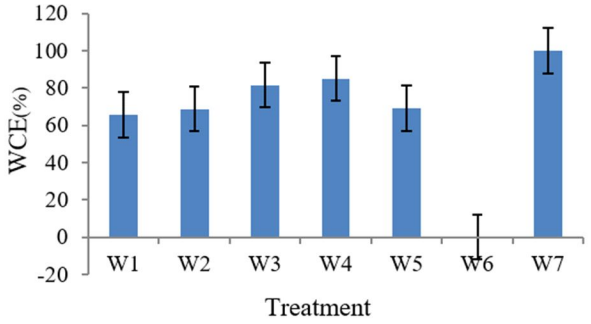

Figure 1. Weed control efficiency (%) of different weed management practices at 45 DAS in DSR

W_1- pendimethalin at 1000 g /ha, **W_2**- oxadiargyl (topstar 80 WP) at 1000 g /ha, **W_3**- pendimethalin PE (stomp 30 EC) *fb* bispyribac-sodium (nominee gold 10 SC) (1000 + 25 g /ha), **W_4**- oxadiargyl (topstar 80 WP)PE *fb* bispyribac-sodium (nominee Gold 10 SC) (1000 + 25 g /ha), **W_5**- bispyribac-sodium (nominee gold 10 SC) 25 g /ha, **W_6**- weedy check and **W_7**- weed free

25 g/ha PoE (**Table 2**). Oxadiargyl at 100g/ha *fb* bispyribac-sodium at 25 g/ha recorded 30.51 and 49.53% higher grain yield as compared to application of oxadiargyl alone and pendimethalin, respectively. These results were in accordance with Dhanpal *et al.* (2018) and Singh and Pairka (2014). Though weed free check registered significantly the highest grain yield of 3462 kg/ha of direct-seeded rice, it was comparable with oxadiargyl at 100 g/ha PE *fb* bispyribac-sodium at 25 g/ha PoE treatment.

Weed index (%) was calculated on the basis of grain yield and all the weed management practices recorded lower weed index (WI) compared to weedy check (**Table 2**). The lowest value of WI was recorded with oxadiargyl at 100 g/ha PE *fb*

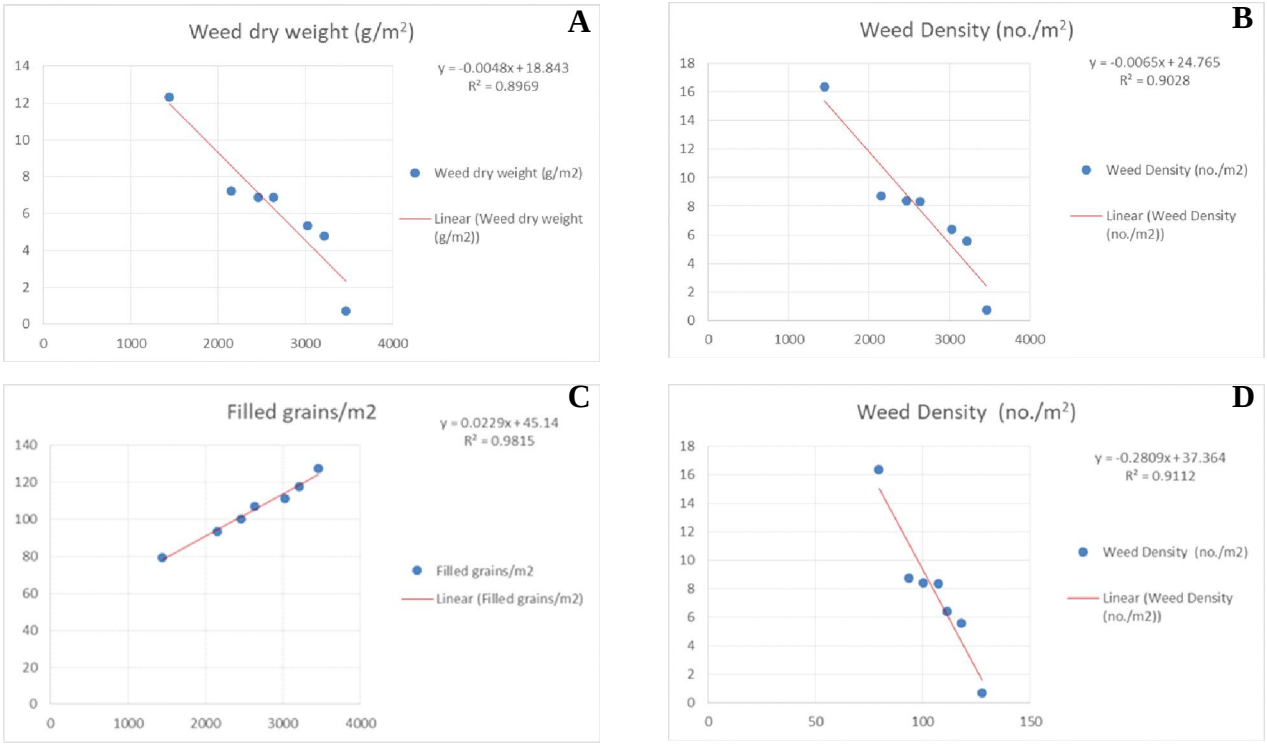

Figure 2. Relationship between (a) grain yield and weed dry weight; (b) grain yield and weed density; (c) yield and number of filled grains/ panicle; and (d) weed density and number of filled grains/ panicle as affected by different integrated weed management practices

Table 3. Pearson's correlation matrix among the weed density and dry weight at 45 days after application of herbicides and yield components

	Weed density	Weed dry weight	Panicle length	No. of panicles	1000-seed wt.	Filled grains	Yield	Weed index
Weed density	1							
Weed dry weight	0.9976	1						
Panicle length	-0.9921	-0.9841	1					
No. of panicles	-0.9373	-0.9469	0.9202	1				
1000-seed wt.	-0.8703	-0.8658	0.8753	0.9107	1			
Filled grains	-0.9545	-0.9570	0.9408	0.9782	0.9464	1		
Yield	-0.9501	-0.9470	0.9341	0.9605	0.9447	0.9907	1	
Weed index	0.9500	0.9469	-0.9340	-0.9605	-0.9447	-0.9907	-1	1

bispyribac-sodium at 25 g/ha PoE treatment this was followed by pendimethalin at 1000g/ha PE *fb* bispyribac-sodium at 25 g/ha PoE. The highest weed index was recorded under weedy check (58.26%).

Correlation and regression analysis

The weed density and dry matter had highly significant negative correlation with the yield attributes and yield of rice in both the years (**Table 3** and **Figure 2a, b, d**). However, the yield attributes like panicle length, number of panicles per m^2 and filled grains per m^2 were positively correlated with yield (**Table 3** and **Figure 2.c**). It implies that yield attributes and yield of rice decreased with proportional increase in weed interference and vice-versa. Similar negative correlation between weeds and crop was reported by Ganai *et al.* (2014), who stated that higher weed density and weed dry weight caused significant reductions in yield attributes which in turn reduced the crop yield significantly.

It was concluded that integrated use of pre-emergence herbicide oxadiargyl at 100g/ ha *fb* bispyribac-sodium at 25 g/ha PoE found to be promising for effective weed management in direct-seeded rice under Odisha conditions of India.

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