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Effect of different crop establishment methods and weed management options on growth and control of weeds in rice

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Abstract
Field experiment was conducted during *Kharif* 2016 at College Farm, College of Agriculture, Rajendranagar, Hyderabad to identify the effect of different crop establishment methods and weed management options in rice. The weed spectrum of the experimental field consisted of all the three groups of weeds *viz., Cynodon dactylon, Dinebra retroflexa, Echinochloa crusgalli* and *Paspalum distichum*among grasses; *Cyperus difformis, Cyperus iria a*nd *Scirpus spp.,* among sedges and *Eclipta alba, Ammania baccifera, Trianthema portulacastrum, Euphorbia geniculata, Euphorbia hirta* and *Amaranthus viridis* among BLWs. Among different establishment methods transplanted rice recorded lowest weed density, weed dry weight and higher weed control efficiency. Among weed management practices, application of pretilachlor as PE fb hand weeding twice at 20 and 40 DAS/T recorded the lowest weed density, dry matter and higher weed control efficiency.

Keywords: weed density, weed dry matter, WCE, establishment methods.

Introduction

Rice (Oryza sativa L.) is one of the most important cereal crop and it is a staple food of more than 70 per cent of world's population (Yadav and Singh, 2006) [13]. Rice occupies 11 per cent of world agricultural land. Asia dominates the world in rice production as it accounts for about 90 per cent of world's rice area and 92 per cent of production (Pandey *et al.,* 2010) [4]. India shares around 21 per cent of global rice production from about 28 per cent of rice area. It ranks first in rice area (43.46 M ha) with second position in production (103.5 MT) in the world, but its productivity (2380 kg ha^{-1}) is much below the world's average 3900 kg ha^{-1} (Department of Agriculture and Cooperation, 2015-16) [3]. In India, transplanting is the common method of establishing rice crop. However, this method is not much profitable due to several reasons such as labour shortage, power crisis and water shortage due to late release of water into the canals, higher cost of cultivation and delayed monsoon showers. This has forced to identify alternate methods of rice cultivation without reduction in yield in addition to saving energy, water and time. Further, rice production under current inputs and technology fails to meet the projected demand thus, there is an urgent need to increase rice productivity per unit area in the world. Direct seeding is one of the alternative methods to transplanting, as it reduces labour requirement and performs as good as transplanting method at many places (Yadav and Singh, 2006) [13].

An appropriate weed control cover has always been one of the major inputs in the production strategy and a vital component of sustainable development. It is important for both the direct effects of weeds on yield and production costs as well as the indirect effects on grain quality. It has been reported that for each kilogram weeds, the loss in yield is approximately 0.75 kg. In wetland rice culture, weed control techniques include manual and chemical. Hand weeding is the most useful method for controlling annual and certain perennial weeds that usually do not regenerate from underground parts. It is practical and traditional but labour intensive method, which usually takes around 120 h ha^{-1}, while chemical weed control takes around 4 h ha^{-1}. Moreover, hand weeding of young weeds at the initial crop growth stage is very difficult especially if the soil moisture is inadequate. Under such conditions, the use of herbicides could be the best alternative for weed control in both transplanted and direct seeded rice cultures. It is time, labour and energy saving technique, however its indiscriminate use raises concerns for the individual's safety at particular and the environment at large. Researchers have reported

the diminished growth parameters of weeds and simultaneous increase in rice crop due to the application of herbicides or other weed management tools (Baloch *et al.*, 2006) [1]. The present studies were aimed to figure out the most suitable and economical techniques of weed control in transplanted, direct wet-seeded rice and aerobic rice and their impact on growth of weeds.

