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Influence of sowing time and weed control methods on weed flora and productivity of direct seeded upland rice

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ABSTRACT

The field experiments were conducted during *kharif* seasons of 2008 and 2009 at the Agronomy Research Area, Birsa Agricultural University, Ranchi on sandy loam soil to study the effect of sowing time and weed control methods on weed flora and productivity of direct seeded upland rice. Results showed that broad leaf weeds constituted 56%, grasses 40% and sedges 4% of the total weed population at 30 days after sowing. Post monsoon sown direct seeded rice produced significantly higher grain (1967 kg/ha) and straw (2967 kg/ha) yield with net return of Rs 9465/ha and benefit: cost ratio of 1.92 than pre monsoon sown crop owing to higher total and effective tillers, grains/ panicle and 1000- grain weight along with lower weed density, weed dry matter and higher weed control efficiency. Grain yield of rice was statistically at par among pretilachlor + safener 0.5 kg/ha and butachlor 1.5 kg/ha + one hand weeding at 25 days after sowing (DAS) but significantly higher than other weed control methods except weed free. Application of pretilachlor + safener 0.5 kg/ha was remunerative in direct seeded rice as it had higher net return (Rs 9459/ha) and benefit: cost ratio (1.98).

Key words : Sowing time, Herbicides, Weed dynamics, Productivity, Upland rice

Rice occupies a pivotal position in the food security system of India. Direct seeded rice under upland conditions are usually broadcasted prior to onset of monsoon resulting in severe weed competition due to simultaneous emergence of rice and weeds. Yield loss due to weeds in direct seeded rice varied from 40 -100 % (Choubey *et al.* 2001) depending on the weed flora, their intensity and duration of competition. Alternation in sowing time and effective weed control methods can decrease losses due to weeds to improve the productivity of direct seeded rice. Therefore, an attempt was made to study the effect of sowing time and weed control methods for improving the productivity of direct seeded rice under upland conditions.

MATERIALS AND METHODS

The field experiments were conducted during *kharif* 2008 and 2009 at the Agronomy Research Area, Birsa Agricultural University, Ranchi (Jharkhand), at 23^{0}17' N latitude, 85^{0}10' E longitude and 625 m above mean sea level. The soil of the experimental site was sandy loam in texture, with pH 6.2, organic carbon 0.42%, low in available N (185 kg/ha), medium in available P (19.8 kg/ha) and exchangeable K (210 kg/ha). Two sowing times *viz.*, pre monsoon and post monsoon as main plot treatments and 6 weed control treatments *viz.*, pretilachlor + safener 0.5 kg/ha pre emergence, butachlor 1.5 kg/ha as pre emergence *fb* one hand weeding at 25 DAS, chlorimuron + metsulfuron (RM) 4 g/ha as post emergence (at 15 DAS), sesbania (broad cast) + 2,4-D 0.5 kg/ha at 30 days after sowing (DAS), weed free (weeding at 25 and 40 DAS) and weedy check as sub-plot treatments were laid out in split plot design with three replications. Rice cultivar *"Vandana"* was sown at 20 cm apart using 80 kg seed/ha on June 9 and June 29 as pre monsoon whereas on June 21 and July 16 as post monsoon during 2008 and 2009, respectively. Crop received recommended fertilizer 40 kg N, 20 kg P and 20 kg K/ha. Half of N and full dose of phosphorus and potash were applied as basal at sowing time and the remaining half N was top dressed at 30 days after sowing. Data on weed density and dry matter were recorded at 30 and 60 DAS with the help of quadrate (0.5 m x 0.5 m) placed at two places per plot and then converted to per square metre. Data on weed density and dry weight was subjected to square root transformation before analysis. Treatment effects in both years were same so pooled analysis of data was made.

