



Bio-efficacy of herbicide combinations for control of weeds in transplanted rice (*Oryza sativa*)

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ABSTRACT

The present study during *kharif* 2013-14 at Professor Jayashankar State Agricultural University, Hyderabad, Telangana to study the efficiency of herbicide combinations for controlling weeds in rice. The study comprised 14 treatments in Randomized block design replicated thrice. During both years of investigation the higher weed control efficiency and herbicide efficiency index was noticed with hand weeding twice at 25 and 45 DAT, pyrazosulfuron ethyl 20 g/ha as PE at 3 DAT followed by manual weeding at 25 DAT and pretilachlor 750 g/ha as PE at 3 DAT followed by metsulfuron methyl + chlorimuron ethyl 4 g/ha as PoE at 25 DAT. Significantly higher grain yield and gross returns were noticed with hand weeding twice at 25 and 45 DAT and was comparable with pyrazosulfuron ethyl 20 g/ha as PE at 3 DAT followed by manual weeding at 25 DAT, pretilachlor 750 g/ha as PE at 3 DAT followed by metsulfuron methyl + chlorimuron ethyl 4 g/ha as PoE at 25 DAT and bispyribac sodium 20 g/ha + metsulfuron methyl + chlorimuron ethyl 4 g/ha as PoE at 25 DAT. However, pyrazosulfuron ethyl 20 g/ha as pre emergence at 3 DAT followed by manual weeding at 25 DAT noticed higher net returns and B:C ratio.

Key words: Bioefficacy, Herbicide combinations, Transplanting, Weeds

Weed competition is one of the major yield limiting factors among biotic constraints in rice. The reduction in paddy yield due to weed competition ranges from 9-51%. Advent of capital intensive technology like dwarf high yielding varieties tailored to respond to external inputs like fertilizers, irrigation and new intensive cropping systems also aggregate the problem of weeds (Yaduraj and Mishra 2002). Despite the maintenance of standing water in transplanted rice throughout the rice-growing season, the annual weeds subsequently infest the succeeding crops in higher intensity (Hassan *et al.* 2003). Herbicide technology offers an alternative method of selective and economical control of weeds right from the beginning, giving crop an advantage of good start and competitive superiority. Herbicides not only save time and money but also allow coverage of more area in short period of time (Nyarko and Datta 1991). The development of herbicides for weed control was a fascinating success story during the last decade, generally most herbicides are effective for selective weed control and a single herbicide cannot control all weeds of the community (Corbalt *et al.* 2004). Combination products consisting of two or more herbicides have greater activity on diverse weed flora due to differential mode of action and have become popular in recent years. The present study was therefore,

conducted to study the efficacy of herbicide combinations for control of complex weed flora in transplanted rice, and compare economics in different weed management.

MATERIALS AND METHODS

The present study was carried out during *kharif* 2013-14 at college farm of Professor Jayashankar State Agricultural university, Hyderabad, Telangana situated at an altitude of 542.3 m amsl at 17°19' N latitude and 78°23' E longitude. Mean weekly maximum temperatures ranged from 25.3-34.0°C, while mean weekly minimum temperatures varied from 11.4-25.0°C. During the cropping period rainfall of 601.1 mm was received in 36 rainy days 2013. MTU-1010 (Cotton Dora Sannalu) is short duration rice variety that matures in 120-125 days. Fourteen treatments consisting of T₁-pretilachlor @ 625 g a.i/ha as PE at 3 DAT, T₂ - pyrazosulfuron ethyl @ 20 g a.i/ha 3 DAT, T₃ -pretilachlor 6% + bensulfuron methyl 0.6% @ 10 kg granules/ha as PE at 3 DAT, T₄ -pyrazosulfuron ethyl @ 20 g a.i/ha at 3 DAT followed by manual weeding at 25 DAT, T₅ -penoxsulam @ 22.5 g a.i/ha as PoE at 12 DAT, T₆ -cyhalofop-p-butyl @ 100 g a.i/ha as PoE 12 DAT, T₇ - bispyribac sodium @ 25 g a.i/ha as PoE 25 DAT, T₈ -azimsulfuron @ 35 g a.i/ha as PoE at 25 DAT, T₉ - bispyribac sodium @ 25 g a.i/ha + ethoxysulfuron 18.75 g a.i/ha as PoE at 25 DAT, T₁₀ -bispyribac sodium @ 20 g a.i/ha + metsulfuron methyl + chlorimuron ethyl @ 4 g a.i/ha as PoE at 25 DAT, T₁₁-pretilachlor @ 750 g a.i/ha as PE at 3 DAT followed

