



Integration of post-emergence herbicide application with hand weeding for managing weeds in transplanted rice

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ABSTRACT

A field experiment was conducted during *Kharif* seasons of 2015 to 2017 for three years at Agricultural Research Station, Vadgaon Maval, Pune, Maharashtra to find out the economical methods of weed control in transplanted rice. Post-emergence application of bispyribac-sodium 0.020 kg/ha (PoE) at 21 days after transplanting (DAT) followed by (*fb*) hand weeding at 45 DAT has effectively managed weeds in transplanted rice and produced the highest net returns (₹ 70107/ha) with higher B:C ratio (2.3) having lower weed index (2.83) and higher weed control efficiency (87.74 %).

Rice (*Oryza sativa* L.) is a staple food for more than half of the world population, providing energy for about 40% of the world population. Weed infestation during the early stages of crop growth is one of the major factors responsible for low productivity of transplanted rice.

Yield reduction in transplanted rice due to weeds was reported to be 28-45% (Raju and Reddy 1995, Nandal *et al.* 1999, Singh *et al.* 2003 Rao and Nagamani 2010). Weeds also increase the cost of cultivation, reduce input efficiency, interfere with agricultural operations and impair quality. Pre-emergence herbicides such as pretilachlor, butachlor, oxadiargyl and anilofos are being frequently used for effective management of weeds in transplanted rice (Sureshkumar *et al.* 2016) but the window of their application is very narrow (1-3 days after transplanting). The need of post-emergence herbicides is often realized by the growers to combat weeds emerging during later growth stages of crop. This situation warrants for initiating research efforts to evaluate and identify suitable post-emergence herbicides. Hence, present study was carried out to evaluate the efficacy and economics of different post emergence herbicides in managing weeds in transplanted rice.

A field experiment was carried out during *Kharif* 2015, 2016 and 2017 at Agricultural Research Station, Vadgaon Maval, Pune, Maharashtra. The experiment consisted of nine treatments comprising

of unweeded check, weed free and weed control treatments, *viz.* 2,4-D EE 0.85 kg/ha, post-emergence application (PoE) at 21 days after transplanting (DAT), metsulfuron-methyl + chlorimuron-ethyl 0.004 kg/ha, PoE at 21 DAT, bispyribac-sodium 0.020 kg/ha PoE at 21 DAT, 2,4-D EE 0.85 kg/ha PoE at 21 DAT *fb* hand weeding at 45 DAT, metsulfuron-methyl + chlorimuron-ethyl 0.004 kg/ha, PoE at 21 DAT *fb* hand weeding at 45 DAT, bispyribac-sodium (0.020 kg/ha PoE at 21 DAT) *fb* hand weeding at 45 DAT and one hand weeding at 25 DAT. The experiment was laid out in randomized block design with three replications. The rice variety '*Phule Samruddhi*' was transplanted at 20 x 15 cm distance. All the herbicides were sprayed by using water 500 l/ha with the help of sprayer fitted with flat fan nozzle. The weed samples were taken in each of the treatment and were oven dried for about one week. The weed biomass was recorded by weighing the dried weed samples. All the other recommended package of practices, except weed control, were followed to raise the transplanted rice.

Effect on weeds

In the experimental plots dominant weed flora consisted of monocots as *Echinochloa colona* and *Echinochloa crus-galli* among grasses; *Cyperus iria* and *Cyperus difformis* among sedges while dicots like *Eclipta alba*, *Alternanthera philoxeroides*, *Bergia capensis* and *Sphenoclea zeylanica*.

Significantly lowest weed biomass and weed index with highest weed control efficiency were recorded in the weed free treatment (Table 1 and 2). The second best treatment was bispyribac-sodium 0.020 kg/ha, PoE at 21 DAT *fb* one hand weeding at 45 days having lowest weed biomass (19.80 g/m²) with higher weed control efficiency (87.74%) and lower weed index (2.83). The highest weed biomass

was recorded in unweeded check. Similar result were reported by Schmidt *et al.* (1999) and Das *et al.* (2015).

Effect on rice

The highest mean grain and straw yields of paddy (5.62 t/ha and 6.27 t/ha, respectively) were obtained in the weed free treatment. It was at par with

Table 1. Weed biomass, weed control efficiency and weed index in transplanted rice as affected by different weed management treatments

Treatment	Weed biomass (g/m ²)				Weed control efficiency (%)				Weed index			
	2015	2016	2017	Pooled	2015	2016	2017	Pooled	2015	2016	2017	Pooled
2,4-D EE 0.85 kg/ha PoE	62.0	71.1	59.6	64.2	63.0	55.2	62.3	60.2	38.3	39.3	37.5	38.4
Bispyribac-sodium 0.020 kg/ha PoE	57.6	66.8	52.7	59.1	65.6	58.0	66.6	63.4	30.4	31.5	28.8	30.2
Metsulfuron-methyl + chlorimuron-ethyl 0.004 kg/ha PoE	59.7	69.8	57.6	62.3	64.4	56.1	63.7	61.4	34.3	36.6	34.1	35.0
2,4-D EE 0.85 kg/ha PoE <i>fb</i> 1 HW (45 DAT)	37.0	39.1	35.4	37.2	77.9	75.3	77.5	76.9	21.4	22.6	21.1	21.7
Bispyribac-sodium 0.020 kg/ha PoE <i>fb</i> 1 HW (45 DAT)	19.5	21.1	18.8	19.8	88.4	86.7	88.1	87.7	2.3	2.1	4.1	2.8
Metsulfuron-methyl + chlorimuron-ethyl 0.004 kg/ha PoE <i>fb</i> 1 HW (45 DAT)	29.7	31.8	27.8	29.8	82.3	80.1	82.5	81.6	15.4	16.8	13.8	15.3
Hand weeding (25 DAT)	94.5	91.8	91.4	92.6	43.6	42.0	42.1	42.6	56.8	50.4	55.8	54.3
Weed free	0	0	0	0	100.0	100.0	100.0	100.0	0	0	0	0
Unweeded check	167.7	159.6	158.6	161.9	0	0	0	0	72.6	73.1	72.2	72.6
LSD (p=0.05)	5.4	9.6	8.5	7.4	2.66	4.17	3.65	3.26				

