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Short communication

Herbicides combinations for control of complex weed flora in transplanted rice in Lateritic belt of West Bengal

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Rice (*Oryza sativa* L.) is one of the world's most important food crops (Singh and Khush 2000). Currently more than half of the world's population depends on rice for food, calories and protein, especially in developing countries. Rice is the world's most important food among all staple food crops and more than half of the world's population depends on rice for food, calories and protein, especially in developing countries. It is grown by manual transplanting of seedlings into puddled soil. Like other cereal crops, rice also suffers severely from weed competitions (Rao *et al.* 2007). Uncontrolled weeds compete with rice and cause yield losses to the tune of 50-65% under wet-seeded rice (Subbaiah and Sreedevi 2000) and up to 76% in transplanted rice (Singh *et al.* 2004). The farmers generally do hand weedings in transplanted rice. Post-emergence application of metsulfuron-methyl + chlorimuron-ethyl and early post-emergence application of ehoxysulfuron showed promising results in achieving more grain yield of transplanted rice (Pal *et al.* 2008). Pre-emergence application of pyrazosulfuron, penoxsulam (Chauhan and Seth 2013) and post-emergence bispyribac (Khaliq *et al.* 2012) herbicides were considered to be an alternative/supplement to hand weeding. Therefore, the present experiment was conducted to find out the effective herbicides or herbicide mixtures for weed control in transplanted rice.

The field trial was laid out in RBD with 12 treatments and replicated thrice in Agricultural Farm of Visva-Bharati during *Kharif*, 2014. The herbicide treatments were bispyribac-Na 25 g/ha and penoxsulam 22.5 g/ha alone, tank-mix of bispyribac-Na 25 g/ha with ethoxysulfuron 18.75 g/ha and (chlorimuron + metsulfuron) 4 g/ha, pretilachlor 750 g/ha followed by (*fb*) ethoxysulfuron 18.75 g/ha and (chlorimuron + metsulfuron) 4 g/ha, pyrazosulfuron 20 g/ha *fb* (chlorimuron + metsulfuron) 4 g/ha, ready mix of penoxsulam + cyhalofop 135 g/ha, ready mix of triafamone + ethoxysulfuron 60 g/ha and pendimethalin 750 g/ha *fb* bispyribac 25 g/ha. Two hand weeding and weedy check were also included. Herbicides were applied with knapsack sprayer fitted with flat fan nozzle using 500 L/ha of water. The rice (var. *'IR-36'*) was transplanted on 26th August, 2014 and harvested on 11th November 2014. . The weed population, biomass of weed, yield attributes and yield were recorded. The weed population and biomass of weeds were subjected to square-root transformation ($\sqrt{x+0.5}$). The data were analyzed according to randomized block design by standard ANOVA at p=0.05 level of significance.

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Weed flora

The experimental rice field was infested with 9 weed species out of which 2 were grasses, 5 were broad-leaved and 2 were sedges. The weeds species were *Cynodon dactylon*, *Echinochloa colona*, *Ludwigia parviflora*, *Spilanthes acmella*, *Oldenlandia corymbosa*, *Ammania multiflora*, *Hydrolea zeylanica*, *Cyperus iria* and *Fimbristylis miliacea*. The predominant weed species were *Ludwigia parviflora* (48.02%) and *Fimbristylis miliacea* (38.35%).

Effect on weeds

All the herbicidal treatments significantly controlled the complex weed flora prevailing in transplanted rice. Early post-emergence application of penoxsulam was less effective in controlling *Ludwigia parviflora* and *Fimbristylis miliacea*. Post-emergence applications of bispyribac and bispyribac + ethoxysulfuron were also found less effective in controlling *Hydrolea zeylanica*. Post-emergence application of bispyribac, penoxsulam, bispyribac + ethoxysulfuron, bispyribac + (chlorimuron + metsulfuron) ready mix of penoxsulam + cyhalofop, ready mix of triafamone of ethoxysulfuron and pendimethalin *fb* bispyribac-sodium were found most effective in controlling grass weed population. Pre-emergence application of pendimethalin *fb* bispyribac, pyrazosulfuron *fb* bispyribac and tank mix of bispyribac and chlorimuron + metsulfuron

successfully controlled grass weed population. Early post-emergence application of penoxsulam + cyhalofop (ready-mix) controlled broad-leaved weeds namely, *Hydrolea zeylanica, Oldenlandia corymbosa, Ammania baccifera* and *Spilanthes acmella* successfully. With regards to suppression of sedge weeds, bispyribac-Na + ethoxysulfuron, pretilachlor *fb* ethoxysulfuron, pretilacholor *fb* chlorimuron + metsulfuron, pyrazosulfuron *fb* chlorimuron + metsulfuron, penoxsulam + cyhalofop and ready-mix of triafamone + ethoxysulfuron were found most effective. Early post-emergence application of penoxsulam + cyhalofop was found most effective in controlling total weed population. Similar trend was also observed in case of dry matter of weeds.