Materials and methods

The experiment was carried out at College Farm, College of Agriculture, Rajendranagar, Hyderabad. The farm is geographically situated at $17^0$19' 16.4" North latitude and 78^0 24' 43" East longitudes and at an altitude of 542.3 m above mean sea level. The soil of the experimental field was sandy clay loam in texture with pH 7.85, low in available nitrogen (213.2 kg ha^{-1}), high phosphorus (36.8 kg ha^{-1}) and potassium (379.0 kg ha^{-1}).The experiment was laid out in split plot design with three replications. The treatments consisted of three establishment methods of rice *viz.*, transplanted rice, direct seeded rice and aerobic rice, five levels of weed management practices *viz.*, Farmers method (Hand weeding 20 and 40 DAT/DAS), bispyribac sodium 10% SC 25 g ha-1 as PE fb fenoxaprop-p-ethyl 9.3% EC 62 g ha-1 + 2, 4-D 80% WP 0.5 kg ha-1, pendimethalin + penoxsulam 25% SE 25 g + 600 g ha-1 PE at 4-7 DAS/DAT, pretilachlor 50 % EC 0.75 kg ha-1 as PE fb hand weeding at 20 and 40 DAT/ DAS and unweeded control. In aerobic rice, seeds were sown at 20 cm apart. While, in direct seeded rice (under puddled condition) sprouted seeds were sown in line manually at 20 cm.The recommended nursery area (20 cents ha^{-1}) was puddled, leveled and the sprouted seeds (40 kg ha^{-1}) were broadcasted uniformly with a thin film of standing water. The nursery was managed well with irrigation.A uniform dose of 150, 60 and 60 kg N, P_2O_5 and K_2O ha^{-1}as urea, SSP and muriate of potash. Nitrogen was applied in three equal splits at transplanting, maximum tillering stage and panicle initiation stage. The recommended dose of phosphorous was applied as basal dose at the time of transplanting and potassium was applied in two splits at transplanting and panicle initiation stage.

The weed density, weed dry weight and weed control efficiency were recorded to assess the effect of weed management treatments. Weeds were sampled in each plot at60 DAS/T of the crop from an area of 1.0 m^{-2} counted and dried to constant weights at 60°C in hot air oven.Weed density and dry weight of each group of weeds were expressed as number m^{-2} and g m^{-2} respectively. The data on weed density and weed dry weight were subjected to square root transformation ($\sqrt{(X+1)}$ to normalize their distribution. Weed control efficiency (WCE) was computed using the total dry weight of weeds.

$$WCE\ (\%) = \frac{WDC - WDT}{WDC} \times 100$$

Where, WDC- Dry matter production of weeds in unweed control plot (g m^{-2})

WDT- Dry matter production of weeds in treated plot (g m^{-2})

Results and discussion

Effects on weeds

Prominent weed flora found in the experimental fields were, *Cyperus iria, Cyperus difformis* and *Cyperus rotundus* among sedges. *Eclipta alba, Alternanthera phyloxeroides, Ammannia baccifera, Euphorbia hirta, Caesulia axillaris, Celosia argentea (L.), Commelina benghalensis (L.) and Trianthema portulacastrum (L.)* among broad leaved weeds. *Cynodon dactylon* and *Paspalum distichum* are the grass species. Similar weed flora was reported by Bhanu Rekha *et al.* (2002) [2] in transplanted rice and in direct seeded rice and aerobic rice by Parameshwari and Srinivas (2014) [5].

Weed density (no m^{-2})

Transplanted rice recorded significantly lower density of grasses, sedges and broad leaved weeds as compared to direct seeded rice. Aerobic rice recorded significantly higher density of weeds. Among different weed management practices, distinctly lower weed density was recorded with pretilachlor *fb* hand weeding at 20 and 40 DAS/ T which was significantly superior over hand weeding at 20 and 40 DAS/T pendimethalin + penoxsulam and bispyribac sodium *fb* fenoxaprop-p-ethyl + 2,4-D. The highest density of weeds was noticed with unweeded control at 60 DAS/T. Lowest weed population under transplanted rice and direct seeded rice might be due to continuous submergence of the crop that could have effectively suppressed the weed population and weed seed germination under transplanted rice and similar trend was observed by (Subramanian *et al.* 2007and Parameshwari and Srinivas 2014) [12, 5]. Higher density of weeds was observed in aerobic rice, the unpuddled condition in aerobic rice is congenial for weed seed germination. The results are is conformity with those of (Prakash *et al*. 1995) [6]. Higher weed density in aerobic rice could be due to earlier weed germination than crop because of alternate wetting and drying in the field resulted in flush of terrestrial and aquatic weeds in early stages of crop growth. Similar results were reported by (Sharma and Bahunia 1999) [9].

The interaction between methods of establishment and weed management practices was significant for density of grasses, sedges and broad leaved weeds at 60 DAS/T. The lowest density of grasses, sedges and broad leaved weeds was recorded with transplanted rice in combination with pretilachlor *fb* H.W at 20 and 40 DAT/DAS which was significantly superior over hand weeding 20 and 40 DAT/DAS and pendimethalin + penoxsulam and bispyribac sodium *fb* fenoxaprop-p-ethyl + 2, 4-D in all establishment methods.

