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WEED MANAGEMENT AND BIOFERTILIZER EFFECTS ON PRODUCTIVITY OF TRANSPLANTED RICE

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Abstract

Field experiment was conducted to evaluate the performance of weed management and biofertilizer on productivity of transplanted rice variety '*MTU-7029 (Swarnaf.* Experiment was laid out in factorial randomized block design with 24 treatments, comprising of twelve weed management practices and two nutrient management practices *viz.* No biofertilizer and biofertilizer *(Azotobacter* + PSB), replicated thrice. All the herbicidal treatment resulted in significant reduction in total weed dry weight and weed population than weedy check. The higher grain and straw yield was recorded in the plot where pendimethalin 0.75 kg/ha *fb* bispyribac-sodium 50 g/ha was applied. In case of grain yield, it was statistically at par with application of pendimethalin 0.75 kg/ha *fb* bispyribac-sodium 25 g/ha and weed free check during both the years. The highest net returns and benefit-cost ratio was realized under the application of pendimethalin 0.75 kg/ha*fb* bispyribac-sodium 25 g/ha and also in biofertilizer applied plot.

Keywords **:** Biofertilizer, Bispyribac-sodium, Yield, Pendimethalin, Rice, Weed management

Introduction

Rice is a principal source of food for more than half of the world population. It is a dominating staple food crop of India as well as West Bengal. The only way to meet the future food requirements of ever increasing population and maintain self sufficiency is to increase the productivity per unit area by improved production technology. One of the major production constraints in rice production is the poor management of weeds. Hence, successful weed control is essential for obtaining optimum yield of rice (Hussain *et al.,* 2008). Herbicides play a significant role in controlling the weeds and thereby increasing the production. Though many pre-emergence herbicides are available for controlling weeds, the need for post-emergence herbicide or sequential application of herbicides is often realized to combat the weeds emerged during later stages of crop growth. Nutrient management especially biofertilizer is important to maintain the soil fertility and plant nutrient supply to an optimum level for sustaining the desired crop productivity and provide food for ever increasing population. In this context, present experiment was carried out to study the performance of weed management and biofertilizer on productivity of transplanted rice.

Materials and Methods

Field experiment was conducted during wet season of 2018 and 2019 at Experimental farm, Annamalai University in Tamil Nadu to evaluate most effective weed control method and biofertilizer treatment for transplanted rice. The experiment was laid out in factorial randomized block design with 24 treatments in three replications, comprising of twelve weed management practices *viz.* pendimethalin 0.75 kg/ha at 3 DAT, pendimethalin 0.75 kg/ha at 3 DAT *fb* hand weeding at 50 DAT, bispyribac-sodium 25 g/ha at 30 DAT, pendimethalin 0.75 kg/ha at 3DAT *fb* bispyribac-sodium 25 g/ha at 30 DAT, bispyribac- sodium 50 g/ha at 30 DAT, pendimethalin 0.75 kg/ha at 3 DAT *fb* bispyribac-sodium 50 g/ha at 30 DAT, orthosulfamuron 50 g/ha at 12 DAT, pendimethalin 0.75 kg/ha at 3 DAT *fb* orthosulfamuron 50 g/ha at 12 DAT, orthosulfamuron 150 g/ha at 12 DAT, pendimethalin 0.75 kg/ha at 3 DAT *fb* orthosulfamuron 150 g/ha at 12 DAT, weed free check, weedy check and two nutrient management practices, *viz.* no biofertilizer and biofertilizer *(Azotobacter* + PSB). The recommended dose of fertilizers (N:P:K- 80:40:40) was used for the experiment. The seedlings of variety *'MTU-7029 (Swarnaf* were transplanted at 20 x 15 cm spacing. The experimental soil was sandy loam in texture, slight acidic in nature with 177.93 kg/ha available nitrogen, 30.67 kg/ha available phosphorus and 207.41 kg/ha available potassium, population of nitrogen fixing bacteria 66.45 x 10^4 cfu/g and phosphate solubilising bacteria 61.55 x 10^4 cfu/g. Herbicides were applied as foliar spray in the respective treatments as per schedule and for weed free check, hand weeding was done as and when required. Biofertilizer was applied by root dipping of seedlings. The data on weed population and dry weight of weeds were recorded at 45 and 60 DAT. The weed dry weight was expressed as g/m^2. The grain and straw yield of rice were recorded and economics was also worked out.

