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RESEARCH ARTICLE

Effect of Weed Management Practices on Growth and Yield of Machine Transplanted Rice

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A field experiment was conducted at Wetland farms of Tamil Nadu Agricultural University, Coimbatore to evaluate the different weed management practices on growth and productivity of rice variety CO 51 during late *Samba,* 2017-18. The experiment consisted of eight treatments *viz*., Unweeded check (T_1); Pretilachlor @ 1 kg a.i. ha^{-1} (PE) followed by hand weeding at 20 DAT (T_2); Pretilachlor @ 1 kg a.i. ha^{-1} (PE) followed by Metsulfuron methyl + Chlorimuron ethyl @ 4 g a.i. ha^{-1} (POE) at 20 DAT (T_3), Pretilachlor @ 1 kg a.i. ha^{-1} (PE) followed by Power weeder at 20 DAT (T_4); Pretilachlor @ 1 kg a.i. ha^{-1} (PE) followed by Power weeder at 20 and 35 DAT (T_5); Pretilachlor @ 1 kg a.i. ha^{-1} (PE) followed by Power weeder at 20, 30 and 40 DAT (T_6); Power weeder at 20 and 35 DAT (T_7); Power weeder at 20, 30 and 40 DAT (T_8). The experiment was conducted in RCBD and replicated thrice. The results revealed that the application of Pretilachlor combined with either hand weeding on 20 DAT (T_2) or with power weeding twice (T_5) or thrice (T_6) or with chemical combinations had registered more LAI, drymatter production, number of tillers m^{-2}, resulted more productive tillers m^{-2}, filled grains $panicles^{-1}$, panicle length which ultimately resulted in higher grain and straw yields.

Keywords: *Growth parameters, Machine transplanted rice, Weed management, Yield.*

Rice is the staple food of more than a half of the world's population. In India, rice ensures food security. Among the major rice growing countries, India has the largest area (43.5 m ha) and it is the second largest producer (104 m.t.) of rice in world. The rice productivity in India is 2.4 t ha^{-1}. Tamil Nadu alone contributes 3.9 per cent of the national rice production from an area of 2.0 million hectares, with a production of 4.1 million tonnes (Indiastat, 2017). Generally, rice growers face the problem of skilled labour shortage at the time of transplanting which resulted in delayed transplantation, low plant population and eventually low yield. As per the recent estimates by ILOSTAT database, labour availability in India was reduced from 63 per cent (1991) to 44 per cent (2017). In order to offset these problems, mechanical transplanting has been considered as the most promising options which helps in not only changing the structure of labour in agriculture, but also, influences the nature of the workload, ensures timely planting and attain optimum plant density that contribute to more productivity (Tripathi *et al*., 2004).

The weed flora under transplanted conditions was very much diverse and consisted of grasses, sedges and broad-leaved weeds caused yield reduction up to 76 per cent (Singh *et al*., 2004). So, controlling the weeds during critical crop-weed competition is very much essential. Every weed management practices has its own advantages and disadvantages. Hand weeding is very effective which helps to eradicate all types of weed flora present in field, but, it is labour intensive which increases the cost of cultivation and reduced returns. The undependable labour availability and escalating labour wages lead to boosts the development and use of chemicals for the control of weeds (Hasanuzzaman *et al*., 2009). Power weeding ensures incorporation of weeds *in-situ* which helps in effective recycling of depleted nutrients together with aeration in rhizosphere of rice and also without polluting the environment (Subbulakshmi *et al*., 2005). However, information on the different weed management practices on machine transplanted rice are seldom available. Therefore, present study was undertaken to evaluate different weed management practices in machine transplanted rice.

Material and Methods

A field experiment was conducted at Wetland farms of Department of Farm Management, Tamil Nadu Agricultural University, Coimbatore during late *Samba* (October to February) season of 2017-18. The

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experimental site is located in the Western Agro-climatic Zone of Tamil Nadu at 11° N latitude, 77° E longitude and at an altitude of 426.72 m above mean sea level. The soil of the experimental site was clay loam in texture with a pH of 8.2, medium in organic carbon (5.60 g kg^{-1}), low in available nitrogen (225.4 kg ha^{-1}), medium in available phosphorus (16.80 kg ha^{-1}) and high in available potassium (423.8 kg ha^{-1}).

