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Short communication

Bioefficacy of new herbicides in transplanted rice

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In India, rice is the staple food for millions of people and is next to wheat. It plays a pivotal role in the economy of India. Feeding the 9 billion people expected to inhabit our planet by 2050 will be an unprecedented challenge for the mankind. Modern sustainable rice cultivation worldwide involves extensive use of agrochemicals such as insecticides, fungicides and herbicides. The goal of herbicide use is to kill or stunt weed infestation allowing the rice to grow and gain a competitive advantage. Weeds are the most important biological constraint to increasing yield. It has been estimated that without weed control, the yield loss can be as high as 90% (Ferrero and Tinarelli 2007). Various methods like cultural, mechanical, biological and chemicals are used for weed control. The chemical weed control method is becoming popular among the farmers because it is the most efficient means of reducing weeds competition with minimum labor cost. The yield of rice in India is much lower than that of other countries. Therefore, proper weed management is essential for satisfactory rice production. The present study was undertaken to evaluate bioefficacy of new herbicides on yield and weed control efficiency in transplanted rice.

A field experiment was conducted during *Kharif* season of 2009 and 2010 at the Agriculture Research Station, Kota, Rajasthan. The soil was clayey in texture, slightly alkaline in reaction (pH 7.5), low in organic C (0.56%) and medium in available N (278 kg/ha) and available P (14.3 kg/ha) and high in available K (305 kg/ha). The experiment was laid out in randomized block design with 7 treatments comprising of butachlor 1.5 kg/ha at 5-7 days after transplanting (DAT), bispyribac-sodium 25 g/ha at 15-20 DAT, bispyribac-sodium 35 g/ha at 15-20 DAT, bispyribac-sodium 50 g/ha at 15-20 DAT, weed-free until harvest, two hand weedings at 20 and 40 DAT and unweeded control, replicated four times. Fertilizers were applied uniformly @ 120-60-40 kg/ha of N-P_2O_5-K_2O in the form of from urea, single superphosphate, muriate of potash, respectively. The whole amount of P and K was applied as basal dose while N was top-dressed in three equal installments at 20, 40 and 55 DAT. The variety '*Jaya*' was used as the test crop. Thirty-day old rice seedlings were transplanted at 20 x 10 cm spacing in the end of July. Data on weed infestation were collected from each unit plot at 30, 60, 90 DAT and at harvest. The weeds inside each quadrate were uprooted, cleaned and separated species-wise. After drying, weight and weed control efficiency was calculated.

Major weeds in the experimental plots were: *Echinochloa colonum, Echinochloa crusgalli* among grasses; *Cyperus rotundus, Cyperus difformis, Cyperus iria* among sedges; and *Eclipta alba* and *Ammenia baccifera* among broad-leaved weeds.

Results revealed that all the treatments gave significant control of weed population (Table 1). The highest weed control was achieved with manual hand weeding (64-82%). However, the hand weeding is laborious, tedious, expensive and time-consuming, hence it cannot be practicable on a large scale. Among the weedicides, bispyribac-sodium 50 g/ha at 15-20 DAT gave the highest weed control (58-75%). Bispyribac-sodium at 25 and 35 g/ha at 15-20 DAT reduced the weed density. The weed control efficiency with bispyribac-sodium 50 g/ha at 15-20 DAT ranged between 58 and 75% The weed control efficiency with butachlor 1.5 kg/ha at 5-7 DAT ranged between 28 and 47%, which was comparatively lower than other treatments. Lower weed persistence index were observed in all the weedicide treated plots. Among the herbicides, bispyribac-sodium gave lower weed persistence index (0.02). The highest herbicidal efficiency index (3.39-4.02) was found with bispyribac-sodium 50 g/ha, followed by bispyribac-sodium 35 g/ha (2.60-2.96). This was due to the fact that bispyribac-sodium inhibited the plant enzyme acetolactate synthase (ALS), which was involved in biosynthesis of the branched-chain amino acids. Without these amino acids, protein synthesis and growth are inhibited, ultimately causing plant death (WSSA 2007).

