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RESEARCH ARTICLE :

Effect of herbicide combinations for management of broad spectrum weed flora in drum seeded rice

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SUMMARY : Rice (*Oryza sativa* L.) is the staple food crop for more than 60% of the world's population. Direct seeded rice is gaining momentum due to high demand of labour during peak season of transplanting and short period of water availability. However, the productivity of rice in India is declining due to an array of biotic and abiotic factors. Weed competition is one of the prime yield-limiting biotic constraints in rice. Weed infestation and competition are severe in puddled direct seeded rice as compare to transplanted rice, because of the simultaneous growth of both crops and weeds. Results of this study indicated that integration of azimsulfuron (35g/ha) with pre emergence application of oxadiargyl 80 g/ha proved better in terms of reducing weed density, dry weight of weeds and increased plant characters, *viz.*, dry matter production, productive tillers and higher grain yield (24%) than hand weeding twice. Among weed management practices the pre emergence application of oxadiargyl 80 g/ha *fb* azimsulfuron 35 g/ha on 30 DAS was very effective to realize higher weed control efficiency (88.04%), increased productivity and economics (BC ratio 2.80) and it was comparable with oxadiargyl 80 g/ha *fb* HW on 40 DAS and pretilachlor (S) 450 g/ha *fb* azimsulfuron 35 g/ha on 30 DAS which recorded BC ratio of 2.56 and 2.54, respectively.

KEY WORDS : Herbicide combinations, Management of broad, Spectrum weed flora, Drum seeded rice

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BACKGROUND AND OBJECTIVES

In the 21st century, along with population pressure, rising scarcity of agricultural land and water and continuing shortage of labour will maintain pressure for a shift towards direct seeding method in rice production system (Mortimer *et al*., 2005).Traditionally direct seeding of rice in India has been largely practiced in low productivity systems common to rainfed areas.Transplanting can be replaced by direct seeding under puddle condition where water and labour scarcity exists (Parameswari *et al*., 2014).

Direct seeded rice is gaining momentum due to high demand of labour during peak season of transplanting and short period of water availability. Any delay in weeding will lead to increased weed biomass which has a negative correlation with yieldvaries from 40 to 100 per cent in direct seeded rice (Choubey *et al*., 2001). Direct seeding of rice will only be successful provided good crop establishment as well as adequate weed

control methods are available to keep crop free from weeds (Rao *et al*., 2007). The chemical weed control in direct seeded rice has gained importance because of the intensity of weed problems, coupled with the lack of labour for weeding and high cost.

Timely weed control is crucial to increase rice productivity. Many of the rice herbicides presently used are mainly pre emergence and weeds coming at later stages of crop growth are not effectively controlled. Sometimes continuous use of a single herbicide may lead to build up of herbicide resistance in weeds (Kalaiselvi *et al*., 2009). In such situations, post-emergence herbicides are needed for use in combination with pre-emergence herbicides to control the late emerging weeds in direct seeded rice. Therefore, to manage the weeds in rice in a better way this study was conducted to evaluate the effect of herbicide combinations for control of complex weed flora in drum seeded rice.

RESOURCES AND METHODS

Field experiments were conducted during *Rabi* 2014-15 at Tamil Nadu Agricultural University, Coimbatore (11° N latitude with 77° E longitude, 426.7 m mean sea level) to find out appropriate combination of herbicides in drum seeded rice. The experiment field was clay loam in texture with 36.7 per cent clay, 20.4 per cent silt and 41.7 per cent and. It was low in available nitrogen (238 kg/ha), medium in available P (17 kg/ha) and high in K (727 kg/ha). The pH of the soil was 8.8 with organic carbon and available soil moisture content of 0.24 and 27.83 per cent, respectively. The treatments are pre-emergence application of either pretilachlor (S) 450 g/ha on 5 DAS or pyrazosulfuron ethyl 20 g/ha on 10 DAS or oxadiargyl 80 g/ha on 10 DAS *fb* HW on 40 DAS or POE azimsulfuron 35 g/ha on 30 DAS, either PE bensulfuron methyl + pretilachlor (RM) 660 g/ha on 5 DAS or POE bispyribac sodium 25 g/ha 20 DAS *fb* HW on 40 DAS, POE azimsulfuron 35 g/ha on 30 DAS, either mechanical or hand weeding on 20 and 40 DAS and unweeded check.