Field experiment was laid out in randomized complete block design with three replications and eight treatments *viz.,* Unweeded check (T_1); Pretilachlor @ 1 kg a.i. ha^{-1} at 3 DAT (PE) followed by hand weeding at 20 DAT (T_2); Pretilachlor @ 1 kg a.i. ha^{-1} at 3 DAT (PE) along with Metsulfuron methyl + Chlorimuron ethyl @ 4 g a.i. ha^{-1} at 20 DAT (POE) @ 20 DAT (T_3); Pretilachlor @ 1 kg a.i. ha^{-1} at 3 DAT (PE) followed by Power weeder at 20 DAT (T_4); Pretilachlor @ 1 kg a.i. ha^{-1} at 3 DAT (PE) followed by power weeder at 20 and 35 DAT (T_5); Pretilachlor @ 1 kg a.i. ha^{-1} at 3 DAT (PE) followed by power weeder at 20, 30 and 40 DAT (T_6); Power weeder at 20 and 35 DAT (T_7); Power weeder at 20, 30 and 40 DAT (T_8). The field was prepared by ploughing the field under dry condition by using tractor drawn cultivator followed by roto-puddler and kept ready for machine transplanting. The treatments were imposed in time with the pre-fixed combinations of pre-emergent herbicide with hand weeding, with power weeding and with post-emergent herbicide in appropriate recommended dose. All other intercultural practices (irrigation, fertilizer application, etc.) were followed as per the recommendation given in CPG (2012).

Five plants were selected at random from the net plot area and tagged. From the tagged plants, LAI at flowering stage was worked out using leaf length and breadth for 0.75 as correction factor. The total leaf area to the ground area was expressed as leaf area index. Five plants $plot^{-1}$ at random from outside the net area of the plot were pulled out at maturity stage. The samples were initially air dried in shade and then oven dried at 70°C ± 5°C till the samples attained constant weight and then weighed. The DMP was computed to kg ha^{-1}. The total number of tillers m^{-2}, productive tillers m^{-2} were counted at maturity stage from five randomly marked hills in the net plot area. The panicle length was measured from the base to tip of the panicle obtained from the marked five hills. The panicles were collected from the five tagged plants at maturity and counted to filled grains $panicle^{-1}$. The crop was harvested at physiological maturity, threshed and cleaned manually. The dry weight of grain and straw yield was recorded after proper sun drying. Data were subjected to statistical scrutiny as per the procedure suggested by Gomez and Gomez (2010).

Results and Discussion

Leaf area index

At flowering stage, there is a significant influence on leaf area index (LAI) of rice by imposing different weed management treatments (Table 1). Among the treatments, application of Pretilachlor @ 1 kg a.i. ha^{-1} at 3 DAT as pre-emergence followed by Power weeding at 20, 30 and 40 DAT recorded higher LAI (6.62) which was on par with Pretilachlor herbicide @ 1 kg a.i. ha^{-1} at 3 DAT applied either in combination with hand weeding (6.52) or in combination with Metsulfuron methyl + Chlorimuron ethyl @ 4 g a.i. ha^{-1} at 20 DAT (POE) (6.49) or with power weeding twice at 20 and 35 DAT (6.39). This might probably due to increased tiller production, number of leaves, leaf length and breadth, which was in accordance with the findings of Rafi (2015). The LAI recorded was lesser in unweeded check (5.04).

Drymatter production

During maturity stage, weed management practices had significant influence on drymatter production of rice (Table 1). Among the weed management treatment imposed, application of Pretilachlor @ 1 kg a.i. ha^{-1} at 3 DAT as pre-emergence herbicide followed by either with hand weeding at 20 DAT (15467 kg ha^{-1}) or with operating power weeder both thrice at 20, 30 and 40 DAT (15109 kg ha^{-1}) and twice at 20 and 35 DAT (14892 kg ha^{-1}) or with applying early post-emergence Metsulfuron methyl + Chlorimuron ethyl herbicide @ 4 g a.i. ha^{-1} at 20 DAT (14397 kg ha^{-1}) secured better drymatter production of rice when compared with other treatments. Increase in drymatter production was mainly due to increase in tiller production and leaf area of the plant. Findings are in accordance with the reports of Babu (2008). The lesser DMP was recorded in unweeded check (7350 kg ha^{-1}).