All herbicide treatments showed significantly higher number of panicles and panicle weight over the unweeded check due to less competition for moisture, light and nutrient uptake by the crop plants. Significantly higher number of panicle/m^2 and weight/panicle were observed in plots treated with bispyribac-sodium 35 g/ha at 15-20 DAT,

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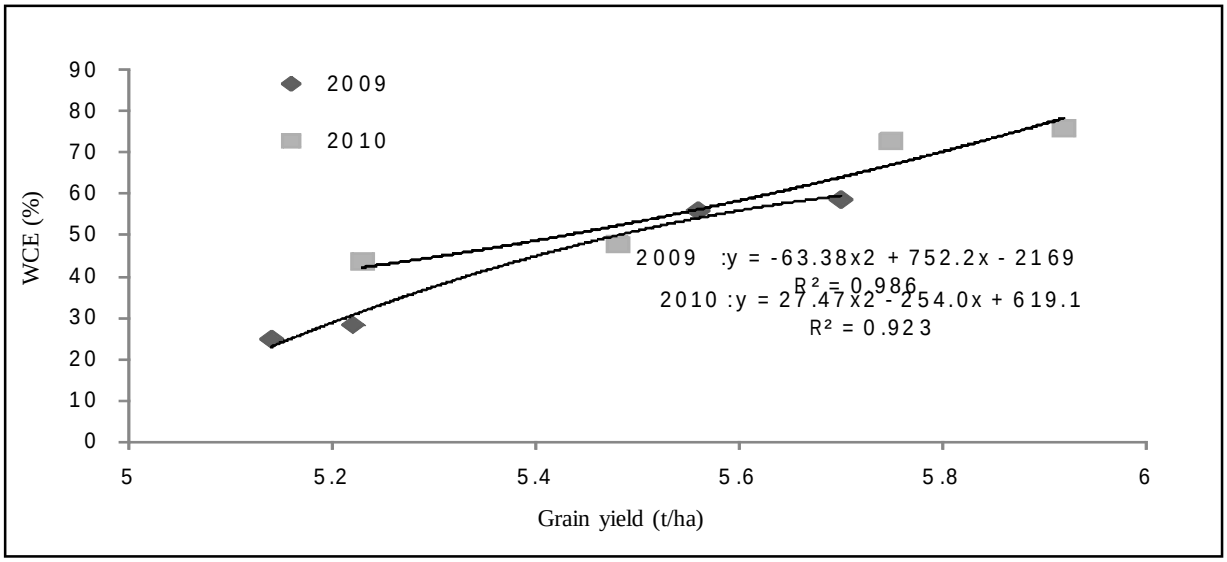

Fig. 1. Regression between gain yield and weed control effeciency

Table 1. Effect of bispyribac-sodium on weed growth in transplanted rice

Treatment	Weed density (no./m^2)		Dry weight of weeds (g/m^2)		Weed persistence index		Weed competition index (%)		Weed control efficiency (%)		Herbicidal efficiency index	
	2009	2010	2010	2010	2009	2010	2009	2010	2009	2010	2009	2010
Butachlor 1.5 kg/ha at 5-7 DAT	24	22	32.7	35.8	0.18	0.14	13.6	16.4	28.2	47.7	0.80	0.97
Bispyribac-sodium 25 g/ha at 15-20 DAT	27	25	35.2	39.2	0.22	0.18	15.0	20.2	24.8	43.8	0.70	0.74
Bispyribac-sodium 35 g/ha at 15-20 DAT	9	10	12.6	13.6	0.03	0.03	8.1	12.3	55.8	72.8	2.60	2.96
Bispyribac-sodium 50 g/ha at 15-20 DAT	7	8	10.4	11.0	0.02	0.02	5.7	11.5	58.7	75.7	3.39	4.02
Weed-free	-	-	-	-			-	-	-	-		
Two hand weedings (20 and 40 DAT)	4	4	6.3	4.8	0.01	0.00	2.2	4.8	64.3	82.8		
Unweeded control	59	62	73.0	88.2	1.00	1.00	36.5	4.0				
LSD (P=0.05)	2.13	2.10	2.13	3.14								

which was at par with next higher dose of bispyribac-sodium. These results are in close conformity with those of Kumar and Sharma (2005) and Singh *et al.* (2005)