Effect on yield attributes and yield

The yield attributes namely, number of effective tillers/m^2, number of grains/panicle and test weight differed significantly among the treatments. Early post-emergence application of penoxsulam + cyhalofop (ready-mix) recorded the highest number of effective tillers/$m^2$and number of grains/panicle. With respect to grain yield of transplanted rice, early post-emergence application of penoxsulam + cyhalofop (ready-mix) recorded the highest grain yield of transplanted rice (4.867 t/ha), which was closely followed by hand weeding twice (4.782 t/ha) and bispyribac + ethoxysulfuron (4.762 t/ha). It was noted that all the herbicidal treatment either alone or in combination produced grain yield of rice at par with the best treatment.

Table 1. Effect of treatments on species wise weed density (no./m^2) in transplanted rice under herbicides combinations at 60 DAT

Treatment	*Cynodon dactylon*	*Echinochloa colona*	*Ludwigia parviflora*	*Spilanthes acmella*	*Oledenlandia corymbosa*	*Ammania multiflora*	*Hydrolea zeylanica*	*Fimbristlylis miliacea*	*Cyperus iria*
Bispyribac-Na	0.7(0.0)	0.7(0.0)	0.0(27.7)	0.7(0.0)	2.6(6.3)	1.7(2.7)	2.7(6.7)	3.3(10.3)	1.8(2.7)
Penoxsulam	0.7(0.0)	0.7(0.0)	12.0(147.3)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0.0)	5.2(27.0)	0.7(0.0)
Bispyribac + ethoxysulfuron	0.7(0.0)	0.7(0.0)	4.2(21.0)	0.7(0.0)	2.3(5.0)	0.7(0.0)	2.5(5.7)	0.7(0.0)	0.7(0.0)
Bispyribac + chlorimuron + metsulfuron (Almix)	0.7(0.0)	0.7(0.0)	5.3(33.0)	3.0(8.3)	1.1(0.7)	0.7(0.0)	0.7(0.0)	3.2(9.7)	0.7(0.0)
Pretilachlor *fb* ethoxysulfuron	0.7(0.0)	1.0(0.7)	3.3(11.0)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0.0)
Pretilachlor *fb* chlorimuron + metsulfuron (Almix)	2.3(4.7)	1.1(0.7)	4.1(17.3)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0.0)
Pyrazosulfuron *fb* chlorimuron + metsulfuron (Almix)	0.7(0.0)	3.2(9.7)	6.7(47.7)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0.0)
Penoxsulam + cyhalofop 6% OD (RM)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0.0)
Triafamone + ethoxysulfuron 30% WG (RM)	0.7(0.0)	0.7(0.0)	6.3(39.3)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0.0)
Pendimethalin (38.7% CS) *fb* bispyribac-sodium	0.7(0.0)	0.7(0.0)	4.6(24.0)	2.5(5.7)	0.7(0.0)	0.7(0.0)	0.7(0.0)	2.7(6.7)	0.7(0.0)
Hand weeding at 25 and 45 DAT	1.5(1.7)	2.5(5.7)	5.7(34.3)	2.5(6.0)	2.4(5.3)	1.5(1.7)	0.7(0.0)	3.6(12.3)	0.7(0.0)
Weedy check	2.8(7.7)	3.4(11.3)	15.3(230.0)	3.2(9.7)	3.8(14.3)	2.2(4.3)	3.1(9.3)	13.6(183.7)	3.0(8.7)
LSD (p=0.05)	0.21	0.41	1.30	0.27	0.29	0.26	0.21	0.32	0.15

Figures in the parentheses indicate the actual values; Transformed value = ($\sqrt{x+0.5}$); RM - Ready-mix

Table 2. Effect of treatments on weed density and dry matter of weed in transplanted rice under herbicides combinations at 60 DAT

