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Weed management effect to increase grain yield in dry direct-seeded rice

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ABSTRACT

An experiment was conducted during *Kharif* 2016 and 2017 at Agricultural Research Station, Dhadesugur, University of Agricultural Sciences, Raichur, Karnataka, India, to study the bio-efficacy of weed control practices on weeds and grain yield of dry-seeded rice. The dominant grassy weeds in fields were *Echinochloa* sp. *Panicum repens, Cynodon dactylon, Bracharia mutica, Digitarias sanguinalis, Commelina communis* and *Leptochloa chinensis*. Broad-leaf weeds were *Eclipta alba,* and *Ludwigia parviflora* and *Cyperus* sp. as sedge. Results revealed that, pre-emergence application of pretilachlor + pyrazosulfuron-ethyl (600 + 15 g/ha) recorded significantly lower weed dry weight at 15, 30 and 45 DAS during *Kharif* 2016 and 2017, higher weed control efficiency at 15, 30 and 45 days after sowing (DAS) (82.6, 80.2 and 80.6% during *Kharif* 2016 and 82.1, 82.7 and 80.2%, respectively during *Kharif* 2017, respectively) and higher rice grain yield (4.92 and 4.98 t/ha during *Kharif* 2016 and 2017, respectively) and which was at a par with twice hand weeding at 20 and 40 DAS.

INTRODUCTION

Among several reasons for low rice productivity, the losses due to weeds are one of the most important. Weeds are most severe and widespread biological constrains to crop production in India and alone cause 33% of losses out of total losses due to pests (Verma *et al.* 2015). Irrespective of the method of rice establishment, weeds are a major impediment to rice production due to their ability to compete for resources. In general, weeds problem in transplanted paddy is lower than that of direct-seeded rice (Rao *et al.* 2007). But in situations where continuous standing water cannot be maintained particularly during the first 45 days, weed infestation in transplanted rice also may be as high as direct-seeded rice. According to Singh *et al.* (2004), weeds can reduce the grain yield of dry-seeded rice (DSR) by 75.8%, wet-seeded rice (WSR) by 70.6% and transplanted rice (TPR) by 62.6%. Weeds by virtue of their high adaptability and faster growth dominate the crop habitat and reduce the yield potential. Therefore, the present investigation was undertaken to study the effect of early post-emergent herbicide for control of major weeds in irrigated dry-seeded rice.

MATERIALS AND METHODS

A field experiment was taken during *Kharif* 2016 and 2017 on effect of weed control practices on bio-efficacy of weeds and grain yield of dry-seeded rice at Agricultural Research Station, Dhadesugur, Raichur, Karnataka. The soil of the experimental site was medium deep black and neutral in pH (8.04), EC (0.47 ds/m), medium in organic carbon content (0.41%), low in nitrogen (189 kg/ha), medium in phosphorus (58.5 kg/ha) and potassium (287.5 kg/ha). There were eight treatments, *viz.* bispyribac-sodium (25 g/ha), penoxusulam (25 g/ha), azimsulfuron (35 g/ha), pretilachlor + pyrazosulfuron-ethyl (600 + 15 g/ha), pyrazosulfuron-ethyl (20 g/ha), 2,4-D Na Salt (1000 g/ha), hand weeding at 20 and 40 DAS and weedy check and these treatments were replicated thrice. Herbicides were sprayed using a knapsack sprayer fitted with a flat-fan nozzle at a spray volume of 500 l/ha. Rice was sown by tractor drawn seed drill at spacing of 20 cm (between the rows) in both the years. Recommended dose of fertilizer (150:75:75 kg NPK/ha) was applied uniformly in three equal splits. Irrigation comprised of alternate drying and wetting followed by intermittent irrigation at seven days interval up to 15 days before harvest. Other agronomic and plant

protection measures were adopted as recommended during the crop growth. The efficacy of different treatments on weeds was evaluated at crop maturity. Quadrates (0.25 m^2) were placed in each plot at random to determine the weed density. Weed seedlings within these quadrates were counted and the efficacy of weed control treatments was evaluated by comparing the density with the untreated control. Weeds were cut at ground level, washed with tap water, oven dried at 70 ^{0}C for 48 hours and then weighed for biomass. The weed control efficiency was calculated using the formula given by Tawaha *et al.* (2002). After harvest and threshing of crop, grain yield was recorded in net plot wise and converted to grain yield per hectare. The data of each year was analyzed separately. MSTAT was used for statistical analysis of data and means were separated using critical difference (CD) at p=0.05. The data on weeds were transformed by square root transformation by adding one before being subjected to ANOVA (Gomez and Gomez 1984).