All the weed control treatments significantly reduced the weed growth as compared to weedy check, and thus recorded higher grain yield of rice. The crop yield and weed control efficiency were positively correlated (Fig. 1). It was revealed that all the herbicides showed significant effects on grain yield. The highest rice yield was recorded from weed-free plot, followed by two hand weedings treatment. Among the herbicides, bispyribac-sodium 50 g/ha at 15-20 DAT resulted in the highest yield, which was at par with bispyribac-sodium 35 g/ha. These results are in close conformity with Hussain *et al.* (2008). The grain yield with butachlor 1.5 kg/ha at 5-7 DAT was also higher than untreated check.

It was concluded that application of bispyribac-sodium 35 g/ha at 15-20 DAT may be recommended in transplanted rice for controlling predominant weeds in the sub-humid south east plain zone of Rajasthan.

SUMMARY

An experiment was conducted in randomized block design with 7 treatments comprising butachlor 1.5 kg/ha at 5-7 DAT, bispyribac-sodium 25 g ha at 15-20 DAT, bispyribac-sodium 35 g/ha at 15-20 DAT, bispyribac-sodium 50 g/ha at 15-20 DAT, weed-free, until harvest, two hand weedings at 20 and 40 days after transplanting and unweeded control. Results revealed that application of bispyribac-sodium 50 g/ha at 15-20 DAT resulted in significantly higher grain yield (5.70 t/ha), which was at par with bispyribac-sodium 35 g/ha at 15-20 DAT. Number and dry weight of weeds was also minimum in these treatments.

Table 2. Yield performance of transplanted rice as influenced by different treatments

Treatment	No. of panicles /m^2		Panicle weight (g)		Grain yield (t/ha)		Straw yield (t/ha)		Harvest index (%)	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Butachlor 1.5 kg /ha at 5-7 DAT	323	320	3.56	3.40	5.22	5.48	7.45	7.47	41.2	42.3
Bispyribac-sodium 25 g/ha at 15-20 DAT	316	314	3.68	3.46	5.14	5.23	7.24	7.05	41.5	42.6
Bispyribac-sodium 35 g/ha at 15-20 DAT	345	347	3.95	3.90	5.56	5.75	7.68	7.87	42.0	42.2
Bispyribac-sodium 50 g/ha at 15-20 DAT	356	351	4.06	4.01	5.70	5.92	8.13	8.45	41.2	41.2
Weed-free	382	385	4.41	4.32	6.05	6.55	8.28	8.75	42.2	42.8
Two hand weedings (20 and 40 DAT)	371	374	4.30	4.25	5.91	6.23	8.30	8.75	41.6	41.6
Unweeded control	268	270	3.12	3.10	3.84	3.94	5.76	5.41	40.0	42.1
LSD (P=0.05)	15.0	13.5	0.18	0.21	0.20	0.23	3.60	3.90	2.3	2.3

However, the highest grain yield (6.05 and 6.55 t/ha) was obtained from weed-free treatment. Significantly lower weed density (9-10/m^2), weed dry weight (12.5-13.7 g/m^2), weed persistence index (0.03) and weed competition index (8.05-12.55) were recorded in the plots where bispyribac-sodium 35 g/ha at 15-20 DAT was applied. Significantly higher weed control efficiency and herbicidal efficiency index were recorded with bispyribac-sodium 35 g/ha at 15-20 DAT .

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