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Weed parameters and economics as influenced by weed management practices in transplanted rice

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ABSTRACT

A field experiment was conducted during *kharif*, 2024 at Agricultural College Farm, Bapatla. The experiment was laid out in a randomized block design with ten treatments and replicated thrice. Data on weed dynamics revealed that hand weeding at 20 and 40 DAT recorded significantly higher weed control efficiency at 30, 60, 90 DAT and at harvest and among the herbicidal treatments tested, bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* florpyrauxifen-benzyl @ 26 g a.i. ha^{-1} + cyhalofop-butyl @100 g a.i. ha^{-1} (RM) as PoE at 20-25 DAT recorded significantly higher weed control efficiency at harvest. Hand weeding at 20 DAT and 40 DAT recorded highest grain yield of transplanted rice. However, it was on par with bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* florpyrauxifen-benzyl @ 26 g a.i. ha^{-1} + cyhalofop-butyl @100 g a.i. ha^{-1} (RM) as PoE at 20-25 DAT and bensulfuron methyl @ 60 g a.i. ha^{-1} + pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* ethoxysulfuron @ 18.75 g a.i. ha^{-1} + fenoxaprop-p-ethyl with safenor @ 57 g a.i. ha^{-1} (TM) as PoE at 20-25 DAT.

Keywords: *Bensulfuron methyl, Economics, Pretilachlor, Ready mix (RM), Tank mix (TM), Transplanted rice and Weed management*

Rice (*Oryza sativa* L.) which belongs to the family Poaceae is one of the most important crops farmed for staple food grains. Rice is grown in more than 100 nations on almost every continent except Antarctica and is a staple meal for more than half of the world's population, particularly in Asia.

A variety of weed species, including grasses, broad-leaved weeds, and sedges, are encountered by transplanted rice. Grain yield reduced by weeds in transplanted rice (62.6 %), wet seeded rice (70.6 %) and dry seeded rice (75.8 %) (Singh *et al.,* 2005). The most popular and successful technique for controlling weeds in rice is hand weeding, but it is becoming more and more challenging and unfeasible every day because of high labour costs and a shortage of workers during the crucial times of the farming season. In order to overcome this obstacle, herbicides provide targeted and cost-effective weed management from the very start of the crop. Due to the ongoing usage of butachlor, anilofos and pretilachlor in the main rice-growing regions, weed flora shift has become common in transplanted rice fields. Weed shift from grasses to broad-leaved weeds and sedges were observed in transplanted rice due to continuous and intensive use of herbicides like butachlor and pretilachlor (Mohapatra *et al.,* 2017). Herbicide use, either in combination or sequentially, may be helpful in these circumstances for broad-spectrum weed control in transplanted rice (Sreelakshmi *et al.,* 2016). Combining herbicides with diverse modes of action prevents resistance in weed species by binding to different target locations (Tripathy *et al*., 2018).

MATERIAL AND METHODS

A field experiment was conducted during *kharif,* 2024 at Agricultural College Farm, Bapatla with an objective to study the effect of post emergence herbicides on growth, yield and weed control in transplanted rice. The results of the soil analysis showed that the experimental field was sandy clay loam in texture, neutral in pH (7.1), low in organic carbon (0.39 %), low in available nitrogen (180 kg ha^{-1}), medium in available phosphorus (20 kg ha^{-1}) and high in available potassium (320 kg ha^{-1}). The weekly mean maximum and minimum temperatures during the crop period ranged from 29.5 ^{0}C to 36.3 ^{0}C and 19.6 ^{0}C to 25.5 ^{0}C, respectively, while the

Table 1. Weed control efficiency (%) and weed index (%) as influenced by weed management practices in transplanted rice

