

Original Research Article

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Yield Improvement of Kharif Rice by Different Weed Management Practices

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A B S T R A C T

A field experiment was conducted during *kharif* 2017 at the Agricultural Farm, Palli Siksha Bhavana, Visva-Bharati, Sriniketan, Birbhum, West Bengal to study the effect of different weed management practices on yield improvement of transplanted *kharif* rice. Nine treatments viz; pretilachlor 500 g/ha as pre emergence, oxadiargyl 90 g/ha as pre emergence, pyrazosulfuron ethyl 25 g/ha as pre emergence, pretilachlor 500 g/ha as PE followed by hand weeding at 40 DAT, oxadiargyl 90 g/ha as PE followed by hand weeding at 40 DAT, pyrazosulfuron ethyl 25 g/ha as PE followed by hand weeding at 40 DAT, hand weeding twice at 20 and 40 DAT, weed free and unweeded control were tested in randomized complete block design with three replications. The predominant weed flora present in the experimental field was *Echinochloa glabrescens*, *Cyperus difformis*, *Cyperus iria* and *Ludwigia parviflora*. All weed control treatments significantly reduced the population and dry weight of all categories of weeds viz., grasses, sedges and broadleaf weeds than unweeded control which resulted significant increase in different growth parameters of transplanted *kharif* rice. Among the herbicide applied treatments, pyrazosulfuron ethyl 25g/ha fb one hand weeding at 40 DAT resulted in significantly higher values of plant height, leaf area index, dry matter accumulation, crop growth rate and ultimately grain yield (5.22 t/ha) of rice than that of unweeded control. Hand weeding at 20 and 40 DAT was statistically at par with pyrazosulfuron ethyl 25g/ha fb one hand weeding at 40 DAT.

Keywords

Pyrazosulfuron ethyl, Hand weeding, Weed management, Rice

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Introduction

Rice is the world's most important staple food crop for more than half of the world's population, occupying a prime place after wheat and is the main source of carbohydrate, protein and calories for a large section of the population. Globally, rice occupies an area of 147 million hectares with production of 525 million tonnes. In India, it is produced in an area of 46.19 million hectares with a

production of 106.29 million tonnes and productivity of 2462 kg ha⁻¹.

Rice is cultivated in a very wide range of ecosystems from irrigated to shallow lowlands, mid-deep lowlands and deep water to uplands. Transplanting in puddled soil with continuous flooding is the major method of rice cultivation in India. Weed infestation is one of the serious constraints in rice production. Weed affects rice by competing

for nutrient, light, water and space accounting nearly one third of crop loss. Transplanted rice crop faces diverse type of weed flora, consisting of grasses, sedges and some broad-leaf weeds, which reduces yield up to 48 per cent with an annual loss of 15 million tonnes due to weed competition. Prevention of weed competition and provision of weed free environment at critical period of rice growth is necessary for successful rice production (Murali and Gowthami, 2017). Most transplanted rice growers in India mechanically weed their crops two or three times per season (Rodder, 2001) raising cost of labour and their non-availability in time lead to the search for alternative methods. Herbicides offer the most effective, economical and practical way of weed management (Sureshkumar and Durairaj, 2016). So, there is a need to evaluate the effect of new herbicides on growth of transplanted rice for providing wider options to farmers.

Materials and Methods

A field experiment, "Weed management in transplanted *kharif* rice (*Oryza sativa L.*)" was conducted in Block-A, Plot no- 2 of the Agricultural Farm of Palli Siksha Bhavana, Visva-Bharati, Sriniketan during *kharif* season of 2017 to study the effect of different weed management practices on growth of transplanted *kharif* rice. The experiment was laid out in RBD design with nine treatments and three replications. The net plot size was 5 m x 4 m. The fertilizers were applied considering 80:40:40 kg of N: P₂O₅: K₂O per ha as recommended dose as urea, single superphosphate and murate of potash, respectively.

The experimental site was sandy loam with acidic pH (5.36), EC (0.61 dSm⁻¹), medium in organic carbon (0.57 %), available N (385 kg ha⁻¹), P₂O₅ (23.4 kg ha⁻¹) and K₂O (191 kg

ha⁻¹). Rice seeds were sown first in nursery and after 21 days they were uprooted and transplanted in the main field at the rate of 7 kg ha⁻¹ by following 20 cm x 15 cm spacing on 16th July 2017. The rice variety used was MTU-1010.

