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Economic Analysis of Weed Management Practices for Transplanted Rice in Coastal Ecosystem of Puducherry UT

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A field experiment was conducted during *rabi* season of 2011-12 at Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, Puducherry U.T. The experiment consisted of nine treatments laid out in randomized complete block design comprising of three pre- emergence herbicides alone or integrated with a hand weeding at 40 days after transplanting (DAT) and hand weeding twice. Maintaining weed free condition throughout the crop duration resulted in higher weed control efficiency by virtue of significantly lower weed density and dry weight. Economic analysis revealed that pre-emergence application of pyrazosulfuron ethyl (20 g ha^{-1}) integrated with a hand weeding at 40 DAT was better in terms of net returns and B: C ratio than the weed free and hand weeding twice. Unweeded control accounted for 44.2% yield loss in coastal ecosystem of Karaikal,Puducherry UT.

Key words: Transplanted rice, Pre- emergence herbicides, Integrated weed management, Coastal ecosystem

Rice occupies an area of 45.5 million hectares with the production of 99.2 million tonnes in India. Weed competition is one of the major factors in limiting biotic constraints resulting into yield reduction upto 76% in transplanted rice (Singh *et al*., 2004). Now-a-days, the use of herbicides is gaining popularity in rice fields due to their rapid effects and the lower costs compared to traditional methods (Karim, 2008). But, continuous use of herbicides alone at higher dose may lead to the problems of residual toxicity, besides causing a shift in weed flora. Dependence on manual weed control alone is time consuming and costly. Hence, integrated weed management practices offer most practical and cost effective means of reducing weed competition in transplanted rice. Also, only minimum number of studies is available about the economic analysis of different weed management strategies in transplanted rice. Hence, a field investigation was undertaken to study the economic analysis of different pre-emergence herbicides alone or in combination of a hand weeding for transplanted rice in deltaic coastal ecosystem of Karaikal, Puducherry UT.

Materials and Methods

A field experiment was conducted at Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, Puducherry U.T during *rabi* (September 2011- January 2012) to study the economic analysis of pre-emergence herbicides alone or in integration with hand weeding on the diverse weed spectrum in transplanted rice. The soil of the experimental field was clay loam with the pH of 8.08,. The soil was low in available nitrogen (110 kg ha^{-1}), high in available phosphorus (42 kg ha^{-1}) and potassium (289 kg ha^{-1}). The experiment was laid out in a randomized block design with nine treatments. The treatments were butachlor 1.25 kg ai ha^{-1}(T_1), anilophos 0.40 kg ai ha^{-1}(T_2), pyrazosulfuron ethyl 20 g ai ha^{-1}(T_3), butachlor 1.25 kg ai ha^{-1} + hand weeding on 40 days after transplanting (DAT) (T_4), anilophos 0.40 kg ai ha^{-1} + hand weeding on 40 DAT(T_5), pyrazosulfuron ethyl 20 g ai ha^{-1} +hand weeding on 40 DAT(T_6), hand weeding twice at 20 and 40 DAT (T_7), weed free condition throughout the crop period (T_8) and unweeded control (T_9). Pre- emergence herbicides were sprayed by knapsack sprayer fitted with flat fan T-jet nozzle using a spray volume of 500 litres ha^{-1}. Unweeded plots remained infested with native population of weeds till harvest. Observations on weeds were recorded using quadrate method at 60 DAT. The data on weed density and dry weight were then analyzed by using square root transformation (“x+0.5) to normalize their distribution. The rice cultivar ADT 45 was transplanted with the spacing of 20 cm x 10 cm and all the recommended package of practices (CPG, 2005) except weed control was adopted during the period of experimentation.

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Results and Discussion

Effect on weeds

The experimental field was infested with grassy weeds *viz*., *Echinochloa crusgalli* (L), *Leptochloa chinensis* (L.) and *Digitaria sanguinalis* (L.) Scop., broad leaved weeds *viz*., *Bergia capensis* (L.) and *Eclipta alba* (L.) and *Cyperus iria* (L.) was the lone sedge. In general, application of herbicides alone resulted in lower weed control efficiency (WCE) ranging from 56.2 to 68.7%. However, pre-emergence application of pyrazosulfuron ethyl 20 g

Table 1. Weed growth, crop yield and economics as influenced by weed management practices in transplanted rice.