Table 1: Effect of establishment methods and weed management practices density of grasses, sedges and broad leaved weeds (no. m^{-2}) at 60 DAS/T in rice.

Treatments		Density of grasses (no. m^{-2})	Density of sedges (no. m^{-2})	Density of broad leaved weeds (no. m^{-2})
Establishment methods	**Weed management practices**			
M_1-Transplanted Rice	S_1	2.88 (7.33)	2.85 (7.18)	3.37 (10.36)
	S_2	3.20 (9.33)	4.04 (15.33)	4.12 (16.00)
	S_3	3.06 (8.40)	3.21 (9.33)	3.78 (13.34)
	S_4	2.64 (6.00)	2.60 (5.78)	2.48 (5.14)
	S_5	3.87 (14.00)	6.1 (37.33)	5.14 (25.47)
M_2-Direct seeded	S_1	3.31 (10.00)	3.78 (13.33)	3.41 (10.67)

rice (In puddled condition)	S_2	3.82 (13.63)	4.20 (16.67)	4.79 (22.00)
	S_3	3.44 (10.87)	3.90 (14.22)	4.35 (18.00)
	S_4	2.88 (7.33)	3.31 (10.00)	2.75 (6.67)
	S_5	4.86 (22.67)	7.50 (55.33)	5.34 (27.52)
M_3-Aerobic rice	S_1	4.24 (17.08)	5.32 (27.33)	4.79 (22.00)
	S_2	4.67 (20.83)	6.37 (9.67)	5.80 (32.75)
	S_3	4.35 (18.00)	5.68 (31.33)	4.92 (23.33)
	S_4	4.01 (15.12)	4.98 (24.00)	4.02 (15.33)
	S_5	6.35 (39.33)	8.01 (63.33)	6.29 (38.67)
MEAN				
Establishment methods (Main plots)				
M_1-Transplanted rice		3.13(9.01)	3.78 (14.99)	3.78 (14.07)
M_2-Direct seeded rice (In puddled condition)		3.66(12.90)	4.54 (21.91)	4.13 (16.97)
M_3-Aerobic rice		4.72(22.07)	6.07 (37.13)	5.17 (26.41)
Weed management practices (Sub plots)				
S_1		3.48(11.46)	3.98 (15.94)	3.86 (14.34)
S_2		3.90(14.60)	4.87 (23.88)	4.90 (23.57)
S_3		3.62 (12.42)	4.26 (18.29)	4.35 (18.23)
S_4		3.18(9.48)	3.63 (13.26)	3.09 (9.05)
S_5		5.02(25.33)	7.23 (52.00)	5.59 (30.55)

	SE(m)±	CD (P =0.05)	SE(m)±	CD (P =0.05)	SE (m)±	CD (P =0.05)
Establishment methods	0.02	0.09	0.04	0.19	0.06	0.26
Weed management practices	0.05	0.15	0.05	0.16	0.06	0.18
SUB AT MAIN	0.66	1.93	0.95	2.7	0.94	2.75
MAIN AT SUB	0.51	1.29	0.85	2.3	0.85	3.05

(Values in the parenthesis are original and $\sqrt{(x+1)}$ transformed)

S_1- Farmers method (Hand weeding 20 and 40 DAT/DAS), S2-Bispyribac sodium 10% SC 25 g ha^{-1} as PE fb fenoxaprop-p-ethyl 9.3% EC 62 g ha-1+ 2, 4-D 80% WP 0.5 kg ha^{-1},**S_3-** Pendimethalin + Penoxsulam 25% SE 25 g + 600 g ha^{-1} PE at 4-7 DAS/DAT, **S_4-** Pretilachlor 50 % EC 0.75 kg ha^{-1} as PE fb Hand weeding at 20 and 40 DAT/ DAS, **S_5-** Unweeded control.