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by ethoxysulfuron @ 18.75 g a.i/ha as PoE at 25 DAT, T₁₂ - pretilachlor @ 750 g a.i/ha as PE at 3 DAT followed by metsulfuron methyl + chlorimuron ethyl @ 4 g a.i/ha as PoE at 25 DAT, T₁₃ - hand weeding twice at 25 and 45 DAT and T₁₄ - weedy check were replicated thrice in randomized block design. Weed density (No./m²), Weed control efficiency (WCE %) and Weed control index (WCI %) were determined as per formulae given by Mishra and Tosh (1979).

RESULTS AND DISCUSSION

Effect on weed density: The dominant weeds in rice were *Echinochloa crusgalli* (L.), *Echinochloa colona* (L.), *Paspalum distichum* among grasses, *Cyperus difformis* (L.), *Cyperus rotundus* and *Fimbristylis dichotoma* (L.) among sedges and *Eclipta alba* (L.), *Bacopa monnieri* and *Ammannia baccifera* among broad leaved weeds and comprised sedges (44%), grasses (30%) and broadleaved

weeds (26%). (Table 1). The study revealed that at all stages of observation, weedy check recorded the maximum number of weed population indicating the native soil was full of weed seeds. All herbicidal treatments reduced weed population significantly compared with weedy check. T₁₃ was efficient to destroy all groups of weeds. T₄ was the most potential killer of weeds (Bhuvaneswari *et al.* 2009) and superior to all herbicidal treatments, which was comparable with T₁₃, it inhibited the growth of grasses, sedges and broad leaf weeds severely. All sequential application of herbicides recorded lesser number of weeds reflecting its high bioefficacy in controlling and suppressing weed growth than single application of any one herbicide. T₈ recorded greater control of sedges, but poor efficacy on grasses and broad leaf weeds in rice crop, corroborating the findings of Sah *et al.* (2012) Yadav *et al.* (2008). The lower total weed density was recorded with T₄ at 60 DAT and T₁₃ at 90 DAT and these were at par with T₁₂ and T₁₀. In turn these treatments

Table 1 Total weed density (No/m²), weed control efficiency and weed control index of rice as influenced by weed management practices at different crop growth stages

Treatment	60 DAT		90 DAT		Weed control efficiency				Weed control index			
	2013	2014	2013	2014	30DAT	60DAT	90DAT	Harvest	30DAT	60DAT	90DAT	Harvest
T ₁	8.33 (69.45)	8.25 (67.47)	10.72 (99.08)	10.29 (105.13)	57.70	7.10	7.25	5.80	36.74	6.57	5.87	4.82
T ₂	7.21 (51.40)	7.01 (48.52)	9.37 (86.95)	9.92 (97.35)	63.17	31.25	18.61	18.16	46.41	10.24	9.79	9.66
T ₃	6.39 (39.96)	6.73 (45.52)	8.12 (65.89)	8.61 (73.20)	66.34	46.55	38.32	34.49	49.04	32.90	37.80	35.33
T ₄	3.31 (9.09)	3.74 (13.18)	4.34 (17.82)	4.99 (23.95)	87.13	87.84	83.32	79.83	96.45	89.78	80.91	75.33
T ₅	7.50 (55.33)	7.00 (48.29)	9.36 (86.64)	9.58 (91.38)	57.32	25.99	18.90	16.99	46.91	15.04	6.60	4.60
T ₆	8.50 (72.10)	8.42 (70.14)	10.32 (105.51)	10.35 (106.14)	5.63	3.56	1.24	1.53	5.20	5.24	2.70	2.60
T ₇	7.72 (58.68)	7.57 (56.67)	9.62 (91.69)	9.72 (93.61)	24.93	21.51	14.17	12.57	10.38	13.62	8.36	7.63
T ₈	6.48 (41.00)	6.16 (36.99)	8.38 (69.89)	8.69 (74.60)	48.49	45.15	34.58	34.26	10.80	42.53	29.86	28.88
T ₉	6.01 (35.09)	6.52 (41.57)	7.95 (62.29)	8.63 (73.58)	42.14	53.07	41.69	39.37	10.84	42.00	33.83	32.99
T ₁₀	3.55 (18.70)	4.03 (21.12)	4.90 (23.35)	5.34 (27.96)	63.23	74.99	78.15	72.50	10.60	84.49	76.23	72.78
T ₁₁	6.35 (39.37)	6.34 (39.23)	7.69 (58.12)	8.40 (69.63)	84.35	47.34	45.59	41.76	83.73	48.10	40.17	38.73
T ₁₂	3.66 (12.94)	4.00 (15.04)	4.76 (21.88)	5.32 (27.93)	85.66	82.70	79.52	76.51	87.23	85.00	76.60	72.90
T ₁₃	3.33 (10.12)	3.77 (13.31)	4.26 (17.19)	4.78 (21.99)	86.38	86.46	83.91	81.12	91.46	88.56	79.75	78.03
T ₁₄	8.69 (74.76)	8.58 (72.64)	10.38 (106.83)	10.63 (112.01)	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SEm±	0.29	0.20	0.24	0.19								
CD (P=0.05)	0.83	0.58	0.70	0.57								

