

Effect of mechanical weeding on weeds infestation productivity and profitability of aerobic rice

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ABSTRACT

Field experiments were conducted at wetland farm of TNAU during *rabi* 2006-07 and *kharif* 2007, to evaluate the efficiency of mechanical weeders on weeds, productivity and economics of aerobic rice. Minimum weed density, weed dry weight and higher weed control efficiency including grain yield of aerobic rice were obtained in plots receiving pre-emergence application of pendimethalin at 1.0 kg/ha followed by mechanical weeding with single type sweep weeder at 45 DAS followed by single wheel hoe at 45 DAS and both proved more remunerative than hand weeding twice at 25 and 45 days.

Key words : Mechanical weeders, Aerobic rice, Weed management

Rice is the staple food for more than three billion people in the world. Water-saving technologies are adopted in aerobic rice system of rice production to mitigate the effect of water shortages at farm level (Bouman *et al.* 2005). Aerobic rice requires less water and labour than rice established through transplanting. It is usually subjected to higher weed pressure (Balasubramanian and Hill 2002). But, weeds are perceived to be the most severe constraint in aerobic rice production. The yield loss due to weeds as high as 43 per cent have been reported in direct seeded rice (Moody 1983). Mostly aerobic rice growers remove weed two or three times in each season (Roder 2001). Hand pulling, hand hoeing and intercultivation with animal drawn implements are still common on small farms growing aerobic rice in tropical Asia and Africa. Though manual weeding is considered to be the best, the undependable labour availability and escalating wages in many cases has given impetus to the development and use of chemicals for the control of weeds. Timely weeding is necessary for mechanical control and also it needs the optimum moisture for its easy working. Thus, integrated weed management involving use of herbicides along with mechanical weeding with tools and implements is gaining momentum in the developed countries. Keeping this in view, the field experiment has been taken to evaluate the efficiency of different kinds of mechanical weeder alone and in combination with herbicides in aerobic rice.

MATERIALS AND METHODS

Field experiments were conducted during *rabi* 2006-2007 and *kharif* 2007 at wetland of Tamil Nadu Agricultural University. The soil of the experimental field was clayey in texture. The soil was medium in nitrogen and high in available phosphorus and potassium. The

experiment was laid out in randomized block design. The experiment consisted of eleven treatments involving mechanical weeding through wheel hoe, star rotary, peg rotary, single tyne sweep weeder alone at 25 and 45 DAS (TG) and in combination with pre-emergence application of pendimethalin 1.0 kg/ha and these treatments were compared with two hand weedings on 25 and 45 DAS (TG), pre emergence application of pendimethalin 1.0 kg/ha along with one hand weeding on 45 DAS (TG) including unweeded control. The seeds of PMK-3 were sown in each plots using the drum seeder at a rectangular geometry of 20 x 10 cm at 1-2 cm depth. The observations of weed density and weed dry weight were recorded at treatment wise 25 and 45 DAS with the help of least count method using quadrat of 100 x 100 cm. The economics of treatments was determined by considering the cost of inputs used and value of products (grain and straw).

RESULTS AND DISCUSSION

Effect on weeds

The predominant weed flora in the experimental field was consisted of *Cynodon dactylon*, *Echinochloa colona*, *Dactyloctenium aegyptium* and *Chloris barbata* among the grasses and *Alternanthera pungens*, *Portulaca oleraceae*, *Cleome chelidoni*, *Parthenium hysterophorus*, *Eclipta alba* and *Tridax procumbens* were among the predominant broad leaved weeds, which constituted the major proportion of the weed density.

Weed control treatments caused marked variation on density and dry weight of weeds during *rabi* 2006-2007 and *kharif* 2007 (Table 1). Mechanical weeding twice at 25 and 45 DAS without pre-emergence application of pendimethalin 1.0 kg/ha did not curb the density and dry weight of weeds to the level of satisfaction. However,

marked reduction in both indices was observed in plots receiving pre-emergence application of pendimethalin 1.0 kg/ha following by mechanical weeding at 45 DAS with the sets of hoes/weeders being the minimum under pre-emergence application of pendimethalin (1.0 kg/ha) *fb* hand hoeing with hand hoe as single type sweep weeder at 45 DAS and proved superior over other treatments. But the former treatments could not impose hand weeding twice (25 and 45 DAS) and pre-emergence application of pendimethalin 1.0 kg/ha *fb* hand weeding once at 45 DAS, which attained the lower values of weed density including their dry weight. Mulder and Dolt (1983) also recorded minimum weed growth with pre-emergence application of herbicides along with mechanical weeding.