Weed dry matter (g m^{-2})

Weed dry matter was a better parameter to measure weed competition than weed density as it measures more precisely the weed growth and the resources utilized by weeds. Among the establishment methods, transplanted rice recorded lowest dry weight and it was on par with direct wet seeded rice. Both direct seeded and transplanted rice produced lower dry weight and significantly superior to aerobic rice at 60 DAS/T. The highest dry matter was recorded in aerobic rice over other establishment methods owing to better conditions for weeds emergence and its survival. Transplanted and wet seeded rice resulted in lower weed dry matter mainly because of puddling which recorded lesser emergence of deeply placed weed seeds. These results are in agreement with the findings of Singh *et al*. (2005) [10]. Among the weed management practices at 60 DAS/T, pretilachlor as PE *fb* hand weeding at 20 and 40 DAT/S registered lower dry weight over farmers practice (HW at 20 and 40 DAS/T) and significantly superior over pendimethalin + penoxsulam PE followed by bispyribac sodium PE *fb* fenoxaprop-p-ethyl + 2, 4-D. Similar trend was observed at 60 DAS/T and at harvest. The dry weight of weeds was found to be distinctly higher under unweeded control. This might be due to the Pretilachlor S being a broad spectrum herbicide has effectively controlled the weed flora at early stages furthermore hand weeding twice at 20 & 40 DAS/T helped in effective removal of weeds at both early and later stages which helped in reducing the weed density and weed dry weight (Saha 2006) [7]. Among the herbicide mixtures, pre-mix herbicide pendimethalin + penoxsulam as PE recorded lower weed dry matter this is due to broad spectrum control of weeds compared to sequential application of herbicides, bispyribac sodium as PE *fb* fenoxaprop-p-ethyl + 2, 4-D as PoE. Integrated weed management involving pretilachlor as PE *fb* HW at 20 and 40 DAS/T resulted in lowest weed dry weight and it may be attributed to broad spectrum weed control from time to time that created weed free environment for crop growth by reducing weed dry weight (Parameshwari and Srinivas 2014) [5].

The interaction between methods of establishment and weed management practices was significant for weed dry matter at 60 DAS/T. Significantly lower dry weight was recorded under pretilachlor as PE *fb* hand weeding at 20 and 40 DAT/S over rest of the treatments among all establishment methods.

Table 2: Effect of establishment methods and weed management practices total weed density (no. m^{-2}), dry matter (g m^{-2}) and Weed control efficiency (%) at 60 DAS/T in rice.

Treatments		Total weed density (no. m^{-2})	Total weed dry matter (g m^{-2})	Weed control efficiency (%)
Establishment methods	**Weed management practices**			
M_1-Transplanted Rice	S_1	5.08 (24.88)	4.62 (20.49)	-
	S_2	6.45 (40.67)	5.38 (28.05)	-
	S_3	5.66 (31.07)	4.97 (23.87)	-
	S_4	4.22 (16.92)	4.56 (19.81)	-
	S_5	8.82 (76.80)	8.07 (64.47)	-
M_2-Direct seeded rice	S_1	5.91 (34.00)	4.54 (19.74)	-
	S_2	7.30 (52.30)	5.26 (26.80)	-

(In puddled condition)	S_3	6.64 (43.08)	4.88 (23.04)		-	
	S_4	4.99 (24.00)	4.49 (19.24)		-	
	S_5	10.32 (105.52)	8.52 (71.77)		-	
M_3-Aerobic rice	S_1	8.20 (66.41)	6.18 (37.28)		-	
	S_2	9.70 (93.25)	7.91 (61.71)		-	
	S_3	8.58 (72.67)	7.32 (52.76)		-	
	S_4	7.43 (54.45)	6.06 (35.89)		-	
	S_5	11.92 (141.33)	13.89 (192.08)		-	
MEAN						
Establishment methods (Main plots)						
M_1-Transplanted rice		6.04 (38.06)	5.52 (31.34)		-	
M_2-Direct seeded rice (In puddled condition)		7.03 (51.78)	5.54 (32.12)		-	
M_3-Aerobic rice		9.17 (85.62)	8.28 (75.94)		-	
Weed management practices (Sub plots)						
S_1		6.40 (41.76)	5.12 (25.84)		73.62	
S_2		7.82 (62.07)	6.19 (38.85)		62.16	
S_3		6.96 (48.94)	5.73 (33.22)		67.54	
S_4		5.55 (31.79)	5.04 (24.98)		74.28	
S_5		10.35(107.88)	10.17 (109.4)		-	
		SE(m)±	CD (P =0.05)	SE(m)±	CD (P =0.05)	SE (m)±	CD (P =0.05)
Establishment methods		0.05	0.22	0.15	0.59	NA	NA
Weed management practices		0.06	0.17	0.09	0.28	NA	NA
SUB AT MAIN		1.48	4.32	2.37	6.92	NA	NA
MAIN AT SUB		1.44	4.49	2.01	7.06	NA	NA

