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Efficacy of herbicides on weed management in wet season transplanted rice

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ABSTRACT

A field experiment was conducted during the kharif (wet) season of 2013 at farmer's field of village Benuria, Sriniketan, Birbhum, West Bengal with rice variety 'Swarna' (MTU 7029) to study the effect of bensulfuron-methyl + pretilachlor and other herbicides on weed growth and productivity of wet season transplanted rice. The experiment comprising of twelve treatments was laid out in a randomized block design with three replications. From the experimental findings it revealed that rice was infested with the three categories of weeds viz. grassy, broadleaved and sedges. Cynodon dactylon, among the grasses; Fimbristylis miliacea, among the sedges and Ludwigia parviflora, among the broadleaved weeds were predominant throughout the cropping period. The experimental field was dominated by broadleaved weeds. Among the herbicides application of bensulfuron-methyl 0.6%+ pretilachlor 6% at 60+600 g ha^{-1} at 3 DAT registered the lower number as well as dry weight of grassy, broadleaved, sedge and total weeds at 45 DAT but it was at par with bensulfuron-methyl 0.6%+ pretilachlor 6% at 90 + 900 and 120 +1200 g ha^{-1} at 3 DAT. Metsulfuron methyl + chlorimuron-ethyl (Almix) + azimsulfuron at 4+35 g ha^{-1} at 15 DAT was also quite effective in controlling broad spectrum weeds. Lower values of weed density, total weed dry weight and weed index, higher values yield attributes and yield of rice, weed control efficiency, net return as well as return per rupee invested were registered with application of bensulfuron-methyl 0.6%+ pretilachlor 6% at 60 + 600 g ha^{-1} at 3 DAT and metsulfuron methyl + chlorimuron-ethyl (Almix) + azimsulfuron at 4+35 g ha^{-1} at 15 DAT. The loss of grain yield of rice due to weed infestation was to the tune of 40%. Application of bensulfuron-methyl 0.6%+ pretilachlor 6% at 60+600 g ha^{-1} at 3 DAT or metsulfuron methyl + chlorimuron-ethyl (Almix) + azimsulfuron at 4 + 35 g ha^{-1} at 15 DAT appeared to be the most promising for managing weeds, obtaining higher yield and net return of transplanted kharif (wet) rice in the lateritic belt of West Bengal.

***Keywords*:** Azimsulfuron, bensulfuron-methyl, pretilachlor, transplanted rice and weed management

Rice is the main staple food in the Asia and the Pacific region, providing almost 39% of calories (Yaduraju and Rao, 2013). In India rice is grown over 42.4 million ha area with the production of 104.4 million tons and a productivity of 2.46 tons ha^{-1}. The average yield of rice in India is low due to several constraints. Among them weeds pose a major threat for increasing productivity. Uncontrolled weed growth caused 33-45% reduction in grain yield of rice (Manhas *et al.,* 2012). Bensulfuron methyl + pretilachlor is a new herbicide combination reported to provide effective control of broad leaved weeds, sedges and grasses in rice when applied at 3 DAT. It was found effective for complex weed flora in rice without any phytotoxic symptoms in the crop (Sunil *et al*., 2010). Several new herbicide molecules including azimsulfuron and bispyribac-sodium have also been launched for effective weed management in transplanted rice (Chandra Prakash *et al*., 2013 and Singh *et al.,* 2010) but the information on their efficacy in transplanted *kharif* rice is not adequate particularly in the sub-humid lateritic belt of West Bengal. Therefore, the present study was aimed to evaluate the efficacy of these comparatively new herbicides either alone or in combination with other as pre-emergence and early post-emergence in wet season transplanted rice.

Short Communication
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A field experiment was conducted during *kharif* season of 2013 in the farmer's field of village Benuria, Sriniketan, Birbhum, West Bengal. The field is situated at about 23^{0}39.823' N latitude and 87^{0}37.972' E longitude with an average altitude of 60 m above the mean sea level. The soil was sandy loam in texture, slightly acidic in reaction (pH 6.8), low in organic C (0.46%) and available N (149.6 kg ha^{-1}), high in available P (28.42 ha^{-1}) and medium in available K (129.5 kg ha^{-1}). The twelve treatments comprising of bensulfuron methyl 0.6%+ pretilachlor 6% at 30+300 g ha^{-1} at 3 DAT, bensulfuron methyl 0.6%+ pretilachlor 6% at 60+600 g ha^{-1} at 3 DAT, bensulfuron methyl 0.6%+ pretilachlor 6% at 90+900 g ha^{-1} at 3 DAT, bensulfuron methyl 0.6%+ pretilachlor 6% at 120+1200 g ha^{-1} at 3 DAT, pretilachlor at 0.50 kg ha^{-1} at 3 DAT, pretilachlor at 0.75 kg ha^{-1} at 3 DAT, metsulfuron-methyl + chlorimuron-ethyl (Almix) at 4 g ha^{-1} at 10 DAT, azimsulfuron at 35 g ha^{-1} at 20 DAT, metsulfuron methyl + chlorimuron-ethyl (Almix) + azimsulfuron at 4+35 g ha^{-1} at 15 DAT, bispyribac-Na at 25 g ha^{-1} at 20 DAT, hand weeding twice at 20 and 40 DAT and unweeded control were assigned in randomized block design replicated thrice. The rice crop, variety '*Swarna*' (MTU-