Tillering behaviour

Different weed management practices had significant influence on production of total number of tillers m^{-2} and productive tillers m^{-2} (Table 1). The total number of tillers were higher with pre-emergence application of Pretilachlor @ 1 kg a.i. ha^{-1} at 3 DAT followed by post-emergence application of Metsulfuron methyl + Chlorimuron ethyl @ 4 g a.i. ha^{-1} at 20 DAT (578 m^{-2}) which was on par with Pretilachlor @ 1 kg a.i. ha^{-1} at 3 DAT applied as pre-emergence followed by either with hand weeding at 20 DAT (543 m^{-2}) or with power weeding twice at 20 and 35 DAT (531 m^{-2}) or with power weeding thrice at 20, 30 and 40 DAT (528 m^{-2}). The lesser total number

of tillers was recorded in unweeded check (332 m^{-2}). This might be due to broad spectrum control of weeds with chemicals during early stages and with either hand weeding or with power weeding at later stages. These findings are in accordance with Srivastava *et al*. (2008) and Maity and Mukherjee (2009).

Table 1. Effect of weed management practices on growth characters of machine transplanted rice

Treatments	Leaf Area Index	Total number of tillers (m^{-2})	DMP (kg ha^{-1})	Productive tillers (m^{-2})	Panicle length (cm)	Number of filled grains $panicle^{-1}$	1000 grain weight (g)
T_1 : Control (No weeding)	5.04	332	7350	229.4	18.1	128.2	15.12
T_2 : Pretilachlor @ 1 kg a.i. ha^{-1} at 3 DAT (PE) *fb* Hand weeding at 20 DAT	6.52	543	15467	460.7	21.7	152.6	15.65
T_3 : Pretilachlor @ 1 kg a.i. ha^{-1} at 3 DAT (PE) *fb* Metsulfuron methyl + Chlorimuron ethyl (POE) @ 4 g a.i. ha^{-1} at 20 DAT	6.49	578	14397	410.9	21.1	167.5	15.53
T_4 : Pretilachlor @ 1 kg a.i. ha^{-1} at 3 DAT (PE) *fb* Power weeder at 20 DAT	5.91	502	13142	368.1	20.2	144.5	15.21
T_5 : Pretilachlor @ 1 kg a.i. ha^{-1} at 3 DAT (PE) *fb* Power weeder at 20, 35 DAT	6.39	531	14892	425.6	20.7	172.8	15.34
T_6 : Pretilachlor @ 1 kg a.i. ha^{-1} at 3 DAT (PE) *fb* Power weeder at 20, 30, 40 DAT	6.62	528	15109	441.7	20.8	176.4	15.45
T_7 : Power weeder at 20, 35 DAT	5.66	468	11990	292.2	18.9	158.1	15.22
T_8 : Power weeder at 20, 30, 40 DAT	5.79	480	12821	308.5	19.4	155.3	15.30
SEd	0.26	24	564	18.5	0.9	8.0	0.76
CD (P=0.05)	0.55	51	1179	38.7	1.9	16.6	NS

Pre-emergence application of Pretilachlor @ 1 kg a.i. ha^{-1} at 3 DAT followed by hand weeding at 20 DAT recorded higher productive tillers (460.7 m^{-2}) which was on par with Pretilachlor applied @ 1 kg a.i. ha^{-1} at 3 DAT as pre-emergence followed by either power weeding at 20, 30 and 40 DAT (441.7 m^{-2}) or power weeding at 20 and 35 DAT (425.6 m^{-2}). This was mainly due to the better environment created to the crop for the better utilization of available resources during the critical weed control period. These results are in accordance with Negalur *et al*. (2016) and Shendage *et al*. (2017). The lesser number of productive tillers were recorded in unweeded check (229.4 m^{-2}).

Panicle length

Weed management treatments have significant influence on growth of length of the panicle (Table 1).

The panicle length was recorded higher in the application of Pretilachlor as pre-emergence @ 1 kg a.i. ha^{-1} at 3 DAT either *fb* hand weeding at 20 DAT (21.7 cm) or *fb* Metsulfuron methyl + Chlorimuron ethyl @ 4 g a.i. ha^{-1} at 20 DAT (21.1 cm) or *fb* power weeding at 20, 30, 40 DAT (20.8 cm) or *fb* power weeding at 20, 35 DAT (20.7 cm) and was recorded lower in unweeded check (18.1 cm). This might be mainly due to better source and sink relationship attained in these better treatments. These results are in accordance with the findings of Rafi (2015).

