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Growth and Yield of Aerobic Rice as Influenced by Integrated Weed Management Practices

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ABSTRACT

A field experiment was conducted during **kharif** 2009 at Zonal Agricultural Research Station, V. C. Farm, Mandya, Karnataka. The experiment consisted of 12 treatments laid out in randomized complete block design with three replications consisting of four pre-emergence herbicides integrated with one intercultivation at 40 days after sowing, hand weeding twice at 20 and 40 days after sowing, intercultivation thrice at 20, 40 and 60 days after sowing compared with weed free and unweeded check. The predominant weed flora observed in the experimental field were *Echinochloa colonum, Digitaria marginata, Ageratum conyzoides, Spilanthus acmella, Commelina benghalensis, Celosia argentia, Cyperus iria* and *Cyperus rotundus*. The results revealed that pre-emergence application of bensulfuron methyl+pretilachlor (6.6 GR) @ 0.06+0.60 kg/ha+one intercultivation at 40 days after sowing recorded significantly higher grain and straw yield (4425 and 5020 kg/ha, respectively), lower weed population and their dry weight (17.0 g and 2.32 g 0.25/m^2, respectively). Further the net returns and B : C ratio were also high with the pre-emergence application of bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg/ha+one intercultivation at 40 days after sowing.

Key words : Aerobic rice, integrated weed management, economics

INTRODUCTION

Water shortage is becoming severe in many rice-growing areas in the world, the introduction of aerobic rice which means growing of high yielding rice in non-puddled and non-flooded aerobic soil with the support of external inputs like supplementary irrigation, manures and fertilizers; aerobic rice systems can reduce water use in rice production by as much as 50% (Bouman, 2001). However, direct-seeded aerobic rice is subject to more severe weed infestation than transplanted lowland rice, because in aerobic rice systems weeds germinate simultaneously with rice, and there is no water layer to suppress weed growth. In aerobic rice, weeds cause yield loss to an extent of 50-100% (Mishra and Singh, 2007); they are a major hurdle to broad adoption of aerobic rice. In such conditions integrated weed management offers most practical and cost effective means of reducing weed competitions. Therefore, to study the efficacy of some weed management practices on aerobic rice, the present investigation was undertaken.

MATERIALS AND METHODS

A field experiment was conducted during **kharif** season of 2009 at Zonal Agricultural Station, V. C. Farm, and Mandya district. The soil of the experimental site was red sandy loamy in texture and pH was normal (6.9). The soil was medium in available nitrogen (297.5 kg/ha), available phosphorus (27.2 kg/ha) and available potassium (174.3 kg/ha). The organic carbon content was medium (0.59%) in range. MAS-946-1, a popular medium duration variety, was sown in July with a spacing of 25 x 25 cm. Experiment consisting 12 treatments i. e. T_1–Butachlor (50 EC) @ 1.0 kg/ha as pre-emergent herbicide, T_2–Pyrazosulfuron ethyl (5 WP) @ 0.025 kg/ha as pre-emergent herbicide, T_3–Oxyfluorfen (23.5 EC) at 0.10 kg/ha as pre-emergent herbicide, T_4–Bensulfuron methyl+Pretilachlor (6.6 GR) @ 0.06+0.60 kg/ha as pre-emergent herbicide (pre-mix formulation), T_5–Butachlor (50 EC) @ 1.0 kg/ha as pre-emergent+one intercultivation at 40 DAS, T_6–Pyrazosulfuron ethyl (5 WP) @ 0.025 kg/ha as pre-emergent+one intercultivation at 40 DAS, T_7–Oxyfluorfen (23.5 EC) @ 0.10 kg/ha as pre-emergent+one intercultivation at 40 DAS, T_8–Bensulfuron methyl+Pretilachlor (6.6 GR) @ 0.06 + 0.60 kg/ha as pre-emergent herbicide (pre-mix formulation) + one intercultivation at 40 DAS, T_9–Intercultivation at 20, 40 and 60 DAS, T_{10}–Two hand weedings at 20 and 40 DAS, T_{11}–Weed free check and T_{12}–Unweeded check was laid out in randomized complete block design (RCBD) with three replications. Pre-emergent application of herbicides was done at three days after sowing. Since the data on weed count and weed dry weight showed high variation, the data were subjected to square root transformation using the formula $\sqrt{x+0.5}$ and the statistical analysis was done. Weed index and weed control efficiency were calculated as per the standard formulae.