Results and Discussion

Weed dry weight

Among the herbicidal treatment, lowest dry weight of weed was recorded in pendimethalin 0.75 kg/ha *fb* bispyribac-sodium 50 g/ha during both the years at 45 DAT and 60 DAT. In 2012, at 45 DAT, it was statistically similar with pendimethalin 0.75 kg/ha *fb* bispyribac-sodium 25 g/ha, pendimethalin 0.75 kg/ ha *fb* orthosulfamuron g/ha and pendimethalin 0.75 kg/ha *fb* orthosulfamuron 50 g/ha. In 2013, at 45 DAT, the lowest value was statistically at par with pendimethalin 0.75 kg/ha *fb* bispyribac-sodium 25 g/ ha and pendimethalin 0.75 kg/ha *fb* orthosulfamuron 150 g/ha, which indicated that these herbicidal treatments are very much effective for weed control (Table 1).

Results also revealed that the sole application of herbicides were found least effective in minimizing the dry matter accumulation of weeds due to low weed control. The results confirm the findings of Maity and Mukherjee (2008). Pre-emergence application of pendimethalin controlled only grasses, few broad-leaved weeds but not sedges as reported by Yaduraju and Mishra (2004), whereas postemergence application of bispyribac-sodium effectively controlled all

three types of weeds. So, sequential application of these two herbicides was found to be the ideal combination for reducing weed dry weight. The results are in consonance with Brar and Bhullar (2012). In biofertilizer treatment, total weed dry matter at 45 and 60 DAT was not significantly affected by biofertilizer application which indicated that the use of biofertilizer did not influence the dry weight of total weed.

Weed population

Among the herbicidal weed management treatment, the lowest number of total weed/m^2 was recorded in pendimethalin 0.75 kg/ha *fb* bispyribac- sodium 50 g/ha during both the years at 45 and 60 DAT, but at 45 DAT, it was statistically at par with pendimethalin 0.75 kg/ha *fb* bispyribac-sodium 25 g/ ha and pendimethalin 0.75 kg/ha *fb* orthosulfamuron 150 g/ha (Table 1). This might be due to effective management of all categories of weeds by sequential application of pre- and post-emergence herbicide. So, these two combinations were found promising for controlling the weed population. Considering the total weed population at 60 DAT, in 2012, it was statistically at par with pendimethalin 0.75 kg/ha *fb* bispyribac-sodium 25 g/ha and pendimethalin 0.75 kg/ha *fb* hand weeding at 50 DAT. During 2013, it was statistically at par with pendimethalin 0.75 kg/ha *fb* bispyribac-sodium 25 g/ha. Effective management of weed by pre-emergence pendimethalin followed by post-emergence bispyribac-sodium was also reported by Narolia *et al.* (2014). In biofertilizer treatment, total weed density of 2013 at 45 and at 60 DAT during both years, were not significantly affected by biofertilizer application which indicated that the application of biofertilizer had neither positive nor negative outcome on the total weed population.

Grain yield

Grain yield varied significantly among the weed management practices. The lowest grain yield was registered in weedy check. However, the highest grain yield was recorded in the weed free check during both years. In 2012, it was statistically at par with all the doses of post-emergence application of bispyribac-sodium alone or in combination with preemergence application of pendimethalin, along with pendimethalin 0.75 kg/ha *fb* orthosulfamuron 50 g/ha and pendimethalin 0.75 kg/ha *fb* orthosulfamuron 150 g/ha. During 2013, it was statistically at par with pendimethalin 0.75 kg/ha *fb* bispyribac-sodium 25 g/ ha and pendimethalin 0.75 kg/ha *fb* bispyribac- sodium 50 g/ha. Chemical weed control by preemergence pendimethalin followed by post-emergence bispyribac-sodium application provides higher grain yield (Table 1). Timely and effective control of weeds with integrated use of pre and postemergence herbicides resulted in increased grain yield. The similar results was reported by Walia *et al.* (2011). In biofertilizer treatment, grain yield was significantly affected by biofertilizer application. Biofertilizer applied plot were significantly superior in grain yield than no biofertilizer applied plot. The increase in yield is due to the inoculations with biofertilizers which might not be solely due to nitrogen fixation or phosphate solubilization, but because of several other factors such as release of growth promoting substances, control of plant pathogens, proliferation of beneficial organisms in the rhizosphere. These findings was in accordance with Kundu and Gaur (1984).

Straw yield

It was recorded that the highest straw yield in the weed free check and it was statistically at par with all the herbicidal weed management practices during both years. Among the chemical weed management treatments, highest straw yield was recorded in the plot where application of pendimethalin 0.75 kg/ha *fb* bispyribac-sodium 50 g/ha was applied which was followed by pendimethalin 0.75 kg/ha *fb* bispyribac- sodium 25 g/ha. These were owing to reduced weed density, weed dry weight resulted in higher straw yield in that experimental plot. However, unweeded control recorded lesser straw yield which might be due to higher weed competition to the crop plants which resulted in lower straw yield in control plot and this was in conformity with the findings of Singh *et al.* (2013). In biofertilizer treatment, straw yield was significantly affected by biofertilizer application. Biofertilizer applied plot was significantly superior in straw yield than no biofertilizer applied plot. This was in close conformity with the findings of Wijebandara *et al.* (2009).