(Values in the parenthesis are original and $\sqrt{(x+1)}$ transformed)

S_1- Farmers method (Hand weeding 20 and 40 DAT/DAS), S2-Bispyribac sodium 10% SC 25 g ha^{-1} as PE fb fenoxaprop-p-ethyl 9.3% EC 62 g ha-1+ 2, 4-D 80% WP 0.5 kg ha^{-1},**S_3-** Pendimethalin + Penoxsulam 25% SE 25 g + 600 g ha^{-1} PE at 4-7 DAS/DAT, **S_4-** Pretilachlor 50 % EC 0.75 kg ha^{-1} as PE fb Hand weeding at 20 and 40 DAT/ DAS, S_5- Unweeded control.

Weed control efficiency (%)

At 60 DAS/T the highest weed control efficiency was observed in weed free treatment i.e., pretilachlor as PE *fb* hand weeding at 20 and 40 DAT/S which was closely followed by two hand weedings at 20 and 40 DAT/S and application of pendimethalin + penoxsulam PE at 4-7 DAS/DAT. Lowest weed control efficiency is recorded by application of bispyribac sodium PE *fb* fenoxaprop-p-ethyl + 2, 4-D at all the stages of crop. These results are supported by (Revathi *et al.* 2010) [8] who reported that herbicides with one hand weeding resulted in lower weed density, dry weight and gave higher weed control efficiency compared to chemical weeding alone and unweeded control. The decrease in WCE was due to increase in dry matter of weeds in unweeded control and may be attributed to more resources available to the weeds. The results are in conformity with the findings of (Sreedevi *et al.* 2016) [11].

Conclusion

Application of pre-emergence application of pretilachlor followed by hand weeding twice at 20 and 40 DAT/S registered lower weed density, dry weight and weed control efficiency among all the establishment methods.

References

1. Baloch MS, Awan IU, Hassan G, Khakwani AA. Effect of establishment methods and weed management practices on some growth attributes of rice. Rice Science. 2006; 13(2):131-140.
2. Bhanu Rekha K, Raju MS, Reddy MD. Effect of herbicides in transplanted rice. Indian Journal of Weed Science. 2002; 34(1&2):123-125.
3. Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, 2015-16. *www.India stat.com.*
4. Pandey MP, Verulkar SB, Sharma D. Rice research: past achievements, present scenario and future thrust. *Indian* Journal of Agricultural Sciences. 2010; 80(6):447-469.
5. Parameswari YS, Srinivas A. Influence of Weed Management Practices on Nutrient Uptake and Productivity of Rice under Different Methods of Crop Establishment. Journal of Rice Research. 2014; 7(1 & 2):77-86.
6. Prakash P, Nanjappa HV, Ramchandrappa BK. Chemical weed control in direct puddled rice. Crop research. 1995; 9(2) 197-202.
7. Saha S. Efficacy of herbicides in wet direct-sown summer rice. Indian Journal of Weed Science. 2006; 38(1&2):45-48.
8. Revathi M, Prabhakaran NK, Chinnusamy C, Meena S. Influence of Establishment Methods and Weed Management Practices on Nutrient Removal by Weeds and Uptake by Rice in Puddled Lowland Madras Agricultural Journal. 2012; 99(7-9):496-499.
9. Sharma SK, Bhunia SR. Weed management in transplanted rice (*Oryza sativa*) under Ghaggar flood plains of North-West Rajasthan. Indian Journal of Agronomy. 1999; 42(2):326-330.
10. Singh VP, Singh G, Singh M. Effect of bensulfuron-methyl Londex 60 DF on sedges and non-grassy weeds in transplanted rice. Indian Journal of Weed Science. 2005; 37(1&2):40-44.
11. Sreedevi B, Sandhyarani A, Srinivas D, Venkatanna B, Vinaykartheek A, Mahender KR. Chemical Weed Control in Aerobic Rice. Journal of Rice Research. 2016; 9(2):28-31

12. Subramanyam D, Raghava Reddy C, Srinivasulu Reddy. Influence of puddling intensity and water management practices on weed dynamics and yield of transplanted rice. *oryza sativa* L. Indian Journal of Agronomy. 2007; 52 (3):225-330.
13. Yadav V, Singh B. Effect of crop establishment methods and weed- management practices on rice Oryza sativa L. and associated weeds. Indian Journal of Agronomy. 2006; 51(4):301-303.