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Performance of herbicides and herbicide mixtures on weed control in transplanted rice

B. Venkatesh*, Y.S. Parameswari, M. Madhavi and T. Ram Prakash

Department of Agronomy, College of Agriculture, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana 500 030, India

**Email: venkateshbathulavenkychinna@gmail.com*

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ABSTRACT

The information on efficacy of new low-dose herbicides and herbicide mixtures is very limited in transplanted rice. An experiment was conducted, to study the effect of herbicides and herbicide mixtures on weed control in transplanted rice. Lower weed density and dry weight was recorded with florpyrauxifen-benzyl + cyhalofop-butyl and penoxsulam + cyhalofop-butyl which was at par with hand weeding at 20 and 40 DAT. Herbicide mixtures were more effective to control weeds than single application of either pre- or post-emergence herbicides. Higher grain and straw yields were obtained with florpyrauxifen-benzyl + cyhalofop-butyl EC 150 g/ha PoE *fb* hand weeding at 40 DAT which was comparable to minimum competitive plot.

Rice (*Oryza sativa* L.*)* is the most important staple food for more than half of the world population. Rice is cultivated in different ecosystems to increase production levels due to climate change. Though different ecosystems are emerging day by day but, transplanting is the most dominant and traditional method of rice cultivation under irrigation. Weeds are the major constraints in rice production. Transplanted rice is infested by heterogeneous type of weed flora which causes yield reduction about 33-45% (Duary *et al*. 2015). Due to usage of single herbicide the complex weed flora was not controlled effectively (Mohapatra *et al*. 2017). In order to control heterogeneous type of weed flora and to prevent development of herbicide resistance, there is need to depend on low dose herbicides and herbicide mixtures. The information on low dose herbicides and herbicide mixtures is very scanty. Therefore, to fulfill the above gaps, the present investigation was undertaken to test the effect of new herbicides and herbicide mixtures on weed control of transplanted rice.

A field experiment was conducted at Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad during *Kharif*, (rainy Season) 2019. The farm is geographically situated at 17 ^{0}19' 16.4" North latitude and 78^{0} 24' 43" East longitudes and at an altitude of 542.3 m above mean sea level. According to Troll's climatic classification, it falls under semi- arid tropics (SAT). The soil of experimental site was sandy loam in texture with p^{H} of 7.85, low in available nitrogen (235.2 kg/ha), high in available phosphorus (38.8 kg/ha) and available potassium (379 kg/ha) contents. The experiment consisted of 12 weed management practices laid out in randomized block design with three replications. '*RNR–15048'* (*Telangana sona*) variety was transplanted in main field at the age of 28 days old seedlings with a spacing of 15× 10 cm. All pre-emergence herbicides were applied within three days after transplanting and post-emergence herbicides were applied at 2–3 leaf stage of weeds. All other management practices were done as per recommendations given by PJTSAU. Density of weeds, *viz*. grasses, sedges and broad-leaved weeds were recorded by using of 50 × 50 cm quadrat and dry weight of weeds was recorded from 50 × 50 cm area by destructive sampling. Weed control efficiency (WCE) was calculated based on weed dry weight. The data on weed density and dry weight for all the categories were computed using square root $(\sqrt{x+1})$ transformation.

Effect on weeds

The weed species found in the experimental field were *Echinochloa colona, Echinochloa crus-galli,*

Table 1. Effect of herbicides and herbicides mixtures on density and dry weight of weeds in transplanted rice at 30 DAT