Note: Figures in parenthesis are original values

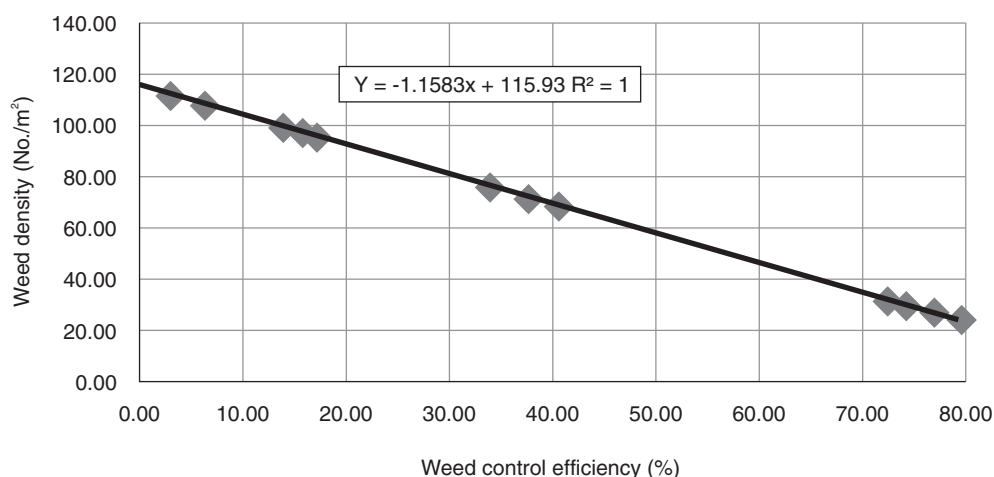


Fig 1 Regression of weed control efficiency versus weed density in rice.

were followed by T_{11} , T_9 , T_3 and T_8 and had comparable total weed density with each other. Thereafter, these were followed by T_2 , T_5 and T_7 treatments showed at par total weed density with each other at 60 DAT and 90 DAT. During entire crop growing season the higher total weed density was registered with T_{14} , which was comparable to T_1 and T_6 at 60 DAT, 90 DAT.

Weed control efficiency (WCE) and Weed control index (WCI)

WCE and WCI (Table 1) was high between 0-30 DAT then decreased sharply between 30-60 DAT, there after it decreased linearly toward harvest in both years owing to increase in weed density and weed dry weight. High WCE and WCI in the initial growth stages appear to be mainly due

to higher herbicide efficacy and WCI lower weed dry weight, respectively.