Observations on weed flora, weed density and weed dry weight were recorded with a quadrate (0.25 x 0.25 m^2) placed randomly in each plot at 60 DAS and data presented as per m^2. The data on weed density and weed dry weight were subjected to square root transformation ($\sqrt{x+0.5}$). Weed control efficiency (WCE) was computed by using weed dry weight. The grain yield and benefit cost ratio were calculated. The data were analyzed using ANOVA and the least significant difference (LSD) values at 5 per cent level of significance were calculated.

OBSERVATIONS AND ANALYSIS

Weed flora of the experimental field consisted of four species of grass weeds, two species of sedge weeds

Table 1: Effect of weed management on total weed density (No./m^2), total weed dry weight(g/m^2) and weed control efficiency (%) at 60 DAS in drum seeded rice

Treatments		Weed density (No./m^2)	Weed dry weight (g/m^2)	WCE (%)
T_1	PE pretilachlor (S) 450 g/ha *fb*HW on 40 DAS	8.13 (65.54)	4.53 (20.07)	84.75
T_2	PE pretilachlor (S) 450 g/ha *fb*POE azimsulfuron 35 g/ha on 30 DAS	6.35 (39.88)	4.17 (16.85)	87.19
T_3	PE pyrazosulfuron ethyl 20 g/ha *fb*HW on 40 DAS	9.16 (83.47)	5.38 (28.43)	78.39
T_4	PE pyrazosulfuron ethyl 20 g/ha *fb*POE azimsulfuron 35 g/ha on 30 DAS	7.89 (61.73)	5.62 (31.09)	76.37
T_5	PE oxadiargyl 80 g/ha *fb*HW on 40 DAS	7.32 (53.06)	4.18 (16.94)	87.12
T_6	PE oxadiargyl 80 g/ha *fb*POE *a*zimsulfuron 35 g/ha on 30 DAS	5.69 (31.91)	4.05 (15.87)	88.04
T_7	PE bensulfuron methyl + pretilachlor (RM) 660 g/ha *fb* HW on 40 DAS	8.47 (71.21)	4.76 (22.15)	83.16
T_8	POE bispyribac sodium 25 g/ha *fb*HW on 40 DAS	6.78 (45.50)	4.54 (20.14)	84.69
T_9	POE azimsulfuron 35 g/ha on 30 DAS	10.08 (101.12)	6.84 (46.23)	64.86
T_{10}	Mechanical weeding on 20 & 40 DAS	10.97 (71.94)	5.84 (33.57)	74.48
T_{11}	Hand weeding on 20 & 40 DAS	6.20 (37.98)	4.29 (17.91)	86.39
T_{12}	Un-weeded check	17.58 (308.65)	11.49 (131.56)	-
	S.E.±	0.41	0.27	-
	C.D. (P = 0.05)	0.86	0.56	-

and four species of broad leaved weeds. *Echinochloa crus-galli, Echinochloa colona*, *Leptochloa chinensis, Paspalum distichum* under grasses, *Cyperus difformis* undersedge and *Ammania baccifera*, *Ecliptaalba, Ludwigia parviflora* and *Monochoria vaginalis* under BLW were observed.

Distinct reduction of total weed density by PE oxadiargyl 80 g/ha *fb* POE azimsulfuron 35 g/ha and PE pretilachlor (S) 450 g/ha *fb* POE azimsulfuron 35 g/ha might be due to the control of weeds at the germination phase by the pre-emergence application of herbicide and significant reduction at later stages as late germinating weeds were controlled by post emergence herbicide application of azimsulfuron 35 g/ha (Table 1). Oxadiargyl effectively control the recently emerged shoots by inhibiting the enzyme protoporphyrinogen oxidase (Dickmann *et al*., 1997).

Pretilachlor inhibits the α-amylase enzymes which causes energy shortage during the weed germination, cell division and ultimately retard the growth of weeds (Wang *et al*., 2004). Azimsulfuron inhibits the ALS, biosynthesis of branched chain amino acids. This results in the inhibition of cell division and growth of weeds (Kenji, 2001). Obviously unweeded control resulted in higher grasses, sedges and broad leaved weeds density due to unchecked and increased weed growth (Arunvenkatesh, 2009) and it was comparable with POE azimsulfuron 35 g/ha on 30 DAS.