	Treatments	Weed control efficiency				Weed index
		30 DAT	60 DAT	90 DAT	Harvest	
T_1	Weedy check	0	0	0	0	59.67
T_2	Hand weeding at 20 and 40 DAT	91.16	88.13	89.55	90.29	0.00
T_3	Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* Florpyrauxifen-benzyl @ 26 g a.i. ha^{-1} + Cyhalofop-butyl @100 g a.i. ha^{-1} (RM) as PoE at 20-25 DAT	83.99	85.28	87.24	87.96	3.05
T_4	Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb*	73.76	77.97	79.66	80.35	15.33
T_5	Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* Bentazone @ 1000 g a.i. ha^{-1} + Quinchlorac 250 g a.i. ha^{-1} (TM) as PoE at 20-25 DAT	63.86	73.22	74.72	75.36	35.01
T_6	Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* Bentazone @ 1000 g a.i. ha^{-1} + Profoxydim @ 75 g a.i. ha^{-1} (TM) as PoE at 20- 25 DAT	71.05	75.12	76.67	77.31	34.61
T_7	Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* Bispyribac Na @ 25 g a.i. ha^{-1} + Cyhalofop Butyl @ 100 g a.i. ha^{-1} (TM) as PoE at 20-25 DAT	79.75	82.55	84.37	85.03	9.22
T_8	Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* Ethoxysulfuron @ 18.75 g a.i. ha^{-1} + Fenoxaprop-p-ethyl with safenor @ 57 g a.i. ha^{-1} (TM) as PoE at 20-25 DAT	82.26	83.91	85.78	86.47	7.78
T_9	Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fbProfoxydim @ 75 g a.i. ha-1 as PoE at 20-25 DAT*	67.18	67.85	71.81	72.69	43.00
T_{10}	Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* Ethoxysulfuron @ 18.75 g a.i. ha^{-1} + Profoxydim @ 75 g a.i. ha^{-1} (TM) as PoE at 20- 25 DAT	74.86	77.00	78.73	79.53	30.02
S.Em (±)		4.033	3.293	3.366	3.236	2.799
CD (P = 0.05 %)		12.903	10.536	10.768	10.352	8.954
CV (%)		10.1	8	8	7.6	20.3

RM- Ready mix, TM- Tank mix

average maximum and minimum temperatures during the crop growth period were 32.1 ^{0}C and 23.1 ^{0}C, respectively. The weekly mean relative humidity at 8:30 AM and 17:30 PM ranged from 74.3 % to 91% and 60.3 % to 87 %, respectively, while the average 85.6 % and 75 %, respectively. A total of 571.8 mm rainfall was received in 23 rainy days during the crop growth period. Experiment comprising of ten treatments was laid out in a randomized block design with three replications. T_1: Weedy check, T_2: Hand weeding at 20 and 40 DAT, T_3: Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* Florpyrauxifen-benzyl @ 26 g a.i. ha^{-1} + Cyhalofop-butyl @100 g a.i. ha^{-1} (RM) as PoE at 20-25 DAT, T_4: Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* Florpyrauxifen benzyl @ 16 g a.i. ha^{-1} + Penoxsulam @ 25 g a.i. ha^{-1} (RM) as PoE at 20-25 DAT, T_5: Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* Bentazone @ 1000 g a.i. ha^{-1} + Quinchlorac 250 g a.i. ha^{-1} (TM) as PoE at 20-25 DAT, T_6: Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* Bentazone @ 1000 g a.i. ha^{-1} + Profoxydim @ 75 g a.i. ha^{-1} (TM) as PoE at 20- 25 DAT, T_7: Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* Bispyribac Na @ 25 ga.i. ha^{-1} + Cyhalofop Butyl @ 100 g a.i. ha^{-1} (TM) as PoE at 20-25 DAT, T_8: Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* Ethoxysulfuron @ 18.75 g a.i. ha^{-1} + Fenoxaprop-p-ethyl with safenor @ 57 g a.i. ha^{-1} (TM) as PoE at 20-25 DAT, T_9: Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* Profoxydim @ 75 g a.i. ha^{-1} as PoE at20-25 DAT, T_{10}: Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* Ethoxysulfuron @ 18.75 g a.i. ha^{-1} + Profoxydim @ 75 g a.i. ha^{-1} (TM) as PoE at 20-25 DAT. Paddy variety BPT-5204 was sown with a spacing of 20 cm X 15 cm. Urea, Single Super Phosphate, and Muriate of Potash were used as sources of nitrogen, phosphorus and potassium, respectively. Prescribed plant protection practices were followed when needed. Pre-emergence herbicide applications were carried out using a hand-operated knapsack sprayer with a flat-fan nozzle, sprayfluid @ 500 liters per hectare. Post emergence herbicides were applied at 22 DAT with knapsack sprayer. To minimize large variations, the weed density data was transformed using the square root transformation.