RESULTS AND DISCUSSION

Weed flora

Experimental field was infested with grassy (*Echinochloa colona*, *Sorghum halepense* and *Setaria glauca)*, sedges (*Cyperus iria, Cyperus rotundus)* and broad-leaf weeds (*Ludwigia parviflora, Commelina benghalensis, Aeschynomene indica, Ageratum conyzoides* and *Cleome viscosa)* to the tune of 40, 4 and 56% , respectively. Weed density was higher at 30 DAS than 60 DAS in weedy check but weed dry matter

accumulation was higher at 60 DAS than 30 DAS (Table 1). Among sowing time, pre monsoon sown crop had significantly higher density of grasses, broad-leaf weeds, sedges and weed dry matter both at 30 and 60 DAS than post monsoon crop. At 30 DAS, density of grasses, broad-leaf weeds and sedges in pre monsoon crop was 67, 209 and 90%, respectively higher than post monsoon crop where as the corresponding weed density at 60 DAS was 96, 103 and 48% higher in pre monsoon crop than post monsoon crop. Consequently, weed dry matter in pre monsoon crop was significantly higher than post monsoon crop at 30 and 60 days after sowing. This might be due to already germinated / grown weeds ploughed down in soil causing lower weed density in post monsoon sown crop. This confirms the findings of Choudhary and Pradhan (1988).

Among weed control methods, application of butachlor 1.5 kg/ha *fb* one hand weeding at 25 DAS reduced grassy weeds while Sesbania (broadcast) *fb* 2,4-D 0.5 kg/ha 30 DAS reduced broad leaf weeds whereas chlorimuron + metsulfuron (RM) 4 g/ha reduced sedges weeds population significantly compared to weedy check at 30 and 60 DAS. Further, application of butachlor 1.5 kg/ha *fb* one hand weeding at 25 DAS also recorded significantly lower weed dry matter (106.3 and 97.6 g/m^2) than all other weed control methods except weed free at 30 and 60 days after sowing.

Effect on crop

Grain and straw yield of direct seeded rice were significantly higher in post monsoon sown (1967 and 2967 kg/ha) than pre monsoon sown crop owing to higher number of total tillers (413), effective tillers (318), filled grains/panicle (37) and 1000-grain weight (23.1 g) coupled with lower weed density, weed dry matter accumulation and higher weed control efficiency (Table 2). Singh *et al*. (2003) also reported that dry seeding of upland rice yielded lowest as compared to other establishment methods. Among weed control methods, application of pretilachlor+ safener 0.5 kg/ha, butachlor 1.5 kg/ha + one hand weeding at 25 DAS and weed free yielded at par but significantly higher than other weed control methods. Straw yield followed the trend of grain yield. Higher crop growth and total tillers caused smothering effect on weeds resulting in lower weed density, weed dry matter, higher weed control efficiency and higher grain yield. This confirms the findings of Singh *et al*. (1988).

Table 1. Weed density and weed dry matter of direct seeded rice influenced by sowing time and weed control method (mean of two years)

Treatment	Weed density/m^2						Weed dry matter (g/m^2)		Weed control efficiency (%)	
	30 DAS			60DAS						
	Grasses	Broadleaf	Sedges	Grasses	Broadleaf	Sedges	30 DAS	60 DAS	30 DAS	60 DAS
Sowing time										
Pre monsoon	18.1 (343)	16.8 (417)	4.2 (30)	15.8 (280)	12.8 (200)	7.4 (67)	13.6 (212.5)	15.4 (271.0)	28.5	42.6
Post monsoon	12.9 (205)	10.3 (135)	2.8 (16)	10.6 (143)	8.9 (99)	5.3 (46)	9.9 (118.5)	12.6 (195.0)	60.1	47.5
LSD (P=0.05)	0.6	1.1	0.5	0.5	0.6	0.4	3.8	0.4	4.4	4.5
Weed control										
Pretilachlor + safener 0.5 kg/ha	13.4 (199)	17.4 (373)	2.8 (18)	14.1 (231)	12.6 (171)	6.5 (52)	11.9 (161.5)	13.0 (191.0)	45.7	56.7
Butachlor 1.5 kg/a *fb* 1 HW 25 DAS	11.7 (164)	13.1 (235)	2.8 (13)	10.0 (132)	15.7 (260)	4.6 (22)	8.9 (106.3)	9.1 (97.6)	64.2	62.1
Chlorimuron + metsulfuron (RM) 4 g/ha	19.6 (410)	10.9 (180)	1.5 (5)	15.6 (264)	9.3 (114)	3.4 (13)	13.2 (189.1)	15.4 (262.4)	36.4	41.1
Sesbania (broadcast) *fb* 2,4-D 0.5 kg/ha 30 DAS	17.1 (308)	7.2 (95)	3.8 (25)	15.1 (274)	6.2 (61)	5.0 (28)	13.7 (194.1)	16.3 (296.0)	34.7	29.9
Weed free	8.8 (83)	8.8 (89)	4.4 (30)	7.6 (69)	6.64 (49)	5.1 (31)	6.2 (45.2)	8.6 (85.0)	84.8	80.4
Weedy	22.6 (480)	23.8 (676)	5.8 (48)	16.8 (297)	14.52 (242)	13.4 (193)	16.9 (297.3)	21.3 (465.4)	0	0
LSD (P=0.05)	0.4	1.7	0.4	0.7	0.5	0.4	3.4	0.5	3.2	3.2
Interaction										
LSD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS		