Table 1 : Effect of weed management and biofertilizer on weed dry weight and weed population of transplanted rice.

Treatment	Weed dry weight (g/m^2)				Weed population (no./m^2)			
	45 DAT		60 DAT		45 DAT		60 DAT	
	2012	2013	2012	2013	2012	2013	2012	2013
Weed management								
Pendimethalin 0.75 kg/ha at 3 DAT	4.05	4.27	5.06	5.12	5.65	5.70	5.06	5.13
	(15.9)	(17.7)	(25.1)	(25.7)	(31.5)	(32.0)	(25.2)	(25.8)
Pendimethalin 0.75 kg/ha at 3 DAT *fb* hand	4.01	4.32	3.69	3.90	5.71	5.76	3.10	3.48
weeding at 50 DAT	(15.6)	(18.2)	(13.1)	(14.7)	(32.2)	(32.8)	(9.2)	(11.7)
Bispyribac-sodium 25 g/ha at 30 DAT	3.68	3.65	4.01	4.11	4.59	4.63	3.99	4.22
	(13.1)	(12.9)	(15.5)	(16.4)	(20.7)	(21.0)	(15.5)	(17.3)
Pendimethalin 0.75 kg/ha at 3 DAT *fb*	2.99	3.12	3.58	3.73	3.35	3.36	3.10	3.24
bispyribac-sodium 25 g/ha at 30 DAT	(8.5)	(9.2)	(12.4)	(13.7)	(10.8)	(10.8)	(9.2)	(10.0)
Bispyribac-sodium 50 g/ha at 30 DAT	3.31	3.36	3.86	4.12	4.48	4.60	3.80	4.02
	(10.5)	(10.8)	(14.4)	(16.5)	(19.7)	(20.7)	(14.0)	(15.7)
Pendimethalin 0.75 kg/ha at 3 DAT *fb*	2.81	3.00	3.26	3.43	3.20	3.20	2.82	3.15
bispyribac-sodium 50 g/ha at 30 DAT	(7.4)	(8.5)	(10.5)	(11.3)	(9.8)	(9.8)	(7.5)	(9.5)
Orthosulfamuron 50 g/ha at 12 DAT	3.72	3.85	4.73	4.83	4.71	4.65	4.31	4.43
	(13.4)	(14.4)	(21.9)	(22.8)	(21.7)	(21.2)	(18.2)	(19.2)

Pendimethalin 0.75 kg/ha at 3 DAT *fb*	3.10	3.46	4.20	4.55	3.57	3.60	4.15	4.34
orthosulfamuron 50 g/ha at 12 DAT	(9.2)	(11.7)	(17.1)	(20.2)	(12.3)	(12.5)	(16.8)	(18.5)
Orthosulfamuron 150 g/ha at 12 DAT	3.57	3.77	4.43	4.69	4.56	4.62	4.11	4.37
	(12.4)	(13.9)	(19.1)	(21.5)	(20.3)	(20.8)	(16.5)	(18.7)
Pendimethalin 0.75 kg/ha at 3 DAT *fb*	2.87	3.02	3.86	4.29	3.31	3.28	4.00	4.20
orthosulfamuron g/ha at 12 DAT	(7.8)	(8.6)	(14.7)	(18.0)	(10.5)	(10.3)	(15.7)	(17.2)
Weed-free check	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Weedy check	11.19	11.72	13.89	14.29	8.68	8.98	8.23	8.29
	(124.6)	(136.8)	(192.4)	(203.8)	(75)	(80.3)	(67.3)	(68.2)
LSD (P=0.05)	0.32	0.31	0.38	0.27	0.34	0.35	0.36	0.32
Biofertilizer								
No biofertilizer	3.82	4.03	4.63	4.84	4.47	4.48	4.02	4.16
	(19.9)	(21.9)	(29.7)	(32.1)	(23.0)	(23.4)	(18.5)	(19.6)
Biofertilizer *(Azotobacter* + PSB)	3.84	4.01	4.58	4.78	4.28	4.37	3.88	4.10
	(19.9)	(21.9)	(29.7)	(32.0)	(21.1)	(22.0)	(17.3)	(19.0)
LSD (P=0.05)	NS	NS	NS	NS	0.14	NS	NS	NS

Figures in parentheses are the original values. The data were transformed to $\sqrt{x+0.5}$ before analysis. *fb*- followed by, DAT- Days after transplanting