Number of filled grains $panicle^{-1}$

There existed a significant influence on total number of filled grains $panicle^{-1}$ by imposing different weed management treatments (Table 1). Higher number of filled grains $panicle^{-1}$ was recorded in Pretilachlor applied as pre-emergence followed by power weeding @ 20, 30 and 40 DAT (176.4) which was on par with pre-emergence herbicide application of Pretilachlor followed by either with power weeding twice @ 20 and 35 DAT (172.8) or with post emergence application of Metsulfuron methyl + Chlorimuron ethyl (167.5). Lesser number of filled grain $panicle^{-1}$ was recorded in unweeded check (128.2). This was mainly due to the better environment created to the crop for greater utilization of available resources. These results are in accordance with the findings of Negalur *et al*. (2016), Shendage *et al*. (2017).

Grain yield

Grain yield of rice was significantly different due to imposing different weed management practices (Table 2). Higher yield was recorded in Pretilachlor @ 1 kg a.i. ha^{-1} at 3 DAT applied as pre-emergence followed by hand weeding @ 20 DAT (5678 kg ha^{-1}) which was on par with pre-emergence application of Pretilachlor @ 1 kg a.i. ha^{-1} at 3 DAT followed by either with power weeding @ 20, 30 and 40 DAT (5254 kg ha^{-1}) or with power weeding @ 20 and 35 DAT (5237 kg ha^{-1}) or with post-emergence application of Metsulfuron methyl + Chlorimuron ethyl @ 4 g a.i. ha^{-1} at 20 DAT (5149 kg ha^{-1}). Lower grain yield was recorded in unweeded check (2890 kg ha^{-1}). Higher number of productive tillers, filled grains $panicle^{-1}$, panicle length recorded in these treatments resulted higher grain yield of rice. These results are in line with the findings of Sanjay *et al*. (2006) and Kiran *et al.* (2010).

Table 2. Effect of weed management practices on yield of machine transplanted rice

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index
T_1 : Control (No weeding)	2890	4726	0.38
T_2 : Pretilachlor @ 1 kg a.i. ha^{-1} at 3 DAT (PE) *fb* Hand weeding at 20 DAT	5678	8460	0.40
T_3 : Pretilachlor @ 1 kg a.i. ha^{-1} at 3 DAT (PE) *fb* Metsulfuron methyl + Chlorimuron ethyl (POE) @ 4 g a.i. ha^{-1} at 20 DAT	5149	7516	0.41
T_4 : Pretilachlor @ 1 kg a.i. ha^{-1} at 3 DAT (PE) *fb* Power weeder at 20 DAT	4912	7280	0.40
T_5 : Pretilachlor @ 1 kg a.i. ha^{-1} at 3 DAT (PE) *fb* Power weeder at 20, 35 DAT	5237	7553	0.41
T_6 : Pretilachlor @ 1 kg a.i. ha^{-1} at 3 DAT (PE) *fb* Power weeder at 20, 30, 40 DAT	5254	8014	0.40
T_7 : Power weeder at 20, 35 DAT	4493	6422	0.41
T_8 : Power weeder at 20, 30, 40 DAT	4839	6915	0.41
SEd	256	418	0.02
CD (P=0.05)	535	872	NS

Straw yield

The effect of different weed management practices on straw yield was found significant (Table 2). Among the weed management treatments, higher straw yield was recorded in Pretilachlor application @ 1 kg a.i. ha^{-1} at 3 DAT as pre-emergence followed by hand weeding @ 20 DAT (8460 kg ha^{-1}), which was on par with Pretilachlor applied @ 1 kg a.i. ha^{-1} at 3 DAT as pre-emergence followed by power weeding @ 20, 30 and 40 DAT (8014 kg ha^{-1}). Unweeded check produced lesser straw yield (4726 kg ha^{-1}). This was mainly due to higher LAI and production of total number of tillers. These results are in accordance with the findings of Sanjay *et al*. (2006) and Kiran *et al.* (2010).

Conclusion

The study on the effect of weed management practices on growth and yield of machine transplanted rice clearly indicated that based on the cheaper availability of farm resources *viz*., labour, power weeder and herbicide, adoption of any of the weed management techniques including pre-emergence application of Pretilachlor @ 1 kg a.i. ha^{-1} at 3 DAT with either in combination hand weeding at 20 DAT or with power weeding thrice (20, 30 and 40 DAT) or twice (20 and 35 DAT) or with herbicide combinations will provide better grain and straw yield.

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