Weed control efficiency varied appreciably under mechanical and integrated weed management practices. It was invariably lesser in all the plots wherever weeds were controlled only through mechanical means during *rabi* (2006-07) and *kharif* (2007) seasons at 25 and 45 DAS (Table 1). But identical increase in weed control efficiency was noted in all the plots receiving integrated

weed management being the maximum under pendimethalin 1.0 kg/ha + single type sweep weeder (90.2 and 93.6%; 94.0 and 94.0%) followed by pendimethalin 1.0 kg/ha + wheel hoeing (88.1 and 91.3%; 90.8 and 91.4%) at both the treatments even surpassed pendimethalin 1.0 kg/ha + hand weeding which registered the lesser values of WCE (80.9 and 89.6%; 81.7 and 88.6%) at 25 and 45 DAS in both the seasons.

Effect on grain and straw yields

Grain and straw yields of rice varied significantly due to different weed control treatments in both *rabi* and *kharif* seasons. Grain and straw yields were minimum during both the seasons when weeds were allowed to compete with rice throughout the growing period. However, marked increase in both the indices was observed when weeds were controlled either by mechanical means or by integrated weed management. Grain and straw yield of rice were higher in plots receiving mechanical weed control twice, which were further increased in plots receiving integrated weed management being the highest under pendimethalin 1.0 kg/ha *fb* mechanical weeding

Table 1. Effect of different weed control methods on weed characters in aerobic rice

Treatment	Weed density (no./m ²)				Weed dry weight (g/m ²)				WCE (%)			
	Rabi 2006-07		Kharif 2007		Rabi 2006-07		Kharif 2007		Rabi 2006-07		Kharif 2007	
	25	45	25	45	25	45	25	45	25	45	25	45
T ₁ - HW twice	1.5 (2.6)	1.6 (3.6)	2.3 (8.5)	1.9 (4.7)	3.29 (25.6)	3.27 (234.6)	3.37 (26.8)	3.37 (25.6)	70.4	87.6	71.7	86.5
T ₂ - Wheel hoe twice	1.9 (4.9)	2.0 (5.6)	2.0 (5.6)	1.9 (4.7)	2.57 (10.4)	2.95 (17.6)	2.34 (8.7)	2.94 (16.4)	88.1	91.3	90.8	91.4
T ₃ - Star rotary twice	2.7 (13.5)	2.9 (16.4)	2.7 (12.5)	2.9 (15.8)	3.21 (23.2)	3.54 (32.8)	3.34 (25.8)	3.52 (31.7)	73.3	83.5	72.8	83.4
T ₄ - Peg rotary twice	3.1 (21.7)	3.4 (27.6)	3.0 (19.4)	3.2 (23.2)	3.63 (36.4)	3.51 (33.7)	3.63 (35.6)	3.64 (35.2)	58.4	83.0	62.4	81.5
T ₅ - Single tyne sweep twice	2.3 (018.5)	3.3 (24.5)	3.0 (17.6)	3.1 (20.6)	3.48 (30.2)	3.67 (36.4)	3.46 (31.4)	3.61 (34.3)	65.2	81.7	66.8	82.0
T ₆ - Pendimethalin 1.0 Kg/ha <i>fb</i> Wheel hoe	2.9 (15.6)	2.5 (10.4)	2.9 (16.4)	2.5 (9.4)	3.14 (21.6)	3.24 (23.5)	3.07 (19.5)	3.21 (22.7)	75.2	88.2	79.4	88.1
T ₇ - Pendimethalin 1.0 Kg/ha <i>fb</i> HW	1.7 (3.5)	1.3 (2.5)	1.9 (4.6)	1.7 (3.6)	2.86 (16.5)	3.14 (20.7)	2.98 (17.4)	3.19 (21.8)	80.9	89.6	81.7	88.6
T ₈ - Pendimethalin 1.0 Kg/ha <i>fb</i> star rotary	2.2 (6.8)	3.0 (18.6)	2.2 (7.3)	2.9 (16.5)	2.96 (16.5)	3.18 (22.3)	2.87 (15.6)	3.14 (20.3)	80.9	88.7	83.5	89.3
T ₉ - Pendimethalin 1.0 Kg/ha <i>fb</i> peg rotary	2.3 (8.5)	2.8 (14.5)	2.5 (9.1)	2.7 (12.5)	3.04 (18.3)	3.24 (24.6)	2.98 (17.4)	3.24 (22.5)	78.9	87.6	81.6	88.2
T ₁₀ - Pendimethalin 1.0 Kg/ha <i>fb</i> single tyne sweep	2.1 (6.3)	1.9 (6.5)	2.2 (7.0)	2.0 (5.4)	2.36 (8.5)	2.68 (12.7)	2.15 (6.6)	2.61 (11.4)	90.2	93.6	93.0	94.0
T ₁₁ - Control	3.8 (40.8)	4.2 (64.5)	3.9 (47.8)	4.4 (73.8)	4.52 (86.7)	5.24 (198.5)	4.57 (94.7)	5.26 (190.5)	-	-	-	-
LSD (P=0.05)	0.6	0.5	0.3	0.4	0.26	0.43	0.42	0.61	-	-	-	-