The Treatments consisted of T₁=Pretilachlor 500 g/ha as pre emergence, T₂=Oxadiargyl 90 g/ha as pre emergence, T₃=Pyrazosulfuron ethyl 25 g/ha as pre emergence, T₄=Pretilachlor 500 g/ha as PE followed by hand weeding at 40 DAT, T₅=Oxadiargyl 90 g/ha as PE followed by hand weeding at 40 DAT, T₆= Pyrazosulfuron ethyl 25 g/ha as PE followed by hand weeding at 40 DAT, T₇= Hand weeding twice at 20 DAT and 40 DAT, T₈=Weed free, T₉=Unweeded control. The pre emergence herbicides were applied at 3 DAT as sand mix application through knap sack sprayer using a spray volume of 500 L ha⁻¹.

Weed density and weed dry weight were recorded at 20, 40, 60 DAT. At each sampling time, two quadrates of 50 cm×50 cm were placed randomly in each plot and weeds were collected from each quadrate and converted to numbers per m². Weeds were uprooted, washed with tap water, sundried, oven-dried at 65 °C for 48 hours. After attaining the constant weight, the samples were weighed and the weed dry weight was expressed in grams per m². The square-root transformation of original data of weeds was done for statistical analysis as described by Cochran and Cox (1957).

The growth parameters like plant height, leaf area index (LAI), dry matter accumulation and Crop Growth Rate (CGR) were recorded at 20, 40, 60 DAT. Yield data recorded after the harvest of rice crop. Collected data were analyzed statistically and the means were separated by least significant difference (LSD) test.

Results and Discussion

Effect of weed management on dry weight of weeds

The data presented in Table 1 on dry weight of weeds revealed that all the weed control treatments reduced the weed dry weight significantly from that of unweeded treatment. The weed free treatment registered the lowest dry weight of weeds (0.71 g/m^2). Among the weed control treatments, the lowest weed dry weight were registered in Pyrazosulfuron ethyl 25g/ha as pre-emergence *fb* hand weeding at 40 DAT at 20 DAT and 60 DAT. It was closely followed by Hand weeding at 20 and 40 DAT. All other weed control treatments did not differ significantly from Pyrazosulfuron ethyl 25g/ha as pre-emergence *fb* hand weeding at 40 DAT at 20 DAT and 60 DAT. The highest weed dry weight recorded with unweeded check for all the stages ($4.89, 13.74, 16.52 \text{ g/m}^2$).

Effect of weed management on plant height

Data recorded on plant height at different growth stages (15, 30 and 45 DAT) were statistically analysed and presented in Table 2. From all the observations it was found that at 15 and 30 DAT, weed free plots recorded highest plant height due to no crop weed competition throughout the crop growth period. Repeated weeding led to better aeration and non occurrence of toxic gases which improve the crop growth. The lowest plant height was observed under unweeded control plots. In unweeded control, the weeds were allowed to grow uninterrupted throughout the crop growth period. It resulted in maximum crop weed competition for growth resources since beginning resulting minimum height of rice plants. Among different chemical weed control treatments Pyrazosulfuron ethyl 25g/ha as pre-

emergence *fb* hand weeding at 40 DAT recorded highest plant height. Pyrazosulfuron ethyl controls the weeds more efficiently than Oxadiargyl and Pretilachlor as the result the growth resources were more available to the plants in Pyrazosulfuron ethyl treated plots (Banerjee *et al.*, 2005).

Effect of weed management on LAI

In all the observations (Table 2) the highest LAI was observed in weed free treatment which may be due to lowest crop-weed competition in that plot. The lowest LAI was found in unweeded control plots. There weed free plot varied significantly from that of the control plot. Leaf Area Index was found in the trend of weedfree > hand weeding at 20 and 40 DAT > Pyrazosulfuron ethyl 25g/ha as pre-emergence *fb* hand weeding at 40 DAT in 15 and 30 DAT and weedfree > Pyrazosulfuron ethyl 25g/ha as pre-emergence *fb* hand weeding at 40 DAT > hand weeding at 20 and 40 DAT, found at 45 DAT. Pyrazosulfuron ethyl treated plot (T_3 and T_6) recorded higher LAI. This might be due to its better efficacy against Oxadiargyl and Pretilachlor. Pal *et al.*, (2012) got similar findings.