Table.1: Effect of treatments on weed density, dry weight, weed control efficiency, weed index and yield and economics of transplanted rice

Treatments	Weed density (no. m^{-2})				Weed dry weight (g m^{-2})				WCE (%)	Weed index (%)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Net return (Rs. ha^{-1})	Return $rupee^{-1}$ invested
	Grass	BLW	Sedge	Total	Grass	BLW	Sedge	Total						
T_1	2.73 (7.00)	2.27 (4.67)	0.71 (0)	3.49 (11.67)	1.36 (1.35)	1.62 (2.12)	0.71 (0)	1.99 (3.47)	86.7	23.49	3956	4778	31450	1.27
T_2	2.47 (5.66)	0.88 (0.33)	0.71 (0)	2.54 (6.00)	1.17 (0.87)	0.80 (0.15)	0.71 (0)	1.23 (1.02)	96.1	0.36	5151	5307	46676	1.82
T_3	2.47 (5.66)	0.71 (0)	0.71 (0)	2.47 (5.66)	1.19 (0.91)	0.71 (0)	0.71 (0)	1.19 (0.91)	96.5	10.12	4647	4925	38881	1.47
T_4	2.47 (5.66)	0.71 (0)	0.71 (0)	2.47 (5.66)	1.19 (0.91)	0.71 (0)	0.71 (0)	1.19 (0.91)	96.5	8.45	4733	5123	39357	1.44
T_5	2.47 (5.67)	3.23 (10)	1.22 (1.00)	4.14 (16.67)	1.21 (0.99)	2.66 (6.61)	1.01 (0.53)	2.93 (8.13)	69.0	17.47	4267	5370	36087	1.46
T_6	2.26 (4.67)	2.53 (6.00)	0.71 (0)	3.33 (10.66)	1.20 (0.95)	2.03 (3.74)	0.71 (0)	2.26 (4.69)	82.1	12.92	4502	5393	38947	1.56
T_7	2.54 (6.00)	1.22 (1.00)	1.34 (1.33)	2.97 (8.33)	1.27 (1.13)	0.95 (0.41)	1.03 (0.55)	1.61 (2.09)	92.0	17.33	4274	5370	36308	1.47
T_8	2.47 (5.67)	1.22 (1.00)	0.71 (0)	2.67 (6.67)	1.27 (1.11)	0.93 (0.37)	0.71 (0)	1.40 (1.48)	94.3	5.90	4865	5487	43034	1.67
T_9	2.48 (5.67)	1.22 (1.00)	0.71 (0)	2.67 (6.67)	1.33 (1.27)	0.92 (0.35)	0.71 (0)	1.45 (1.62)	93.8	3.71	4978	5507	44198	1.70
T_{10}	2.67 (6.67)	1.22 (1.00)	0.71 (0)	2.85 (7.66)	1.35 (1.34)	0.90 (0.30)	0.71 (0)	1.46 (1.65)	93.7	9.88	4659	5351	39121	1.46
T_{11}	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	100	0	5170	5767	43777	1.50
T_{12}	3.76 (13.67)	5.73 (29.00)	2.73 (7.00)	7.08 (49.66)	1.85 (2.91)	4.37 (18.61)	2.27 (4.71)	5.77 (26.24)	0	40.25	3089	4319	20875	0.88
LSD (0.05)	**0.41**	**0.30**	**0.13**	**0.38**	**0.15**	**0.26**	**0.15**	**0.27**	**-**	**-**	**591**	**584**	**-**	**-**

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

T_1: bensulfuron methyl 0.6%+ pretilachlor 6% at 30+300 g ha^{-1} at 3 DAT, T_2: bensulfuron methyl 0.6%+ pretilachlor 6% at 60+600 g ha^{-1} at 3 DAT, T_3: bensulfuron methyl 0.6%+ pretilachlor 6% at 90+900 g ha^{-1} at 3 DAT, T_4: bensulfuron methyl 0.6%+ pretilachlor 6% at 120+1200 g ha^{-1} at 3 DAT , T_5: pretilachlor at 0.50 kg ha^{-1} at 3 DAT, T_6: pretilachlor at 0.75 kg ha^{-1} at 3 DAT, T_7: metsulfuron-methyl + chlorimuron-ethyl (Almix) at 4 g ha^{-1} at 10 DAT, T_8: azimsulfuron at 35 g ha^{-1} at 20 DAT, T_9: metsulfuron-methyl + chlorimuron-ethyl (Almix) + azimsulfuron at 4+35 g ha^{-1} at 15 DAT, T_{10}: bispyribac-Na at 25 g ha^{-1} at 20 DAT, T_{11}: hand weeding twice at 20 and 40 DAT and T_{12}: unweeded control

7029) was fertilized with 60 kg N, 30 kg P_2O_5 and 30 kg K_2O ha^{-1}. One third of nitrogen and full amount of phosphorus and potassium were applied as basal and rest two third quantity of N was applied in two splits as top dressing *i.e.* one third of nitrogen was top dressed at active tillering and rest one third at panicle-initiation. All other recommended agronomic and plant protection measures were adopted to raise the crop. The biometric observations on weeds and crop were recorded following the standard procedure. The data were subjected to square root transformation to normalize their distribution. Weed control efficiency (%) was computed using the dry weight of weeds. Grain yield of rice along with other yield-attributing characters like effective panicles m^{-2} were recorded at harvest.