Treatment	Weed density (no./m^2)				Dry matter of weed (g/m^2)			
	Grass	Broad-leaved	Sedge	Total	Grass	Broad leaved	Sedge	Total
Bispyribac-Na	0.7(0.0)	6.6(43.3)	3.7(13.0)	7.5(56.3)	0.7(0.0)	2.4(15.4)	1.3(3.5)	2.6(18.9)
Penoxsulam	0.7(0.0)	12.0(147.3)	5.2(27.0)	13.1(174.3)	0.7(0.0)	3.6(37.0)	1.7(7.1)	3.9(44.1)
Bispyribac + ethoxysulfuron	0.7(0.0)	5.7(31.7)	0.7(0.0)	5.7(31.7)	0.7(0.0)	1.9(9.4)	0.7(0.0)	1.9(9.4)
Bispyribac + chlorimuron+metsulfuron (Almix)	0.7(0.0)	6.5(42.0)	3.2(9.7)	7.2(51.7)	0.7(0.0)	2.1(11.7)	1.2(3.1)	2.3(14.8)
Pretilachlor *fb* ethoxysulfuron	1.0(0.7)	3.4(11.0)	0.7(0.0)	3.5(11.7)	0.8(0.5)	1.1(2.1)	0.7(0.0)	1.2(2.6)
Pretilachlor *fb* chlorimuron+metsulfuron (Almix)	2.4(5.3)	4.2(17.3)	0.7(0.0)	4.8(22.7)	1.33.6)	1.3(3.8)	0.7(0.0)	1.7(7.4)
Pyrazosulfuron *fb* chlorimuron+metsulfuron (Almix)	3.2(9.7)	6.9(47.7)	0.7(0.0)	7.6(57.3)	2.0(10.5)	2.1(11.5)	0.7(0.0)	2.8(22.0)
Penoxsulam+ cyhalofop 6% OD (RM)	0.7(0.0)	1.0(0.7)	0.7(0.0)	1.0(0.7)	0.7(0.0)	0.9(0.7)	0.7(0.0)	0.9(0.7)
Triafamone+ ethoxysulfuron 30% WG (RM)	0.7(0.0)	6.3(39.3)	0.7(0.0)	6.3(39.3)	0.7(0.0)	2.1(12.0)	0.7(0.0)	2.1(12.0)
Pendimethalin (38.7% CS)*fb* bispyribac-sodium	0.7(0.0)	5.5(29.7)	2.7(6.7)	6.1(36.3)	0.7(0.0)	1.8(7.8)	1.1(2.0)	1.9(9.8)
Hand weeding at 25 and 45 DAT	2.8(7.3)	6.9(47.3)	3.6(12.3)	8.2(67.0)	1.3(3.5)	2.1(11.7)	1.3(3.3)	2.6(18.5)
Weedy check	4.4(19.0)	16.4(267.7)	13.9(192.3)	21.9(479.0)	2.5(17.6)	5.8(98.4)	5.8(98.8)	8.5 (214.8)
LSD (p=0.05)	0.41	1.25	0.30	1.22	0.10	0.21	0.19	0.16

Figures in the parentheses indicate the actual values; Transformed value = ($\sqrt{x+0.5}$)

Table 3. Effect of treatments on yield attributes and grain yield of transplanted rice under herbicides combinations

Treatment	No. of effective tillers/m^2	No. grains / panicle	Test weight (g/1000 grain)	Grain yield (t/ha)
Bispyribac-Na	376.3	77.7	22.2	4.527
Penoxsulam	389.7	83.0	22.2	4.534
Bispyribac + ethoxysulfuron	399.7	88.0	22.3	4.762
Bispyribac + chlorimuron + metsulfuron (Almix)	392.3	85.3	22.2	4.722
Pretilachlor *fb* ethoxysulfuron	414.0	95.7	22.3	4.795
Pretilachlor *fb* chlorimuron + metsulfuron (Almix)	368.0	77.7	22.1	4.472
Pyrazosulfuron *fb* chlorimuron + metsulfuron (Almix)	374.3	75.3	22.1	4.465
Penoxsulam + cyhalofop 6% OD (RM)	426.0	103.3	22.3	4.867
Triafamone + ethoxysulfuron 30% WG (RM)	396.3	95.3	22.2	4.691
Pendimethalin (38.7% CS) *fb* bispyribac-sodium	361.3	92.3	22.1	4.625
Hand weeding at 25 and 45 DAT	403.3	95.3	22.2	4.782
Weedy check	315.3	67.7	21.6	3.133
LSD (p=0.05)	43.37	8.47	0.12	0.480

SUMMARY

The field trial was laid out in RBD with 12 treatments and replicated thrice in agricultural farm of Visva-Bharati during *Kharif*, 2014. The herbicidal treatments were bispyribac and penxsulam alone; tank of bispyribac with ethoxysulfuron and (chlorimuron + metsulfuron); pretilachlor *fb* ethoxysulfuron and (chlorimuron + metsulfuron) pyrazosulfuron *fb* (chlorimuron + metsulfuron) ready mix of penoxsulam + cyhalofop, ready mix of triafamone + ethoxysulfuron and pendimethalin *fb* bispyribac. Two hand weeding and weedy check also included with an idea to find out the best herbicides / herbicide mixtures for weed control in transplanted rice. Early post-emergence application of penoxsulam + cyhalofop as ready-mix was found most effective in controlling total weed population recorded the highest number of effective tillers/m^2, number of grains/panicle and grain yield of transplanted rice.

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