Effect of weed management on dry matter accumulation g/m^2

Data presented in Table 2 showed that the highest dry matter was found in weed free plot in all three crop growth stages. Among the chemically treated plots, Pyrazosulfuron ethyl 25g/ha as pre-emergence *fb* hand weeding at 40 DAT shown better dry matter accumulation. The lowest plant dry matter was observed in case of unweeded control plot, as no weed control practices was practiced there; it led to minimum plant dry matter accumulation. In case of weed free plot, maximum dry matter was recorded which might be due to continuous weed

control was followed since beginning. So no weed competition was there and better plant growth was observed. Also better aeration might be lead to maximum dry matter production. Pyrazosulfuron ethyl treated plots (T_3 and T_6) recorded higher dry matter among the chemically controlled plots, which might be due to lower weed competition and dry weight of weeds that lead to more nutrient availability to plants and higher growth parameter and ultimately higher dry matter accumulation as compared to Oxadiargyl (T_2 and T_5) and Pretilachlor (T_1 and T_4).

Effect of weed management on crop growth rate

The CGR value (Table 3) at 15-30 DAT varied from 10.85 g/m²/day to a maximum of 14.31 g/m²/day. The highest CGR value at 15 - 30 DAT recorded in weed free treatment and

lowest in unweeded control plot. In case of weed free plot highest CGR was recorded which was might be due to no crop weed competition. In case of unweeded control more crop weed competition was there so minimum crop growth rate was observed. At 30-45 DAT CGR value varied from a minimum of 12.96 g/m²/day in Pretilachlor 500g/ha as pre-emergence to 19.39 g/m²/day in Oxadiargyl 90g/ha as pre-emergence *fb* hand weeding at 40 DAT.

Effect of weed management on grain yield of rice

The yield data presented in Table 3 depicted that weed control treatments significantly affect the grain yield of transplanted *kharif* rice. Unweeded control plot produced lowest grain yield (3.33 t/ha) which was significantly lower than all weed control treatments.

Table 1 Effect of weed management on dry weight of weeds (g/m²)

Treatments	Dry weight of total weeds (g/m ²)		
	20DAT	40DAT	60 DAT
T_1 (Pretilachlor 500g/ha as pre-emergence)	1.48 (1.71)	1.81 (2.76)	2.10 (3.90)
T_2 (Oxadiargyl 90g/ha as pre-emergence)	1.23 (1.01)	1.63 (2.18)	1.98 (3.41)
T_3 (Pyrazosulfuron ethyl 25g/ha as pre-emergence)	1.08 (0.67)	1.47 (1.65)	1.88 (3.02)
T_4 (Pretilachlor 500g/ha as pre-emergence <i>fb</i> hand weeding at 40 DAT)	1.35 (1.33)	1.80 (2.74)	1.51 (1.79)
T_5 (Oxadiargyl 90g/ha as pre-emergence <i>fb</i> hand weeding at 40 DAT)	1.15 (70.83)	1.64 (2.21)	1.48 (1.68)
T_6 (Pyrazosulfuron ethyl 25g/ha as pre-emergence <i>fb</i> hand weeding at 40 DAT)	1.07 (0.64)	1.27 (1.10)	1.29 (1.15)
T_7 (Hand weeding at 20 & 40 DAT)	1.07 (0.65)	1.19 (0.91)	1.32 (1.25)
T_8 (Weed free)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)
T_9 (Unweeded control)	2.32 (4.89)	3.77 (13.74)	4.12 (16.52)
S.Em (\pm)	0.04	0.03	0.03
CD at 5 %	0.12	0.09	0.09
CV(%)	5.43	2.98	2.74

Table.2 Effect of weed management on Plant height (cm), Leaf Area Index (LAI) and Plant dry matter accumulation (g/m²)

