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Performance of sequential herbicides to control weeds in direct seeded rice

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Abstract: Direct seeded rice is an emerging production technology in India due to less requirement of water, labour and capital input initially. But direct seeded rice face severe infestation of weeds. A field experiment was conducted during the *kharif* 2012 at Students' Farm of College of Agriculture, CCS Haryana Agricultural University; Kaul campus (Kaithal) to study the performance of sequential application of herbicides on weed flora in direct seeded rice. The herbicidal treatments included two pre emergence herbicides i.e. pendimethalin 1000 g/ha and oxadiargyl 100 g/ ha and four post emergence herbicides (bispyribac sodium 25 g/ha, fenoxaprop 67 g/ha, ethoxysulfuron 18.75 g/ha and metsulfuron methyl 10% + chlorimuron ethyl 10% WP ready mix (Almix) 4 g/ha). Weed free and weedy check were also included. The results showed that grasses were the dominant weed flora (49 %) followed by sedges (34%) and broad leaf weeds (17%).Sequential application of pendimethalin 1000 g/ha *fb* bispyribac sodium 25 g/ha and metsulfuron methyl + chlorimuron ethyl RM (Almix) 4 g/ha gave significantly lower weed density (p=0.05) and higher weed control efficiency which resulted in more number of effective tillers (209.3), filled grains/panicle (83.7) and grain yield (3.97 t/ha).

Keywords: Direct seeded rice, Effective tillers, Filled grains, Grain yield, Herbicides, Grain yield, Straw yield

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important cereal crop of India and a staple food of more than 65% of its population. In India, rice is commonly grown by transplanting seedlings into puddled soil. Repeated puddling adversely affects soil physical properties by destroying soil aggregates, reducing permeability in sub-surface layers and forming hard-pans at shallow depths (Sharma *et al.,*2003), all of which can negatively affect the following non-rice upland crop in rotation (Hobbs and Gupta, 2000). Moreover, puddling and transplanting require large amount of water and labour, both of which are becoming increasingly scarce and expensive, making rice production less profitable. All these factors demand a major shift from puddle-transplanted rice (CT-TPR) to direct seeding of rice (DSR) in irrigated areas. Weed control is a major limitation for the success of DSR (Chauhan and Yadav, 2013). Aerobic systems are subjected to much higher weed pressure than conventional puddled transplanting system (Rao *et al*., 2007) in which weeds are suppressed by standing water and by transplanted rice seedlings, which have a "head start" over germinating weed seedlings (Moody, 1983). Therefore, the major challenge for farmers is effective weed management, as failure to eliminate weeds may result in very low or no yield (Singh *et al*., 2008). A weed-free period for the first 30-45 days after sowing (DAS) is required to avoid any loss in yield because the dry weight of weeds increases greatly from 30 DAS in dry-DSR.

Success of DSR depends largely on weed control especially with chemical methods as mechanical weed control is labour intensive and not cost effective.Various herbicides have been used for controlling weeds in DSR (Nandal and Om, 1998) but efficiency of chemical methods based on single herbicide treatment may be unsatisfactory because of their narrow spectrum of weed control. Therefore, application of several herbicides in combination or in sequence can be more useful.Keeping in view the above facts regarding DSR, the present investigation was undertaken to test the performance of different herbicides alone or in combination to control weeds in direct seeded rice.

MATERIALS AND METHODS

A field experiment was conducted during the *kharif* 2012 at Students' Farm of College of Agriculture, CCS Haryana Agricultural University; campus Kaul (Kaithal) situated at latitude 29°51' N and longitude 76°41' E at an elevation of 241 m above mean sea level. It is located in the heart of the rice growing region 'Rice Bowl' of the Haryana State. The soil of the experiment field was clay loam in texture and slightly alkaline in reaction. The soil was low in organic carbon (0.41%), low in available nitrogen (141 kg/ha), medium in available phosphorus (21 kg/ha) and high in

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Table 1. Effect of different weed control treatments on weed density and weed control efficiency at 75 DAS in direct seeded rice.