RESULTSANDDISCUSSION

Effect of different weed management practices on weed control efficiency and weed index

WEED CONTROL EFFICIENCY

At 60 DAT, the highest weed control efficiency was recorded with hand weeding at 20 and 40 DAT (88.13%) which was on par with bensulfuron methyl @ 60 g a.i. ha^{-1} + pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* florpyrauxifen-benzyl @ 26 g a.i. ha^{-1} + cyhalofop-butyl @100 g a.i. ha^{-1} (RM) as PoE at 20-25 DAT (85.28%), bensulfuron methyl @ 60 g a.i. ha^{-1} + pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* ethoxysulfuron @ 18.75 g a.i. ha^{-1} + fenoxaprop-p-ethyl with safenor @ 57 g a.i. ha^{-1} (TM) as PoE at 20-25 DAT (83.91%), bensulfuron methyl @ 60 g a.i. ha^{-1} + pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* bispyribac Na @ 25 g a.i. ha^{-1} + cyhalofop-butyl @ 100 g a.i. ha^{-1} (TM) as PoE at 20-25 DAT (82.55%) and bensulfuron methyl @ 60 g a.i. ha^{-1} + pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* florpyrauxifen benzyl @ 16 g a.i. ha^{-1} + penoxsulam @ 25 g a.i. ha^{-1} (RM) as PoE at 20-25 DAT (77.97%). Similar findings were given by Bhagavathi *et al*. (2024), Mahapatra *et al.* (2023) and Venkatesh *et al*. (2021).

WEED INDEX

Among the weed management practices, the lowest weed index was reported with bensulfuron methyl @ 60 g a.i. ha^{-1} + pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* florpyrauxifen-benzyl @ 26 g a.i. ha^{-1} + cyhalofop-butyl @100 g a.i. ha^{-1} (RM) as PoE at 20-25 DAT (3.05 %), bensulfuron methyl @ 60 g a.i. ha^{-1} + pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* ethoxysulfuron @ 18.75 g a.i. ha^{-1} + fenoxaprop-p-ethyl with safenor @ 57 g a.i. ha^{-1} (TM) as PoE at 20-25 DAT (7.78 %), bensulfuron methyl @ 60 g a.i. ha^{-1} + pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* bispyribac Na @ 25 ga.i. ha^{-1} + cyhalofop-butyl @ 100 g a.i. ha^{-1} (TM) as PoE at 20-25 DAT (9.22 %). This might be due to effective control of all weeds types i.e grasses, sedges and broadleaved weeds leading to less crop weed competition during the critical period which resulted in higher yields and lower weed index. Highest weed index was recorded in weedy check (59.67 %). These results are in

Table 2. Economics (Rs. ha^{-1}) of transplanted rice as influenced by weed management practices

	Treatments	Cost of Cultivation	Gross returns	Net returns	B:C ratio
T_1	Weedy check	51069	66372	15303	0.30
T_2	Hand weeding at 20 and 40 DAT	63069	157640	94571	1.50
T_3	Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* Florpyrauxifen-benzyl @ 26 g a.i. ha^{-1} + Cyhalofop-butyl @100 g a.i. ha^{-1} (RM) as PoE at 20-25 DAT	58019	154769	96750	1.67
T_4	Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb Florpyrauxifen benzyl @ 16 g a.i. ha-1 + Penoxsulam @ 25 g a.i. ha-1 (RM) as PoE at 20 25DAT*	58319	139707	81388	1.40
T_5	Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* Bentazone @ 1000 g a.i. ha^{-1} + Quinchlorac 250 g a.i. ha^{-1} (TM) as PoE at 20-25 DAT	59294	123534	64240	1.08
T_6	Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* Bentazone @ 1000 g a.i. ha^{-1} + Profoxydim @ 75 g a.i. ha^{-1} (TM) as PoE at 20- 25 DAT	60419	127144	66725	1.10
T_7	Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fbBispyribac Na @ 25 g a.i. ha-1 + Cyhalofop Butyl @ 100 g a.i. ha-1 (TM) as PoE at 20-25 DAT*	57795	148329	90534	1.57
T_8	Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* Ethoxysulfuron @ 18.75 g a.i. ha^{-1} + Fenoxaprop-p-ethyl with safenor @ 57 g a.i. ha^{-1} (TM) as PoE at 20-25 DAT	57669	149842	92173	1.60
T_9	Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb Profoxydim @ 75 g a.i. ha-1 as PoE at20-25 DAT*	58619	118565	59946	1.02
T_{10}	Bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fbEthoxysulfuron @ 18.75 g a.i. ha-1 + Profoxydim @ 75 g a.i. ha-1 (TM) as PoE at 20-25 DAT*	59869	134570	74871	1.25
S.Em (±)		-	6353.6	6353.6	0.106
CD (P = 0.05 %)		-	13348.9	13348.9	0.224
CV (%)		-	5.9	10.6	10.5