Effect on weeds

The experimental field was infested with three categories of weeds under eight families. The total number of weeds species was 11 out of which *Ludwigia parviflora* among broadleaved, *Cynodon dactylon* among grasses and *Fimbristylis miliacea* among sedges were predominant throughout the cropping period.

Unweeded control recorded significantly the highest weed density and weed dry weight at 45 DAT. The lowest weed density and weed dry weight was registered under hand weeding twice at 20 and 40 DAT (Table 1). Among the herbicidal treatments application of bensulfuron methyl 0.6%+ pretilachlor 6% at 60+600 g ha^{-1} registered the lower number as well as the lowest dry weight of grassy weeds and was statistically at par with all the higher doses of bensulfuron methyl + pretilachlor, pretilachlor alone at 0.75 kg ha^{-1}, metsulfuron methyl + chlorimuron-ethyl + azimsulfuron at 4+35 g ha^{1}. No broadleaved weed was registered in treatments with the application of higher doses of bensulfuron methyl 0.6%+ pretilachlor 6% which were statistically at par with bensulfuron methyl 0.6%+ pretilachlor 6% at 60+600 g ha^{-1}. Similar trend was observed in case of weed density and weed dry weight of sedges. Higher doses of bensulfuron methyl + pretilachlor registered the lowest number and dry weight of total weeds which were statistically *at par* with bensulfuron methyl 0.6%+ pretilachlor 6% at 60+600 g ha^{-1}, metsulfuron methyl + chlorimuron-ethyl + azimsulfuron at 4+35 g ha^{1}, azimsulfuron at 35 g ha^{-1} and bispyribac-Na at 25 g ha^{-1}. Among the herbicidal treatments both the higher doses of bensulfuron methyl + pretilachlor registered the highest weed control efficiency (96.5%) at 45 DAT but was very close to that of bensulfuron methyl 0.6%+ pretilachlor 6% at 60+600 g ha^{-1}. The lowest value of weed index was recorded in application of bensulfuron methyl 0.6%+ pretilachlor 6% at 60+600 g ha^{-1} followed by metsulfuron methyl + chlorimuron-ethyl + azimsulfuron at 4+35 g ha^{-1} and azimsulfuron at 35 g ha^{-1} (Table 1). The results were in conformity with Das *et al.* (2014); Partipan *et al.,* (2013) and Sunil *et al.,* (2010).

Effect on crop

About 40% yield reduction was recorded due to weed competition in transplanted *kharif* rice. Similar yield reduction in wet season rice due to weed competition in the lateritic belt of West Bengal was also reported by Duary *et al.* (2009) and Mandal *et al.* (2013). The highest grain yield was registered under the treatment hand weeding at 20 and 40 DAT and it was statistically at par with bensulfuron methyl 0.6%+ pretilachlor 6% at 60+600 g ha^{-1}, metsulfuron methyl + chlorimuron-ethyl + azimsulfuron at 4+35 g ha^{-1}, bispyribac-Na at 25 g ha^{-1} and azimsulfuron at 35 g ha^{-1} (Table 1).

Pre-emergence application of bensulfuron methyl 0.6%+ pretilachlor 6% at 60+600 g ha^{-1} recorded the highest net return followed by metsulfuron methyl + chlorimuron-ethyl (Almix) + azimsulfuron at 4+35 g ha^{-1} (Table 1). This was due to higher grain and straw yield of the crop obtained from the above treatments and lower cost of cultivation over hand weeding. The treatment bensulfuron methyl 0.6%+ pretilachlor 6% at 60+600 g ha^{-1} gave the highest value of return per rupee invested also followed by that of metsulfuron methyl + chlorimuron-ethyl + azimsulfuron at 4+35 g ha^{-1} and azimsulfuron at 35 g ha^{-1}.

Application of bensulfuron methyl 0.6% + pretilachlor 6% at 60+600 g ha^{-1} at 3 DAT or metsulfuron methyl + chlorimuron-ethyl + azimsulfuron at 4+35 g ha^{-1} at 15 DAT considerably reduced the weed infestation registering lower weed index, higher weed control efficiency, higher grain yield, net return and return per rupee invested in rice. Thus, bensulfuron methyl 0.6%+ pretilachlor 6% at 60+600 g ha^{-1}at 3 DAT or metsulfuron methyl + chlorimuron-ethyl + azimsulfuron at 4+35 g ha^{-1} at 15 DAT appeared to be the promising herbicides for managing broad spectrum weeds and obtaining higher paddy yield and net return of wet season rice in the lateritic belt of West Bengal.

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