RESULTS AND DISCUSSION

Effect on weed density and dry weight of weeds

The predominant grassy weeds in field were *Echinochloa* sp. *Panicum repens, Cynodon dactylon, Bracharia mutica, Digitarias sanguinalis* and *Leptochloa chinensis*. Pre-emergence application of pretilachlor + pyrazosulfuron-ethyl (600 + 15 g/ha) and twice hand weeded check recorded significantly lower grassy weeds compared to other weed control treatments and weedy check in *Kharif* 2016 and 2017 when observed at 15, 30 and 45 DAS. Singh *et al.* (2007) reported that early post-emergence application of penoxsulam recorded significantly lower grassy weed population in rice. Similarly, Yadav *et al.* (2007) have also reported penoxsulam as an effective post-emergence herbicide against mixed weed flora in rice. The predominant broad-leaf weeds in the trials field were *Eclipta alba, Commelina communis* and *Ludwigia parviflora*. Pre-emergence application of pretilachlor + pyrazosulfuron-ethyl (600 + 15 g/ha) and twice hand weeded check found to be significantly superior treatment with recorded lowest population of broad-leaf weeds over rest of the treatments. Further, weedy check recorded significantly higher weed population of broad-leaf weeds. These results were in conformity with the findings of Yadav *et al.* (2007). Pre-emergence application of pretilachlor + pyrazosulfuron-ethyl (600 + 15 g/ha) and twice hand weeded check were found equally effective in controlling sedges in direct-seeded rice (**Table 1** and **2)**. Weedy check recorded

Table 1. Effect of weed control treatments on weed counts in direct-seeded rice (*Kharif* 2016)

Treatment	Grasses (no./m^2)			Broad-leaf weeds (no./m^2)			Sedges (no./m^2)		
	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS
Bispyribac-sodium (25 g/ha)	2.41(4.80)	2.02(3.10)	2.06(3.26)	2.12(3.50)	2.20(3.84)	1.91(2.65)	1.84(2.40)	2.40(4.78)	2.05(3.21)
Penoxusulam (25 g/ha)	2.43(4.90)	2.07(3.29)	2.29(4.26)	2.15(3.62)	2.20(3.86)	2.28(4.21)	1.90(2.61)	2.49(5.21)	2.67(6.12)
Azimsulfuron (35 g/ha)	2.43(4.92)	2.10(3.40)	2.29(4.25)	2.17(3.71)	2.17(3.72)	2.42(4.85)	1.93(2.71)	2.52(5.35)	2.58(5.65)
Pretilachlor + pyrazosulfuron-ethyl (600 + 15 g/ha)	1.88(2.54)	1.97(2.89)	2.06(3.25)	2.05(3.21)	1.11(0.24)	1.46(1.12)	1.78(2.16)	1.50(1.26)	1.50(1.25)
Pyrazosulfuron-ethyl (20 g/ha)	2.03(3.12)	2.07(3.28)	2.28(4.21)	1.95(2.82)	2.22(3.92)	2.29(4.26)	1.73(2.00)	2.42(4.85)	2.54(5.45)
2,4-D, Na Salt at 1000 g/ha)	2.43(4.91)	2.06(3.25)	2.36(4.56)	2.15(3.62)	2.21(3.89)	2.38(4.65)	1.98(2.92)	2.42(4.86)	2.49(5.21)
Hand weeding at 20 and 40 DAS	2.29(4.25)	1.45(1.10)	1.80(2.25)	2.48(5.13)	1.52(1.32)	1.42(1.01)	1.79(2.21)	1.59(1.52)	1.41(1.00)
Weedy check	2.26(4.12)	4.40(18.4)	4.72(21.3)	2.20(3.82)	4.05(15.4)	4.31(17.6)	1.77(2.12)	3.08(8.48)	3.20(9.21)
LSD (p=0.05)	0.35	0.38	0.42	0.52	0.52	0.48	0.65	0.63	0.48

Figures in outside the parentheses are square root transformed values ($\sqrt{x+1}$); DAS - Days after sowing

Table 2. Effect of weed control treatments on weed counts in direct-seeded rice (*Kharif* 2017)