Treatment	Weed density (no./m^2)			Total weed density (no./m^2)	Total weed dry weight (g/m^2)
	Grasses	Sedges	BLW		
Penoxsulam 0.97% + butachlor 38.8% SE 820 g/ha PE *fb* HW at 30 DAT	3.0(8.3)	2.6 (5.7)	2.4(5.0)	4.5(19.0)	3.9(14.5)
Pyrazosulfuron-ethyl 0.15% + pretilachlor 6% GR 600 g/ha PE *fb* HW at 30 DAT	2.8(6.7)	2.3 (4.3)	2.4(4.7)	4.1(15.7)	3.8(13.3)
Orthosulfamuron + pretilachlor 6% GR 600 g/ha PE *fb* HW at 30 DAT	3.1(8.3)	2.3 (4.3)	2.6(5.70)	4.4(18.3)	3.9(14.0)
Ipfencarbazone 25% SC 156.25 g/ha PE *fb* HW at 30 DAT	3.2(9.0)	2.4 (4.7)	2.9 (7.3)	4.7(21.0)	4.2(16.8)
Penoxsulam 2.65% OD 25 g/ha PoE *fb* HW at 40 DAT	3.3(10.0)	2.6 (6.0)	2.9 (7.7)	5.0(23.7)	4.3(18.0)
Penoxsulam 1.02% + cyhalofop-butyl 5.1% OD 150 g/ha (PoE) *fb* HW at 40 DAT	2.2(4.0)	1.9 (2.7)	2.0(3.0)	3.3(9.7)	2.9(7.4)
Pretilachlor 50 % EC 0.75 kg/ha PE *fb* 2,4 D 1.0 kg/ha PoE	3.6(12.3)	3.4(10.7)	1.7 (2.0)	5.1(25.0)	4.5(19.2)
Bispyribac-sodium 10% SC 25 g/ha PoE *fb* HW at 40 DAT	3.4(10.7)	2.7 (6.3)	2.9 (7.3)	5.0(24.3)	4.4(18.6)
Florpyrauxifen-benzyl + penoxsulam 12% EC 40.64 g/ha (PoE) *fb* HW at 40 DAT	2.3(4.3)	2.0 (3.0)	1.9 (2.7)	3.3(10.0)	2.9(7.7)
Florpyrauxifen-benzyl + cyhalofop-butyl 10% EC 150 g/ha PoE *fb* HW at 40 DAT	2.2(3.7)	1.6 (1.7)	2.1 (3.3)	3.1(8.7)	2.7(6.3)
Hand weeding at 20 and 40 DAT	1.9 (2.7)	1.4 (1.3)	2.1 (3.3)	2.8(7.3)	2.6(6.0)
Unweeded control	5.0(24.0)	5.2(26.3)	5.0(23.7)	8.7(74.0)	8.2(65.7)
LSD (p=0.05)	0.39	0.52	0.42	0.53	0.51

Data were subjected to square-root $(\sqrt{x+1})$ transformation and original values are shown in parentheses, DAT- Date after transplanting

Paspalum distichum and *Cynodon dactylon* among grasses, *Cyperus difformis*, *Cyperus iria* and *Fimbristylis dichotoma* among sedges and among the broad-leaved weeds *Eclipta alba*, *Ammania baccifera* and *Caesulia axillaris*. All the weed management practices significantly reduced weed population and weed dry weight over unweeded control (**Table 1**).

Lower grass weed density and sedge weed density was recorded with hand weeding at 20 and 40 DAT which is statistically at par with flopyrauxifen-benzyl + cyhalofop-butyl EC 150 g/ha PoE, penoxsulam + cyhalofop-butyl OD 150 g/ha PoE *fb* hand weeding at 40 DAT and broad-leaved weeds were lower with pretilachlor EC 0.75 kg/ha PE *fb* 2,4–D WP 1.0 kg/ha PoE which was statistically at par with florpyrauxifen-benzyl + penoxsulam EC 40.64 g/ha PoE, hand weeding at 20 and 40 DAT, penoxsulam + cyhalofop-butyl OD 150 g/ha PoE and flopyrauxifen-benzyl + cyhalofop-butyl EC 150 g/ha PoE *fb* hand weeding at 40 DAT 2,4–D is selectively broad-leaved weed killer results in lower broad-leaved weeds. Similar findings were reported by Singh *et al.* (2010). The lowest total weed density and dry weight of weeds was observed in case of hand weeding at 20 and 40 DAT which is statistically at par with florpyrauxifen-benzyl + cyhalofop-butyl EC 150 g/ha PoE, penoxsulam + cyhalofop-butyl OD 150 g/ha PoE and flopyrauxifen-benzyl + penoxsulam EC 40.64 g/ha PoE *fb* hand weeding at 40 DAT. Lower weed density and dry weight was observed with application of herbicide mixtures compared to single herbicide. It might be due to effective control of complex weed flora by two different modes of action. These results were in tune with the findings of Yakadri *et al.* (2016) and Mohapatra *et al.* (2017). Higher weed control efficiency and lower weed index was observed with flopyrauxifen-benzyl + cyhalofop-butyl EC 150 g/ha PoE *fb* hand weeding at 40 DAT which was statistically at par with hand weeding at 20 and 40 DAT. It might be due to effective control of weeds during critical period of weed competition. Similar findings were reported by Saranraj *et al.* (2018) and Sreedevi *et al.* (2018).