$$\text{Weed control efficiency} = \frac{\text{Dry matter production of weeds in unweeded plot} - \text{Dry weight production of weeds in treated plot}}{\text{Dry matter production of weeds in unweeded plot}} \times 100$$

$$\text{Weed index} = \frac{\text{Yield from weed free plot} - \text{Yield from treatment plot}}{\text{Yield from weed free plot}} \times 100$$

RESULTS AND DISCUSSION

Effect on Weeds

The important weed species observed in the experimental field were *Echinochloa colonum, Digitaria marginata, Dactyloctenium aegyptium*, *Ageratum conyzoides, Commelina benghalensis, Cyanotis axillaris, Croton bonplandianum, Spilanthus acmella, Acanthospermum hispidum, Mollugo disticha, Phyllanthus niruri, Celosia argentia, Protulacae oleraceae*, *Aeschynomene indica*, *Cyperus rotundus* and *Cyperus esculentus.*

Pre-emergent application of bensulfuron methyl +pretilachlor (6.6 GR) @ 0.06+0.60 kg/ha+one intercultivation at 40 DAS recorded lower weed population and dry weight of weeds, respectively. Whereas unweeded check recorded significantly higher weed population and weed dry weight, respectively (Table 1).

Higher weed control efficiency and lower weed index were recorded with bensulfuron methyl+ pretilachlor (6.6 GR) @ 0.06+0.60 kg/ha+one intercultivation at 40 DAS which was followed by bensulfuron methyl+pretilachlor (6.6 GR) @ 0.06+0.60 kg/ha. This was mainly due to better control of weeds' growth even upto harvest resulting in lower dry weight of weeds. The results are in conformity with the findings of Singh *et al.* (2005).

Table 1. Effect of weed control treatments on weed population and weed dry weight of aerobic rice

Treatments	Weed population (No./0.25 m^2)			Weed dry weight (g/0.25 m^2)			WCE (%)	WI (%)
	Monocots	Dicots	Sedges	Monocots	Dicots	Sedges		
T_1	3.29 (10.3)	4.59 (20.7)	3.29 (10.3)	2.46 (5.60)	2.77 (7.13)	0.92 (0.35)	38.8	45.3
T_2	3.13 (9.33)	3.38 (11.0)	2.76 (7.33)	1.52 (1.83)	2.08 (3.90)	0.88 (0.27)	54.0	32.2
T_3	3.24 (10.0)	4.02 (15.7)	3.43 (11.3)	2.02 (3.59)	2.69 (6.77)	0.90 (0.31)	46.1	40.9
T_4	2.73 (7.00)	3.13 (9.33)	2.41 (5.33)	1.46 (1.65)	1.49 (1.73)	0.81 (0.16)	80.3	14.4
T_5	3.18 (9.67)	3.85 (14.3)	3.18 (9.67)	1.89 (3.07)	1.88 (3.03)	0.89 (0.29)	62.0	31.5
T_6	2.86 (7.67)	3.23 (10.0)	2.73 (7.00)	1.54 (1.89)	1.55 (1.93)	0.82 (0.18)	74.6	24.3
T_7	3.07 (9.00)	3.67 (13.0)	2.97 (8.33)	1.76 (2.60)	1.83 (2.87)	0.86 (0.24)	69.2	25.9
T_8	2.48 (5.67)	2.80 (7.33)	2.11 (4.00)	1.24 (1.05)	1.29 (1.17)	0.77 (0.10)	89.4	07.1
T_9	4.10 (16.3)	5.37 (28.3)	3.67 (13.0)	1.68 (2.31)	1.72 (2.47)	0.92 (0.33)	47.7	48.9
T_{10}	3.67 (13.0)	5.21 (26.7)	3.46 (11.7)	2.04 (3.67)	1.82 (2.90)	0.91 (0.32)	48.2	33.5
T_{11}	2.34 (5.00)	2.61 (6.33)	1.86 (3.00)	0.83 (0.19)	0.80 (0.15)	0.72 (0.02)	99.2	-
T_{12}	5.64 (31.3)	9.29 (86.0)	7.60 (57.7)	5.68 (31.9)	3.32 (10.5)	2.11 (3.97)	-	79.2
LSD (P=0.05)	0.31	0.48	0.52	0.290	0.330	0.449	NA	NA

Values in parentheses are original values. NA–Not Analyzed.

Effect on Crop Growth

Bensulfuron methyl+pretilachlor (6.6 GR) @

0.06 + 0.60 kg/ha (pre-mix formulation) applied at 3 DAS + one intercultivation at 40 DAS recorded higher plant height, more number of tillers, higher leaf area and higher dry matter production. Among herbicides, bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg/ha (pre-mix formulation) applied at 3 DAS recorded higher plant height, more number of tillers, higher leaf area and higher dry matter production (Table 2).