Treatments	Plant height (cm)			LAI			Dry matter accumulation (g/m ²)		
	15DAT	30DAT	45DAT	15DAT	30DAT	45 DAT	15DAT	30DAT	45DAT
T ₁ (Pretilachlor 500g/ha as pre-emergence)	41.17	70.38	90.83	1.92	3.10	3.45	39.89	215.38	413.17
T ₂ (Oxadiargyl 90g/ha as pre-emergence)	42.19	70.69	91.81	2.18	3.17	3.51	41.32	223.22	417.67
T ₃ (Pyrazosulfuron ethyl 25g/ha as pre-emergence)	42.24	71.09	93.01	2.39	3.30	3.60	43.44	236.64	486.33
T ₄ (Pretilachlor 500g/ha as pre-emergence <i>fb</i> hand weeding at 40 DAT)	41.21	70.09	94.13	1.86	3.04	3.92	39.86	219.76	508.00
T ₅ (Oxadiargyl 90g/ha as pre-emergence <i>fb</i> hand weeding at 40 DAT))	42.13	70.78	94.24	2.29	3.44	4.01	43.22	220.36	511.22
T ₆ (Pyrazosulfuron ethyl 25g/ha as pre-emergence <i>fb</i> hand weeding at 40 DAT)	42.50	71.47	95.33	2.38	3.50	4.18	52.89	248.89	513.44
T ₇ (Hand weeding at 20 &40 DAT)	42.71	72.06	91.69	2.50	3.68	4.17	42.00	247.67	486.56
T ₈ (Weed free)	45.90	75.07	94.46	2.77	3.75	4.23	62.78	277.47	550.61
T ₉ (Unweeded control)	39.90	68.27	90.81	1.79	2.90	3.36	41.67	204.45	404.39
S.Em (\pm)	0.85	0.64	0.98	0.18	0.09	0.12	3.98	3.71	20.32
CD at 5 %	2.55	1.91	2.94	0.53	0.27	0.37	11.93	11.13	60.90
CV (%)	3.49	1.55	1.83	13.72	4.68	5.59	15.23	2.76	7.38

Table.3 Effect of weed management on Crop Growth Rate (g/m²/day)

Treatments	CGR (g/m ² /day)		Grain yield (t/ha)
	15-30 DAT	30-45DAT	
T ₁ (Pretilachlor 500g/ha as pre-emergence)	11.70	13.19	3.93
T ₂ (Oxadiargyl 90g/ha as pre-emergence)	12.13	12.96	4.01
T ₃ (Pyrazosulfuron ethyl 25g/ha as pre-emergence)	12.88	16.65	4.12
T ₄ (Pretilachlor 500g/ha as pre-emergence <i>fb</i> hand weeding at 40 DAT)	11.99	19.22	4.56
T ₅ (Oxadiargyl 90g/ha as pre-emergence <i>fb</i> hand weeding at 40 DAT))	11.81	19.39	4.90
T ₆ (Pyrazosulfuron ethyl 25g/ha as pre-emergence <i>fb</i> hand weeding at 40 DAT)	13.07	17.64	5.22
T ₇ (Hand weeding at 20 &40 DAT)	13.71	15.93	5.12
T ₈ (Weed free)	14.31	18.21	5.41
T ₉ (Unweeded control)	10.85	13.33	3.33
S.Em (±)	0.37	1.34	0.13
CD at 5 %	1.12	4.02	0.39
CV(%)	5.17	14.25	5.02

Grain yield was recorded highest of 5.41 t/ha (62.46% increase over control) in weed free treatment, due to lowest crop-weed competition. Pyrazosulfuron ethyl 25g/ha as pre-emergence *fb* hand weeding at 40 DAT and Hand weeding at 20 and 40 DAT produced 5.22 t/ha and 5.12 t/ha grain yield respectively which were at par with the weed free treatment. It was also observed that hand weeding at 40 DAT increased the grain yield over sole application of chemical weed control methods.

In conclusion, weeds are a major constraint in transplanted *kharif* rice. The present study has revealed that different weed management practices affect the plant growth parameters significantly. Although hand weeding was the most favorable mean of plant growth Pyrazosulfuron ethyl 25g/ha as pre-emergence *fb* hand weeding at 40 DAT was found good among different combined means of weed management practices.

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