During both years of investigation higher WCE and WCI at all the stages was noticed in T_4 and T_{12} due to higher suppression of weeds with sequential application of herbicide/PoE herbicides or manual weeding and broad spectrum weed control. The treatment T_{10} showed less WCE and WCI at 30 DAT and then from 60 DAT it showed comparatively higher

WCE owing to post emergence application of herbicide. It was clearly evident that combination of two chemicals gave higher WCE and WCI than sole application. T_1 , T_2 , T_3 , T_5 , T_6 , T_7 , T_8 , T_9 and T_{11} showed good WCE and WCI up to 30 DAT due to single application of PE herbicide alone, the herbicide controlled a portion of weed population. Poor weed control efficiency was noticed in T_8 azimsulfuron because it controls only sedges, T_7 bispyribac sodium controls only grasses and T_6 controls only barnyard grass at all crop growth stages in 2013 and 2014 (Parthipan and Ravi 2014). A positive correlation existed between WCE versus weed density and the regressions accounted for 100% variability in WCE (Fig 1) (Rao *et al.* 2007).

Yield and economics: Rice grain yield (Table 2) was significantly higher with T_{13} (6440 kg/ha) and 6929 kg/ha

Table 2 Yield (kg/ha) and economics of rice as influenced by weed management practices

Treatment	Grain yield		Straw yield		Gross returns (₹/ha)		Net returns (₹/ha)		B:C	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
T_1	2962	2838	4229	4410	47806	46353	11206	8753	1.31	1.23
T_2	3200	3048	4392	4700	51388	49729	14588	11929	1.40	1.32
T_3	4247	4233	6133	5584	68652	67642	30327	28317	1.79	1.72
T_4	6392	6868	8035	8425	101541	108788	63541	69788	2.67	2.79
T_5	3239	3375	4571	4787	52202	54436	13915	15149	1.36	1.39
T_6	2775	2892	4286	4381	45275	47064	8295	7764	1.22	1.20
T_7	3033	3156	4387	4478	49037	50898	11006	11867	1.29	1.30
T_8	4542	4389	6310	5998	73058	70443	34733	31118	1.91	1.79
T_9	4321	4203	6272	5603	69902	67649	31159	27906	1.80	1.70
T_{10}	5972	6381	7963	8311	95598	101798	57099	62299	2.48	2.58
T_{11}	4659	4838	6721	6410	75308	77341	37876	38909	2.01	2.01
T_{12}	6169	6677	7972	8233	98319	105833	60832	67646	2.62	2.77
T_{13}	6440	6929	8072	8476	102273	109720	62273	68720	2.56	2.68
T_{14}	2770	2779	4148	4181	44998	45173	8998	8173	1.25	1.22
SEm±	163	211	238	287	2284	3977	2284	3977		
CD (P=0.05)	477	615	694	840	6677	9702	6677	9702		

during 2013 and 2014 respectively. However, comparable with the grain yield recorded in T_4 , T_{12} and T_{10} , all these treatments were superior over rest of the treatments. There was no significant difference in grain yield among the treatments T_{11} , T_8 , T_9 and T_3 . On an average 28.96, 33.19, 36.24 and 36.80% increase in grain yield of the crop was noticed in hand weeding twice at 25 and 45 DAT treatment over T_{11} , T_8 , T_9 and T_3 respectively. Lower grain yield was registered with T_{14} and was statistically comparable to T_5 , T_2 , T_7 , T_1 and T_6 during both the years.

The economic indicators (Table 2) such as gross returns (₹/ha), net returns (₹/ha) and B:C ratio were worked out and these indicators were analyzed statistically. Significantly higher gross returns were achieved in T_{13} (₹ 102273 and ₹ 109720), it was at par with T_4 (₹ 101541 and ₹ 108788), T_{12} (₹ 98319 and ₹ 105833) and T_{10} (₹ 95598 and ₹ 101798); in turn followed by T_{11} , T_8 , T_9 and T_3 . Lower gross returns were achieved under T_{14} which was on par with remaining other weed management practices T_5 , T_2 , T_7 , T_1 and T_6 in both the years.

However, in terms of net returns significantly higher net return was noticed in T_4 (₹ 63541 and ₹ 69788) and was at par with T_{13} (₹ 62273 and ₹ 68720), T_{12} (₹ 60832 and ₹ 67646) and T_{10} (₹ 57099 and ₹ 62299) and superior over rest of the treatments, respectively. In turn these were followed by T_{11} and T_8 and then followed by T_9 and T_3 . The lower net returns was achieved under T_{14} and was on

par with remaining other weed management practices T_5 , T_2 , T_7 , T_1 and T_6 during both the years.

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