PoE –Post-emergence; DAT=Days after transplanting; *fb* = Followed by

Table 2. Grain and straw yields as affected by weed management treatments

Treatment	Grain yield (t/ha)				Straw yield (t/ha)			
	2015	2016	2017	Pooled	2015	2016	2017	Pooled
2,4-D EE 0.85 kg/ha PoE	3.49	3.24	3.66	3.46	3.91	3.63	4.10	3.88
Bispyribac-sodium 0.020 kg/ha PoE	3.94	3.65	4.18	3.93	4.42	4.09	4.68	4.40
Metsulfuron-methyl + chlorimuron-ethyl 0.004 kg/ha PoE	3.73	3.37	3.87	3.66	4.18	3.78	4.34	4.10
2,4-D EE 0.85 kg/ha PoE <i>fb</i> 1 HW (45 DAT)	4.44	4.13	4.62	4.40	4.97	4.63	5.17	4.93
Bispyribac-sodium 0.020 kg/ha PoE <i>fb</i> 1 HW (45 DAT)	5.52	5.24	5.63	5.46	6.19	5.76	6.30	6.08
Metsulfuron-methyl + chlorimuron-ethyl 0.004 kg/ha PoE <i>fb</i> 1 HW (45 DAT)	4.79	4.44	5.07	4.77	5.37	4.97	5.68	5.34
Hand weeding (25 DAT)	2.44	2.65	2.59	2.56	2.73	2.97	2.90	2.87
Weed free	5.66	5.33	5.87	5.62	6.35	5.87	6.58	6.27
Unweeded check	1.55	1.43	1.63	1.54	1.70	1.56	1.79	1.68
LSD (p=0.05)	0.62	0.64	0.66	0.64	0.70	0.71	0.74	0.71

PoE –Post-emergence; DAT=Days after transplanting; *fb* = Followed by

Table 3. Economics of transplanted rice cultivation as affected by weed management treatments

Treatment	Gross returns (x10 ³ /ha)				Net returns (x10 ³ /ha)				B:C ratio			
	2015	2016	2017	Pooled	2015	2016	2017	Pooled	2015	2016	2017	Pooled
2,4-D EE 0.85 kg/ha PoE	78.08	75.79	85.65	79.84	24.76	23.95	32.33	27.01	1.5	1.5	1.6	1.5
Bispyribac-sodium 0.020 kg/ha PoE	88.27	85.42	97.75	90.48	34.03	32.67	43.51	36.74	1.7	1.6	1.8	1.7
Metsulfuron-methyl + chlorimuron-ethyl 0.004 kg/ha PoE	83.44	78.90	90.59	84.31	30.38	27.33	37.53	31.75	1.6	1.5	1.7	1.6
2,4-D EE 0.85 kg/ha PoE <i>fb</i> 1 HW(45 DAT)	99.39	96.68	107.99	101.35	43.55	42.33	52.57	46.15	1.8	1.8	1.9	1.8
Bispyribac-sodium 0.020 kg/ha PoE <i>fb</i> 1 HW (45 DAT)	123.54	122.14	131.52	125.74	66.78	67.71	75.81	70.10	2.2	2.2	2.4	2.3
Metsulfuron-methyl + chlorimuron-ethyl 0.004 kg/ha PoE <i>fb</i> 1 HW (45 DAT)	107.26	103.74	118.50	109.84	51.68	49.66	63.34	54.89	1.9	1.9	2.1	2.0
Hand weeding (25 DAT)	54.64	61.97	60.51	59.04	-6.25	7.56	5.03	3.99	1.0	1.1	1.1	1.1
Weed free	126.75	124.33	137.26	129.45	65.81	63.83	75.06	68.24	2.1	2.1	2.2	2.1
Unweeded check	34.74	33.30	38.12	35.39	-17.37	-17.32	-13.99	-16.23	0.7	0.7	0.7	0.7
LSD (p=0.05)	14.07	15.11	15.49	14.84	14.07	15.11	15.49	14.84				

PoE –Post-emergence; DAT=Days after transplanting; *fb* = Followed by

the bispyribac-sodium (0.020 kg/ha, PoE at 21 DAT) *fb* one hand weeding 45 days with equivalent grain (5.42 t/ha) and straw (6.08 t/ha) yields. These result were in close conformity with those of Yadav *et al.* (2009).

Economics

Weed free treatment recorded significantly the highest gross returns (₹ 129454/ha) (**Table 3**) and was at par with bispyribac-sodium 0.020 kg/ha, PoE at 21 DAT *fb* one hand weeding at 45 DAT with gross returns of ₹ 1,25,740/ha. Significantly the highest net returns (₹ 70,107/ha) and B:C ratio (2.3) were obtained with bispyribac-sodium (0.020 kg/ha, PoE at 21 DAT) *fb* one hand weeding at 45 DAT, which was at par with the weed free treatment (**Table 3**).

It can be concluded that in transplanted rice, effective management of weeds with higher economical returns may be obtained with post-emergence application of bispyribac-sodium 0.020 kg/ha at 21 DAT *fb* one hand weeding 45 DAT.

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