Treatment	Grasses (no./m^2)			Broad-leaf weeds (no./m^2)			Sedges (no./m^2)		
	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS
Bispyribac-sodium (25 g/ha)	2.41(4.82)	2.08(3.31)	2.07(3.27)	2.13(3.52)	2.23(3.98)	1.92(2.67)	1.85(2.42)	2.43(4.92)	2.14(3.56)
Penoxusulam (25 g/ha)	2.43(4.91)	2.08(3.32)	2.30(4.29)	2.15(3.64)	2.21(3.89)	2.29(4.26)	1.93(2.71)	2.50(5.24)	2.74(6.51)
Azimsulfuron (35 g/ha)	2.44(4.94)	2.13(3.52)	2.30(4.28)	2.17(3.73)	2.21(3.89)	2.43(4.89)	1.96(2.84)	2.50(5.24)	2.60(5.74)
Pretilachlor + pyrazosulfuron-ethyl (600 + 15 g/ha)	1.87(2.51)	1.98(2.91)	2.06(3.26)	1.77(2.15)	1.12(0.25)	1.47(1.15)	1.77(2.14)	1.51(1.29)	1.51(1.29)
Pyrazosulfuron-ethyl (20 g/ha)	2.04(3.15)	2.08(3.31)	2.29(4.23)	1.84(2.38)	2.26(4.12)	2.30(4.28)	1.83(2.11)	2.43(4.89)	2.55(5.48)
2,4-D, Na Salt at 1000 g/ha)	2.43(4.92)	2.14(3.56)	2.36(4.57)	2.17(3.71)	2.22(3.92)	2.39(4.69)	1.99(2.95)	2.43(4.92)	2.51(5.32)
Hand weeding at 20 and 40 DAS	2.49(5.21)	1.49(1.21)	1.81(2.26)	2.28(4.18)	1.50(1.25)	1.43(1.05)	1.77(2.14)	1.62(1.61)	1.50(1.25)
Weedy check	2.28(4.21)	4.49(19.2)	4.85(22.5)	2.20(3.82)	4.15(16.2)	4.37(18.1)	1.82(2.32)	3.20(9.25)	3.20(9.26)
LSD (p=0.05)	0.26	0.32	0.54	0.56	0.24	0.65	0.42	0.54	0.32

Figures in outside the parentheses are square root transformed values ($\sqrt{x+1}$); DAS - Days after sowing

significantly higher sedges density as compared to other weed controlling treatments. These results were in conformity with the findings of Jabusch *et al.* (2005) and Jason *et al.* (2007).

Pre-emergence application of pretilachlor + pyrazosulfuron-ethyl (600 + 15 g/ha) and twice hand weeded check found to be significantly superior to the rest of the treatments in controlling the weeds and recorded least weeds dry weight. Further, weedy check recorded significantly higher dry weight of weeds compared to other weed controlling treatments **(Table 3)**. These results were in conformity with the findings of Mishra *et al.* (2007) and Nandal *et al.* (1999).

Effect on weed control efficiency (WCE) and grain yield

Significantly higher weed control efficiency was recorded in the treatments with the pre-emergence application of pretilachlor + pyrazosulfuron-ethyl (600 + 15 g/ha) and twice hand weeded check (**Table 4)**. However, post-emergence application of bispyribac-sodium (250 ml/ha), penoxusulam (104 g/ha), azimsulfuron (70 g/ha), pyrazosulfuron-ethyl (200 g/ha) and 2,4-D Na Salt (1.25 kg/ha) were at par with each other in recording weed control efficiency. These results were in conformity with the findings of Jabusch *et al.* (2005) and Jason *et al.* (2007).

Table 3. Effect of weed control treatments on dry weight of weeds (g) in direct-seeded rice