Treatment	Pr ductive tillers	Leaf number	Weed density (No./m^2)	Weed dry weight (g/m^2)	WCE (%)	Grain yield (kg/ha)	WI (%)	Net returns (Rs./ha)	B:C ratio
T_1 Butachlor 1.25 kg ai ha^{-1}	11.2	54.4	5.97 (32.0)	6.92 (47.6)	56.2	3915	27.1	33,820	2.36
T_2 Anilophos 0.40 kg ai ha^{-1}	11.8	56.7	5.07 (21.3)	6.22 (38.5)	64.6	4052	24.5	35,850	2.44
T_3 Pyrazosulfuron ethyl 20 g ai ha^{-1}	12.3	58.3	4.49 (16.0)	5.84 (34.0)	68.7	4356.	18.9	40,470	2.63
T_4 T_1 + Hand weeding at 40 DAT	12.1	61.7	3.44 (14.0)	5.30 (29.8)	72.6	4627	13.8	42,100	2.54
T_5 T_2 + Hand weeding at 40 DAT	13.1	60.9	2.50 (6.7)	4.72 (23.0)	78.8	5025	6.4	48,040	2.76
T_6 T_3 + Hand weeding at 40DAT	13.2	62.2	2.69 (6.0)	4.55 (21.1)	80.6	5156	4.0	50,060	2.84
T_7 Hand weeding twice (20 & 40 DAT)	12.2	59.2	4.84 (19.3)	5.73 (32.6)	70.0	4550	15.3	39,450	2.37
T_8 Weed free	13.3	62.3	1.79 (2.7)	1.85 (3.6)	96.7	5370	-	44,560	2.24
T_9 Unweeded control	8.4	43.8	8.44 (64.7)	10.37 (108.7)	-	2994	44.2	20,910	1.87
SEd	1.15	4.94	1.23	0.96		365.88			
CD (P=0.05)	2.43	10.48	2.60	2.04	NA	775.64	NA	NA	NA

Figures in parenthesis are original values and were subjected to square root transformation. NA- Data statistically not analyzed.

ha^{-1} integrated with one hand weeding at 40 DAT significantly reduced the weed density (6.0 no/m^2), dry weight (21.1 g/m^2) and resulted in higher WCE of 80.6% at 60 DAT (Table 1). Pal *et al*. (2012) earlier observed that pyrazosulsulfuron-ethyl application at 20 g ha^{-1} significantly reduced the weed density and total weed biomass of *Cyperus iria* and *Echinochloa* sp, since it possess both foliar and soil activity (Rajkhowa *et al*., 2006) and exhibit biological mode of action through inhibiting acetolactate synthase, a key enzyme that participates in the protein synthesis of plants (Zhing *et al*., 2008). It was also noticed that anilophos application had resulted in better control of grassy weeds in transplanted rice (Kumar *et al*., 2012). Employing hand weeding at 20 and 40 DAT of crop growth had resulted in WCE of 70%.

Effect on crop growth

Weeds compete with crops for the available resources like light, water, nutrients, which are necessary for better plant growth to produce higher grain yield. Application of either pyrazosulfuron ethyl 20 g ha^{-1} or anilophos 0.40 kg ai ha^{-1} followed by one hand weeding at 40 DAT resulted in 4 and 6.4% yield reduction, respectively. Farmer's practice of hand weeding twice (20 & 40 DAT) resulted in yield loss of 15.3% and employing chemical weed control devoid of integration with hand weeding resulted in yield loss to the tune of 18.9 to 27.1%.

Economic analysis

Economic analysis of the experimental results clearly indicated that use of only herbicides or manual weed control for weed management in transplanted rice resulted in reduced net returns and B: C ratio (Table 1). However, integrated application of pyrazosulfuron ethyl 20 g ha^{-1} followed by a hand weeding at 40 DAT (T_6) had resulted in higher net returns and B: C ratio of Rs.50,060 ha^{-1} and 2.84, respectively. It was followed by the application of anilophos 0.40 kg ai ha^{-1} integrated with a hand weeding (T_5). Unweeded control resulted in the lowest net return (Rs. 20,910 ha^{-1}) and B: C ratio (1.87) due to lesser rice grain yield.

Conclusion

It is concluded that integrated management of weeds by pre emergence application of pyrazosulfuron ethyl 20 g ha^{-1} followed by one hand weeding at 40 DAT resulted in higher weed control efficiency, better plant growth and rice yield with high net returns and B: C ratio in coastal ecosystem of Puducherry UT.

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