Treatment		Dose (g/ha)	Time of application (DAS)	Weed density (No/m^2) 75 DAS				Weed control efficiency (%) 75 DAS			
				Echinochloa glabrescens	***Leptochloa chinensis***	***Cyperus* spp.**	***Ammania baccifera***	***Echinochloa glabrescens***	***Leptochloa chinensis***	*Cyperus*sp p.	*Ammania baccifera*
T1	Pendimethalin *fb* bispyribac-Na	1000 *fb* 25	3 *fb* 25	3.3(10.0)	5.9(33.9)	4.2(17.0)	3.4(10.7)	77.6	36.7	58.0	42.9
T2	Pendimethalin *fb* bispyribac-Na +ethoxysulfuron	1000 *fb* 25 +18.75	3 *fb* 25	3.2(9.3)	5.4(28.0)	1.9(2.8)	2.1(4.0)	79.1	47.6	93.0	83.3
T3	Pendimethalin *fb* bispyribac-Na +metsulfuron methyl + chlorimuron ethyl RM (Almix)	1000 *fb* 25 +4	3 *fb* 25	3.1(8.5)	5.8(32.6)	1.8(2.4)	1.4(1.3)	80.9	39.1	94.0	92.1
T4	Pendimethalin *fb* fenoxaprop	1000 *fb* 67	3 *fb* 25	4.3(17.9)	2.4(4.5)	4.0(15.7)	3.4(10.7)	59.7	91.5	61.1	44.4
T5	Pendimethalin *fb* fenoxaprop +ethxysulfuron	1000 *fb* 67 + 18.75	3 *fb* 25	4.2(17.2)	2.5(5.1)	2.0(3.3)	2.1(4.0)	61.2	90.4	91.7	81.7
T6	Pendimethalin *fb* fenoxaprop +metsulfuron methyl + chlorimuron ethyl RM (Almix)	1000 *fb* 67 + 4	3 *fb* 25	4.1(16.1)	2.4(5.0)	1.9(3.0)	1.4(1.3)	63.6	90.7	92.5	92.9
T7	Oxadiargyl *fb* bispyribac-Na	100 *fb* 25	3 *fb* 25	4.1(15.9)	5.8(33.3)	4.2(17.1)	3.8(13.3)	64.2	37.7	55.4	28.1
T8	Oxadiargyl *fb* bispyribac-Na +ethoxysulfuron	100 *fb* 25 + 18.75	3 *fb* 25	3.9(14.5)	5.9(34.5)	2.1(4.0)	2.7(6.7)	67.3	35.2	84.9	73.8
T9	Oxadiargyl *fb* bispyribac-Na + metsulfuron methyl + chlorimuron ethyl RM (Almix)	100 *fb* 25 + 4	3 *fb* 25	3.7(12.5)	6.3(39.2)	2.0(3.4)	2.5(5.3)	71.8	26.5	86.7	77.8
T10	Oxadiargyl *fb* fenoxaprop	100 *fb* 67	3 *fb* 25	4.7(21.8)	2.4(5.0)	5.0(24.3)	4.0(14.7)	50.9	90.7	39.8	21.1
T11	Oxadiargyl *fb* fenoxaprop+ ethoxysulfuron	100 *fb* 67 + 18.75	3 *fb*25	4.7(21.3)	2.7(6.3)	2.1(4.1)	2.7(6.7)	52.1	88.2	85.5	73.7
T12	Oxadiargyl *fb* fenoxaprop +metsulfuron methyl + chlorimuron ethyl RM (Almix)	100 *fb* 67 + 4	3 *fb* 25	4.6(20.2)	2.6(6.0)	2.0(3.7)	2.5(5.3)	54.5	88.5	87.2	71.1
T13	Weed free			1.0(0.0)	1.0(0.0)	1.0(0.0)	1.0(0.0)	100.0	100.0	100.0	100.0
T14	Weedy check			6.7(44.5)	7.3(54.3)	6.4(40.3)	4.4(18.7)	-	-	-	-
	SEm±			0.2	0.3	0.2	0.3				
	CD (P=0.05)			0.7	1.0	0.7	0.7				

*Original values are in parenthesis and before statistical analysis were subjected to square root transformation (√x+1)

Table 2. Effect of different weed control treatments on yield attributes, grain yield of direct seeded rice.