RM- Ready mix, TM- Tank mix

conformity with the findings of Sreedevi *et al*. (2020).

Effect of weed management practices on economics in transplanted rice

Among the weed management practices, significantly higher gross returns (Rs. 157640 ha^{-1}) were obtained from hand weeding at 20 and 40 DAT, which was on par with the application of bensulfuron methyl @ 60 g a.i. ha^{-1} + Pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* florpyrauxifen- benzyl @ 26 g a.i. ha^{-1} + cyhalofop-butyl @100 g a.i. ha^{-1} (RM) as PoE at 20-25 DAT (Rs. 154769 ha^{-1}), bensulfuron methyl @ 60 g a.i. ha^{-1} + pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* ethoxysulfuron @ 18.75 g a.i. ha^{-1} + fenoxaprop-p-ethyl with safenor @ 57 g a.i. ha^{-1} (TM) as PoE at 20-25 DAT (Rs. 149842 ha^{-1}) and bensulfuron methyl @ 60 g a.i. ha^{-1} + pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* bispyribac Na @ 25 g a.i. ha^{-1} + cyhalofop- butyl @ 100 g a.i. ha^{-1} (TM) as PoE at 20-25 DAT (Rs. 148329 ha^{-1}). However, significantly lower gross returns (Rs. 66372 ha^{-1}) were obtained from weedy check.

Statistically higher net returns were obtained with the application of bensulfuron methyl @ 60 g a.i. ha^{-1} + pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* florpyrauxifen- benzyl @ 26 g a.i. ha^{-1} + cyhalofop-butyl @100 g a.i. ha^{-1} (RM) as PoE at 20-25 DAT (¹ 96750 ha^{-1}), which was on par with hand weeding at 20 and 40 DAT (Rs. 94571 ha^{-1}), bensulfuron methyl @ 60 g a.i. ha^{-1} + pretilachlor @ 600 g a.i. ha-1 (RM) as PE *fb* ethoxysulfuron @ 18.75 g a.i. ha^{-1} +fenoxaprop-p-ethyl with safenor @ 57 g a.i. ha^{-1} (TM) as PoE at 20-25 DAT (Rs. 92173 ha^{-1}), bensulfuron methyl @ 60 g a.i. ha^{-1} + pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* bispyribac Na @ 25 ga.i. ha^{-1} + cyhalofop Butyl @ 100 g a.i. ha^{-1} (TM) as PoE at 20-25 DAT (Rs. 90534 ha^{-1}) Whereas, significantly lower net returns (Rs. 15303 ha^{-1}) were obtained from weedy check.

CONCLUSION

Based on the findings, it is concluded that higher weed control efficiency, net returns were recorded with hand weeding at 20 and 40 DAT and among herbicide treatments, the combination of bensulfuron methyl @ 60 g a.i. ha^{-1} + pretilachlor @ 600 g a.i. ha^{-1} (RM) as PE *fb* florpyrauxifen- benzyl @ 26 g a.i. ha^{-1} + cyhalofop-butyl @100 g a.i. ha^{-1} (RM) as PoE at 20-25 DAT recorded higher weed control efficiency, lower weed index and high net returns in transplanted rice.

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