Weed dry weight is the most important parameter to assess the weed competitiveness for the crop growth and productivity. Sparse weeds with high biomass might be more competitive for crops than dense weeds with lesser dry weight. Considerable reduction in weed dry weight recorded with PE either oxadiargyl 80 g/ha or pretilachlor (S) 450 g/ha *fb* POE azimsulfuron 35 g/ha at all the stages of observation might be attributed to the minimum number of total weedswith lesser biomass in the cropping period. Weed dry weight reduced due to the efficient weed control and lesser weed density compared to other treatments.

Weed control efficiency (WCE) indicates the magnitude of effective reduction of weed dry weight by weed control treatments over unweeded check. This was highly influenced by different weed control treatments. Higher WCE registered in PE either oxadiargyl 80 g/ha or pretilachlor (S) 450 g/ha *fb* POE azimsulfuron 35 g/ha at 40 and 60 DAS and PE oxadiargyl 80 g/ha *fb* either POE azimsulfuron 35 g/ha or HW at 20 DAS might be due to considerable reduction in weed density and weed dry weight.

Significantly higher grain yield (6286 kg/ha) was recorded with the PE oxadiargy l80 g/ha *fb* POE azimsulfuron 35 g/ha (Deepthi Kiran and Subramanyam, 2010 and Walia *et al*., 2012) which was on par with PE pretilachlor (S) 450 g/ha *fb* POE azimsulfuron 35 g/ha (Mandhata Singh and Singh, 2010 and Pramod *et al*., 2013) (Table 2). This was attributed to efficiency and broad spectrum weed control achieved with the above herbicides. The favourable conditions created through the efficient weed management resulted in lesser weed

Table 2 : Effect of weed management on grain yield (kg/ha) and benefit cost ratio in drum seeded rice

Treatments		Grain yield (kg/ha)	B:C
T_1	PE pretilachlor (S) 450 g/ha *fb*HW on 40 DAS	5339	2.28
T_2	PE pretilachlor (S) 450 g/ha *fb*POE azimsulfuron 35 g/ha on 30 DAS	6043	2.54
T_3	PE pyrazosulfuron ethyl 20 g/ha *fb*HW on 40 DAS	4789	2.13
T_4	PE pyrazosulfuron ethyl 20 g/ha *fb*POE azimsulfuron 35 g/ha on 30 DAS	4139	1.88
T_5	PE oxadiargyl 80 g/ha *fb*HW on 40 DAS	5875	2.56
T_6	PE oxadiargyl 80 g/ha *fb*POE *a*zimsulfuron 35 g/ha on 30 DAS	6286	2.80
T_7	PE bensulfuron methyl + pretilachlor (RM) 660 g/ha *fb* HW on 40 DAS	4872	2.07
T_8	POE bispyribac sodium 25 g/ha *fb*HW on 40 DAS	5072	2.35
T_9	POE azimsulfuron 35 g/ha on 30 DAS	3397	1.59
T_{10}	Mechanical weeding on 20 and 40 DAS	3955	1.96
T_{11}	Hand weeding on 20 and 40 DAS	5542	2.38
T_{12}	Un-weeded check	2765	1.49
	S.E.±	423	-
	C.D. (P = 0.05)	877	-

competition between crop and weeds during the critical period of crop growth. This favoured the crop to produce more leaf area and plant dry matter production.

The BC ratio was higher in PE oxadiargyl 80 g/ha *fb* POE azimsulfuron 35 g/ha (2.80) and was followed by PE oxadiargyl 80 g/ha *fb* HW (T_5) and PE pretilachlor (S) 450 g/ha *fb* POE azimsulfuron 35 g/ha (T_2). POE azimsulfuron 35 g/ha (T_9) recorded lower BC ratio of 1.59 barring unweeded check (T_{12}).

Conclusion :

Pre-emergence application of either oxadiargyl 80 g/ha on 10 DAS or pretilachlor (S) 450 g/ha on 5 DAS followed by post-emergence application of azimsulfuron 35 g/ha on 30 DAS was very effective for the control of wide spectrum of weed flora, increased productivity and profitability in drum seeded rice.

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