Original figures in parenthesis were subjected to square root transformation ($\sqrt{x+1}$) before statistical analysis, DAS - Days after sowing

Post monsoon sown direct seeded rice had 4.3 and 1.5 times higher net return and benefit: cost ratio than pre monsoon sown crop (Rs 2220/ha net return and 1.24 benefit: cost ratio). Among weed control methods, maximum net return (Rs 9459/ha) and benefit: cost ratio (1.98) was recorded with application of pretilachlor + safener 0.5 kg/ha followed by butachlor 1.5 kg/ha *fb* one hand weeding at 25 days after sowing (Table 3).

It was concluded that direct seeded upland rainfed rice should be sown after onset of monsoons as it not only reduces weed population but produces higher yield. Application of pretilachlor + safener 0.5 kg/ha in direct seeded rice was beneficial for higher yield and profit.

Table 2. Yield attributes and yield of direct seeded rice influenced by sowing time and weed control method (mean of two years)

Treatment	Tillers/m^2		Grains/panicle		1000 grain weight (g)	Yield (kg/ha)	
	Total	Effective	Filled	Unfilled		Grain	Straw
Sowing time							
Pre monsoon	214	139	34	20	23.4	1246	1868
Post monsoon	413	318	37	18	23.1	1967	2967
LSD (P=0.05)	72	52	2	3	1	192	1173
Weed control					21.8		
Pretilachlor + safener 0.5 kg/ha	351	225	37	19	22.3	1899	2897
Butachlor 1.5 kg/ha *fb* 1HW 25 DAS	326	271	38	18	21.8	1880	2977
Chlorimuron +metsulfuron(RM) 4 g/ha	299	220	36	19	21.6	1657	2470
Sesbania (broadcast) *fb* 2,4-D 0.5kg/ha 30DAS	358	270	34	18	21.4	1571	2366
Weed free	440	319	35	20	22.2	1800	2541
Weedy	108	67	35	20	22.7	828	1250
LSD (P=0.05)	NS	98	NS	NS	NS	162	796
Interaction							
LSD (P=0.05)	188	139	NS	NS	NS	NS	NS

Table 3. Economics of direct seeded rice influenced by sowing time and weed control methods (mean of two years)

Treatment	Cost of cultivation (Rs/ha)	Net return (Rs/ha)	Benefit : cost ratio
Sowing time			
Pre monsoon	10236	2220	1.24
Post monsoon	10236	9465	1.92
LSD (P=0.05)	-	698	0.18
Weed control			
Pretilachlor + safener 0.5 kg/ha	9633	9459	1.98
Butachlor 1.5 kg/ha *fb* 1 HW 25 DAS	11636	7479	1.64
Chlorimuron + metsulfuron (RM) 4 g/ha	9286	7259	1.79
Sesbania (broadcast) *fb* 2,4 -D 0.5kg/ha 30 DAS	9536	6198	1.65
Weed free	12661	5029	1.40
Weedy	8661	-366	1.04
LSD (P=0.05)	-	589	0.15
Interaction			
LSD (P=0.05)	-	NS	NS

Note : Selling price of rice grain @ Rs 7/ kg and straw Rs 2/kg.

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