Economics

Application of pendimethalin 0.75 kg/ha *fb* bispyribac-sodium 25 g/ha fetched the highest net return during 2012. It was statistically at par with all the herbicidal weed management practices along with weedy free check. In 2013, highest net return was obtained in the weed free check and it was statistically similar with that all the doses of post-emergence application of bispyribac-sodium alone or in combination with pre-emergence application of pendimethalin along with pendimethalin 0.75 kg/ha *fb* hand weeding at 50 DAT, pendimethalin 0.75 kg/ha *fb* orthosulfamuron 50 g/ha, orthosulfamuron 150 g/ha and pendimethalin 0.75 kg/ha *fb* orthosulfamuron 150 g/ha at 12 DAT. The lowest net returns obtained in weedy check were due to high infestation of weed resulting in lower yield. Benefit-cost ratio expressed that the highest economic benefit was realized under the application of pendimethalin 0.75 kg/ha *fb* bispyrilbac- sodium 25g/ha. During 2012, it was statistically at par with all the herbicidal weed management practices.

Table 2 : Effect of weed management and biofertilizer on yield and economics of transplanted rice

Treatment	Grain yield (t/ha)		Straw yield (t/ha)		Net returns (x10^3 ' /ha)		B: C ratio	
	2012	2013	2012	2013	2012	2013	2012	2013
Weed management								
Pendimethalin 0.75 kg/ha	5.98	5.84	7.25	6.97	55.88	53.60	1.59	1.53
Pendimethalin 0.75 kg/ha *fb* hand weeding	6.07	6.19	7.33	7.04	55.22	56.56	1.49	1.52
Bispyribac-sodium 25 g/ha	6.18	6.11	7.28	6.92	57.39	56.06	1.58	1.54
Pendimethalin 0.75 kg/ha *fb* bispyribac-sodium 25 g/ha	6.69	6.72	7.72	7.52	63.73	63.90	1.69	1.70
Bispyribac-sodium 50 g/ha	6.22	6.24	7.48	6.99	55.85	55.69	1.44	1.44
Pendimethalin 0.75 kg/ha *fb* bispyribac-sodium 50 g/ha	6.72	6.79	7.81	7.59	60.75	61.28	1.47	1.53
Orthosulfamuron 50 g/ha	6.05	5.82	7.14	6.92	57.54	54.14	1.68	1.58
Pendimethalin 0.75 kg/ha *fb* orthosulfamuron 50 g/ha	6.17	6.12	7.54	7.27	58.26	57.50	1.64	1.62
Orthosulfamuron 150 g/ha	6.06	5.93	7.39	7.00	57.25	55.00	1.64	1.57
Pendimethalin 0.75 kg/ha *fb* orthosulfamuron g/ha	6.21	6.27	7.61	7.33	58.31	58.87	1.61	1.62
Weed free check	6.73	7.05	7.84	7.68	59.67	64.56	1.43	1.55
Weedy check	3.03	3.09	4.03	4.04	12.70	13.53	0.38	0.40
LSD (P=0.05) *Biofertilizer*	0.61	0.66	0.86	0.80	9.21	9.57	0.25	0.26
No biofertilizer	5.85	5.77	7.00	6.64	51.93	50.72	1.40	1.37
Biofertilizer *(Azotobacter* + PSB)	6.17	6.26	7.40	7.24	56.83	57.72	1.53	1.56
LSD (P=0.05)	0.25	0.27	0.35	0.33	3.76	3.91	0.10	0.11

fb= followed by, DAT= Days after transplanting

In 2013, it was statistically at par with all the herbicidal weed management practices along with weed free check. Among the chemical weed management treatments, though preemergence application of pendimethalin 0.75 kg/ha *fb* post-emergence application of bispyribac-sodium at 50 g/ha recorded slightly higher grain and straw yield, economically it was inferior than the application of pendimethalin 0.75 kg/ha *fb* post-emergence application of bispyribac-sodium at 25 g/ha. Similar result was also reported by Veeraputhiran and Balasubramanian (2013). Biofertilizer applied plot was significantly superior in net returns (?/ha) and benefit-cost ratio than no biofertilizer applied plot. This might be attributed to better growth of plant under the condition adequate availability of nutrient, there by resulted in better grain and straw yield and caused higher net return and benefit-cost ratio.

It was concluded that application of herbicides and biofertilizer performed best than herbicide alone. Therefore, the application of pendimethalin 0.75 kg/ ha at 3 DAT *fb*

bispyribac-sodium 25 g/ha at 30 DAT along with biofertilizer like *Azotobacter* and PSB can be recommended to the farmers.

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