Effect on yield

Higher grain and straw yields were recorded with hand weeding at 20 and 40 DAT which was statistically at par with florpyrauxifen-benzyl + cyhalofop-butyl EC 150 g/ha PoE, penoxsulam + cyhalofop butyl OD 150 g/ha (PoE) and florpyrauxifen-benzyl + penoxsulam EC 40.64 g/ha PoE *fb* hand weeding at 40 DAT. These treatments followed by pre-emergence application of pyrazosulfuron-ethyl + pretilachlor, orthosulfamuron + pretilachlor and penoxsulam + butachlor *fb* hand weeding at 30 DAT. There was 56.3% reduction in grain yield under unweeded control over hand weeding. Weed management practices not only reduced weed density and dry matter but also allows the plant to use available resources efficiently which resulted higher yield over unweeded control. Similar results were reported by Choudhary and Dixit (2018) and Kashid (2019).

It was conducted that application of herbicide mixture florpyrauxifen-benzyl + cyhalofop-butyl EC 150 g/ha PoE *fb* hand weeding at 40 DAT was the most effective in reducing the density and dry weight of weeds in transplanted rice at critical stage of crop-weed competition which resulted in more yields than rest of weed management practices.

Table 2. Effect of herbicides and herbicide mixtures on weed control efficiency, weed index and yield of transplanted rice

Treatment	WCE (%)	WI (%)	Grain yield (t/ha)	Straw yield (t/ha)
Penoxsulam 0.97% + butachlor 38.8% SE 820 g/ha PE *fb* HW at 30 DAT	77.98	16.7	5.93	7.00
Pyrazosulfuron-ethyl 0.15% + pretilachlor 6% GR 600 g/ha PE *fb* HW at 30 DAT	79.81	15.5	6.02	7.04
Orthosulfamuron + pretilachlor 6% GR 600 g/ha PE *fb* HW at 30 DAT	78.69	16.1	5.98	7.01
Ipfencarbazone 25% SC 156.25 g/ha PE *fb* HW at 30 DAT	74.38	22.4	5.52	6.47
Penoxsulam 2.65% OD 25 g/ha PoE *fb* HW at 40 DAT	72.65	22.8	5.50	6.42
Penoxsulam 1.02% + cyhalofop-butyl 5.1% OD 150 g/ha (PoE) *fb* HW at 40 DAT	88.74	1.9	6.98	7.82
Pretilachlor 50 % EC 0.75 kg/ha PE *fb* 2,4 D 1.0 kg/ha PoE	70.73	26.1	5.26	6.19
Bispyribac-sodium 10% SC 25 g/ha PoE *fb* HW at 40 DAT	71.74	25.1	5.33	6.28
Florpyrauxifen-benzyl + penoxsulam 12% EC 40.64 g/ha (PoE) *fb* HW at 40 DAT	88.33	3.6	6.87	7.71
Florpyrauxifen-benzyl + cyhalofop-butyl 10% EC 150 g/ha PoE *fb* HW at 40 DAT	90.36	1.1	7.04	7.92
Hand weeding at 20 and 40 DAT	90.92	-	7.12	7.99
Unweeded control	-	56.3	3.11	4.22
LSD (p=0.05)			0.43	0.50

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