	Treatment	**Dose (g/ha)**	**Time of application (DAS)**	**Effective tillers/m^2**	**No. of filled grains/ panicle**	**1000-grain weight (g)**	**Grain yield (t/ha)**
T1	Pendimethalin *fb* bispyribac-Na	1000 *fb* 25	3 *fb* 25	184.5	79.7	25.9	3.57
T2	Pendimethalin *fb* bispyribac-Na +ethoxysulfuron	1000 *fb* 25 +18.75	3 *fb* 25	206.7	82.0	26.4	3.83
T3	Pendimethalin *fb* bispyribac-Na + metsulfu-ron methyl + chlorimuron ethyl RM (Almix)	1000 *fb* 25 +4	3 *fb* 25	209.3	83.7	27.3	3.97
T4	Pendimethalin *fb* fenoxaprop	1000 *fb* 67	3 *fb* 25	180.0	79.3	25.9	3.57
T5	Pendimethalin *fb* fenoxaprop +ethxysulfuron	1000 *fb* 67 + 18.75	3 *fb* 25	193.3	82.3	26.1	3.71
T6	Pendimethalin *fb* fenoxaprop +metsulfuron methyl + chlorimuron ethyl RM (Almix)	1000 *fb* 67 + 4	3 *fb* 25	198.7	83.3	26.5	3.77
T7	Oxadiargyl *fb* bispyribac-Na	100 *fb* 25	3 *fb* 25	174.7	76.3	26.0	2.93
T8	Oxadiargyl*fb*bispyribac-Na +ethoxysulfuron	100 *fb* 25 + 18.75	3 *fb* 25	182.3	77.7	25.3	3.25
T9	Oxadiargyl *fb* bispyribac-Na + metsulfuron methyl + chlorimuron ethyl RM (Almix)	100 *fb* 25 + 4	3 *fb* 25	188.3	79.3	25.8	3.47
T10	Oxadiargyl *fb* fenoxaprop	100 *fb* 67	3 *fb* 25	165.3	77.0	25.0	2.77
T11	Oxadiargyl *fb* fenoxaprop+ ethoxysulfuron	100 *fb* 67 + 18.75	3 *fb*25	166.7	73.3	26.4	2.87
T12	Oxadiargyl *fb* fenoxaprop +metsulfuron me-thyl + chlorimuron ethyl RM (Almix)	100 *fb* 67 + 4	3 *fb* 25	168.0	74.7	25.2	2.94
T13	Weed free			210.7	85.3	27.1	4.12
T14	Weedy check			97.3	71.7	25.0	1.52
	SE(m) ±			6.8	1.6	1.0	0.15
	CD at 5%			20.0	4.7	NS	0.43

available potassium (301 kg/ha). The experiment was laid out in randomized block design with three replications. The experiment was laid with 14 treatments (Table 1). Rice variety PUSA 1121 was seeded on 19th June 2012 in rows 22.5 cm apart using seed drill. Seed rate of 20 kg/ha was used. The herbicides were sprayed uniformly using knapsack sprayer fitted with flat fan nozzle calibrated to deliver 500 l/ ha water volume. Weed density (no. /m^2) and weed biomass (g/ m^2) were recorded species wise in each plot at 25, 45, 75, 105 DAS and at harvest using quadrate of 50 cm × 50 cm (0.25 m^2) from the area selected randomly for observations. The weed control efficiency (WCE) was calculated by using the following formula (Singh *et al*., 2000).

WCE = (DMC-DMT)/DMC x 100equation (i)

Where, DMC is dry matter of weeds (g) in weedy check and DMT is dry matter of weeds (g) in a particular treatment. The data was analyzed using analysis of variance (ANOVA) as applicable to randomized complete block design. The significance of the treatment effects was determined using F-test at 5% significance level. Data on weed density and biomass of weeds were subjected to square-root transformation ($\sqrt{x+1}$) before statistical analysis.

RESULTS AND DISCUSSION

Weed flora and weed control efficiency: Weed flora of the experimental rice field was dominated by *Echinochloa glabrescens, Leptochloa chinensis, Cyperus difformis, Cyperus rotundus, Ecliptaalba* and *Ammania baccifera*. All the treatments recorded significant reduction in the density of weeds compared to weedy check. Sequential application of pendimethalin 1000 g/ha *fb* bispyribac sodium 25 g/ ha and metsulfuron methyl + chlorimuron ethyl 4 g/ ha gave minimum density of *E. glabrescens*, *C.* spp. and *A. baccifera* among all herbicidal treatments (Table 1). This may be due to broad spectrum control of weeds by bispyribac sodium 25 g/ha. However, the minimum density of *L.chinensis* was reported from herbicidal combination of pendimethalin 1000 g/ha as pre emergence *fb* fenoxaprop 67 g/ha. This may be due to more effectiveness of fenoxaprop 67 g/ha to control *L.chinensis*. The effectiveness of fenoxaprop against *L.* chinensis was also reported by Singh *et al.* (2004). Pre emergence application of pendimethalin 1000 g/ha *fb* bispyribac sodium 25 g/ ha and metsulfuron methyl + chlorimuron ethyl 4 g/ ha gave maximum weed control efficiency among all herbicidal combinations at 75 DAS. Pre emergence application of pendimethalin 1000 g/ha *fb* fenoxaprop 67 g/ha gave maximum weed control efficiency (90.7%) of *L.chinensis* among all herbicidal treatments.