Treatment	*Kharif* 2016			*Kharif* 2017		
	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS
Bispyribac-sodium (25 g/ha)	5.01(24.1)	3.08(8.5)	3.67(12.5)	5.10(25.0)	3.16(9.0)	3.41(10.6)
Penoxusulam (25 g/ha)	5.13(25.3)	3.32(10.0)	3.90(14.2)	5.10(25.0)	3.49(11.2)	3.82(13.6)
Azimsulfuron (35 g/ha)	5.20(26.0)	3.61(12.0)	4.02(15.2)	5.00(24.0)	3.58(11.8)	4.15(16.2)
Pretilachlor + pyrazosulfuron-ethyl (600 + 15 g/ha)	2.07(3.30)	2.55(5.5)	3.09(8.5)	2.02(3.10)	2.63(5.9)	3.09(8.6)
Pyrazosulfuron-ethyl (20 g/ha)	2.14(3.60)	3.10(8.6)	3.39(10.5)	2.24(4.00)	2.81(6.9)	3.46(11.0)
2,4-D, Na Salt at 1000 g/ha)	5.10(25.0)	3.32(10.0)	4.02(15.2)	5.20(26.0)	3.63(12.2)	3.94(14.5)
Hand weeding at 20 and 40 DAS	5.20(26.0)	1.73(2.0)	1.76(2.1)	5.00(24.0)	1.58(1.5)	1.67(1.8)
Weedy check	5.10(25.0)	6.67(43.5)	7.43(54.2)	5.39(28.0)	6.52(41.5)	7.52(55.6)
LSD (p=0.05)	1.20	1.20	1.25	1.12	1.42	1.31

Figures in outside the parentheses are square root transformed values ($\sqrt{x+1}$); DAS - Days after sowing

Table 4. Effect of weed control treatments on weed control efficiency (%) in direct-seeded rice

Treatment	*Kharif* 2016			*Kharif* 2017		
	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS
Bispyribac-sodium (25 g/ha)	6.59	80.5	76.9	10.7	78.3	80.9
Penoxusulam (25 g/ha)	1.94	77.0	73.8	10.7	73.0	75.5
Azimsulfuron (35 g/ha)	5.04	72.4	72.0	14.3	71.6	70.9
Pretilachlor + pyrazosulfuron-ethyl (600 + 15 g/ha)	87.2	87.4	84.3	88.9	85.8	84.5
Pyrazosulfuron-ethyl (20 g/ha)	82.6	80.2	80.6	82.1	82.7	80.2
2,4-D, Na Salt at 1000 g/ha)	3.10	77.0	72.0	7.14	70.6	73.9
Hand weeding at 20 and 40 DAS	5.04	95.4	96.1	14.3	96.4	96.8
Weedy check	-	-	-	-	-	-
LSD (p=0.05)	4.45	6.54	3.21	5.68	2.56	3.85

Table 5. Effect of weed control treatments on growth and grain yield of direct-seeded rice

Treatment	*Kharif* 2016			*Kharif* 2017		
	Tillers/m^2	Grains/ panicle	Grain yield (t/ha)	Tillers/m^2	Grains/ panicle	Grain yield (t/ha)
Bispyribac-sodium (25 g/ha)	200	212	5.01	202	221	5.14
Penoxusulam (25 g/ha)	199	211	4.90	200	218	4.95
Azimsulfuron (35 g/ha)	196	205	4.62	197	212	4.81
Pretilachlor + pyrazosulfuron-ethyl (600 + 15 g/ha)	215	215	5.78	217	225	5.84
Pyrazosulfuron-ethyl (20 g/ha)	199	210	4.92	201	217	4.98
2,4-D, Na Salt at 1000 g/ha)	197	208	4.76	198	209	4.97
Hand weeding at 20 and 40 DAS	220	222	5.89	221	232	5.92
Weedy check	188	158	2.98	186	162	3.25
LSD (p=0.05)	4.52	2.25	0.11	3.65	3.21	0.085

During both the seasons **(Table 5**), twice hand weeding at 20 and 40 days after sowing recorded significantly higher rice grain yield (5.89 and 5.92 t/ha in *Kharif* 2016 and 2017, respectively) and which was at par with pre-emergence application of pretilachlor + pyrazosulfuron-ethyl (600 + 15 g/ha) (5.78 and 5.84 t/ha in *Kharif* 2016 and 2017, respectively). These results were conformity with the findings of Yadav *et al.* (2007) which stated the effectiveness states that, Efficacy of penoxsulam in controlling weeds and increasing rice grain yield. Similar findings were also reported by Ramesha *et al.* (2017), who recorded, post-emergence application of penoxsulam 10 g/l + bentazone 360 g/l SC (2500 ml/ha) effective control weeds and to obtain higher grain yield in irrigated dry-seeded rice.

It was concluded that pre-emergence application of pretilachlor + pyrazosulfuron ethyl (600 + 15 g/ha) was found most effective treatment for control of weeds in dry direct-seeded rice.

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