Figures in parenthesis are the original values; WCE (weed control efficiency)

Table 2. Effect of different weed control methods on yield and economics in aerobic rice

Treatment	Rabi 2006-2007				Kharif 2007			
	Grain yield (kg/ha)	Straw yield (kg/ha)	Net returns (Rs/ha)	B:C ratio	Grain yield (kg/ha)	Straw yield (kg/ha)	Net returns (Rs/ha)	B:C ratio
T ₁ - HW twice	3620	4920	9340	1.83	3475	4712	8511	1.76
T ₂ - Single tyne sweep twice	3845	5225	11298	2.07	3654	4925	10193	1.97
T ₃ - Wheel hoe twice	4020	5460	12290	2.17	3962	5373	11957	1.88
T ₄ - Star rotary twice	3495	4748	9109	1.85	3385	4595	8483	1.79
T ₅ - Peg rotary twice	3650	4960	9990	1.93	3460	4690	8905	1.83
T ₆ - Pendimethalin 1.0 kg/ha <i>fb</i> HW	4182	5465	12273	2.08	4025	5458	11484	1.99
T ₇ - Pendimethalin 1.0 g/ha <i>fb</i> wheel hoe	4165	5658	12544	2.13	3985	5385	11508	2.04
T ₈ - Pendimethalin 1.0 kg/ha <i>fb</i> star rotary	3994	5426	11473	2.02	3795	5120	10325	1.92
T ₉ - Pendimethalin 1.0 kg/ha <i>fb</i> peg rotary	4045	5496	11763	2.05	3950	5374	11227	2.00
T ₁₀ - Pendimethalin 1.0 kg/ha <i>fb</i> single tynesweep	4394	5875	13798	2.24	4125	5650	12340	2.11
T ₁₁ - Control	1835	2626	1668	1.19	1925	2675	2143	1.24
LSD (P=0.05)	342	436	-	-	368	434	-	-

with single type sweep weeder in both the seasons (*rabi* 2006-07 and *kharif* 2007) followed by pendimethalin 1.0 kg/ha *fb* hand weeding twice and pendimethalin 1.0 kg/ha *fb* mechanical weeding with star rotary weeder. Effective control of weeds during critical period of crop-weed competition in rice is the reason for higher yields in the aforesaid treatments.

Economics

Net return and B:C ratio of aerobic rice varied significantly due to different weed control treatments in both *rabi* and *kharif* seasons. Net return and B:C ratio were higher in plots receiving integrated weed management practices. Net return and B:C ratio was higher in plots receiving pendimethalin 1.0 kg/ha *fb* mechanical weeding with single type sweep weeder in both the seasons (*rabi* 2006-07 and *kharif* 2007). Net return and B:C ratio were minimum during both the seasons when weeds were allowed to compete with rice throughout the growing period.

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