Yield attributes and yield: All the treatments produced significantly higher number of effective tillers (p=0.05) than weedy check (Table 2). Weed free recorded maximum number of effective tillers and number of filled grains which was at par with sequential application of pendimethalin 1000 g/ha *fb* bispyribac sodium 25 g/ha and metsulfuron methyl + chlorimuron ethyl 4 g/ha. Similarly more number of effective tillers, filled grains/panicle and grain yield by applying herbicides in direct seeded rice was obtained by Ganie *et al.* (2014). Effect of different weed control treatments on 1000 grain weight was found to be non significant. Among herbicidal treatments, maximum grain yield (3.97 t/ ha) was recorded with application of pendimethalin 1000 g/ha *fb* bispyribac sodium 25 g/ha and metsulfuron methyl + chlorimuron ethyl 4 g/ha while minimum grain yield was obtained with application of oxadiargyl 100 g/ha followed by fenoxaprop 67 g/ha (2.77 t/ha).

Conclusion

Pre-emergence application of pendimethalin 1000 g/ ha *fb* post emergence application of bispyribac sodium 25 g/ha and metsulfuron methyl + chlorimuron ethyl 4 g/ha with highest WCE provided excellent control of complex weed flora in direct seeded rice without any visible phyto-toxic effects on crop.

REFERENCES

Chauhan, B.S. and Yadav, A. (2013). Weed management approaches for direct seeded rice in india: a review. *Indian Journal of Weed Science.*45 (1):1-6

Ganie, Z.A., Singh, S. and Singh S. (2014). Integrated weed management in dry-seeded rice. *Indian Journal of Weed Science.* 46 (2):72-73

Hobbs, P.R. and Gupta, R.K. (2000). Sustainable resource management in intensively cultivated irrigated rice-wheat cropping systems of the Indo-Gangetic Plains of South Asia: Strategies and options. In "*International Conference on Managing Natural Resources for Sustainable Production in 21st Century*", 14-18 February 2000, New Delhi, India, Pp. 584-592

Moody, K. (1983). The status of weed control in Asia. FAO *Plant Protection Bulletin,* 30: 119-120

Nandal, D.P. and Om, H. (1998). Weed control in direct seeded puddle rice. *Indian Journal of Weed Science,* 30 (1&2): 18-20

Rao, A.N., Johnson, D.E., Shivprasad, B., Ladha, J.K. and Mortimer, A.M. (2007). Weed management in direct-seeded rice. *Advances in Agronomy,* 93: 153-255

Sharma, P.K., Ladha, J.K. and Bhushan, L. (2003). Soil physical effects of puddling in rice-wheat cropping systems. In "*Improving the productivity and sustainability of rice-wheat systems: Issues and Impacts*" (J. K. Ladha, J. E. Hill, J. M. Duxbury, R. K. Gupta, and R. J. Buresh, Eds.), Pp. 97-113. ASA, CSSA, SSSA, Madison, WI, ASA Special Publication 65

Singh, S., Bhushan, L., Ladha, J.K., Gupta, R.K., Rao, A.N. and Shivprasad, B. (2008). Weed management in aerobic rice systems under varying establishment methods.

Crop Protection, 27(3-5): 660-671

Singh, T., Brar, L. S. and Walia, U. S. (2000). Comparative efficiency of herbicides for weed control in chickpea (*Cicer arientum* L.). *Crop Research,* 19 (1): 1-5

Singh, V.P. Singh, G. and Singh, M. (2004). Effect of fenoxaprop-p-ethyl on transplanted rice and associated weeds. *Indian Journal of Weed Science,* 36:190-192