Table 2. Effect of weed control treatments on growth parameters of aerobic rice

Treatments	Plant height (cm)	No. of tillers/ hill	Leaf area (cm^2/hill)	Dry weight of plant (g/hill)
T_1	69.30	17.7	1131.29	49.40
T_2	74.10	22.7	1587.96	56.03
T_3	69.60	19.3	1484.61	55.00
T_4	77.60	26.7	2131.16	66.27
T_5	74.50	23.4	1757.61	56.63
T_6	76.90	25.2	1889.98	63.87
T_7	74.80	24.0	1791.05	60.23
T_8	79.10	27.2	2175.41	69.30
T_9	65.60	15.8	1037.71	46.10
T_{10}	73.80	22.3	1530.28	56.07
T_{11}	80.40	29.6	2487.74	71.13
T_{12}	58.70	8.7	502.48	28.07
LSD (P=0.05)	2.77	2.37	312.48	4.56

Effect on Yield and Yield Parameters

Bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06 + 0.60 kg/ha (pre-mix formulation) applied at 3 DAS + one intercultivation at 40 DAS recorded higher grain yield. Among herbicides, bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06+0.60 kg/ha (pre-mix formulation) applied at 3 DAS recorded higher grain yield. The straw yield also followed similar trend as that of grain yield.

Among weed control treatments, bensulfuron methyl+pretilachlor (6.6 GR) @ 0.06+0.60 kg/ha (pre-mix formulation) applied at 3 DAS + one intercultivation at 40 DAS recorded higher yield components like productive tillers per hill, panicle length, weight of panicle, filled spikelets per panicle and lower sterility per cent and 1000-grain weight (23.70 g). Among herbicides, bensulfuron methyl+pretilachlor (6.6 GR) @ 0.06+0.60 kg/ha (pre-mix formulation) applied at 3 DAS recorded higher yield components (Table 3).

Table 3. Effect of weed control treatments on yield parameters and yield of aerobic rice

Treatments	Productive tillers/ hill	Panicle weight (g)	1000-grain weight (g)	Filled spikelets/ panicle	Grain yield (kg/ha)	Straw yield (kg/ha)	Net returns (Rs./ha)	B : C ratio
T_1	13.3	2.97	20.67	95.23	2826	3250	7737	1.38
T_2	20.5	3.17	22.57	101.10	3503	3960	14233	1.70
T_3	17.2	3.03	21.17	106.80	3057	3520	10092	1.50
T_4	24.5	3.67	23.63	125.30	4425	5020	23328	2.14
T_5	21.1	3.27	21.80	111.80	3543	4080	14530	1.70
T_6	22.4	3.47	22.13	120.70	3913	4610	18143	1.87
T_7	21.8	3.33	21.87	114.23	3828	4430	17459	1.85
T_8	25.9	3.80	23.70	128.60	4804	5470	26815	2.29
T_9	11.8	2.93	20.30	86.70	2652	3010	5789	1.28
T_{10}	19.7	3.13	21.77	96.70	3438	3860	12043	1.55
T_{11}	27.2	3.97	24.07	133.20	5171	6030	25193	1.96
T_{12}	07.8	2.63	19.80	84.17	1074	1330	-8857	0.55
LSD (P=0.05)	1.67	0.23	1.50	5.55	568	579	-	-

Economics

Maximum net returns were obtained with bensulfuron methyl+pretilachlor (6.6 GR) @ 0.06+0.60 kg/ha (pre-mix formulation) applied at 3 DAS+one intercultivation at 40 DAS followed by bensulfuron methyl+pretilachlor (6.6 GR) @ 0.06+0.60 kg/ha (pre-mix formulation) applied at 3 DAS. Higher benefit : cost ratio was recorded in bensulfuron methyl+pretilachlor (6.6 GR) @ 0.06+0.60 kg/ha (pre-mix formulation) applied at 3 DAS+one intercultivation at 40 DAS (2.29) followed by bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06+0.60 kg/ha (pre-mix formulation) applied at 3 DAS (2.14). The unweeded check recorded lower B : C ratio (Table 3).

Pre-emergence application of bensulfuron methyl +pretilachlor (6.6 GR) @ 0.06+0.60 kg/ha (pre-mix formulation) applied at 3 DAS+one intercultivation at 40 DAS resulted in higher grain yield and B : C ratio besides giving broad spectrum of weed control followed by application of bensulfuron methyl + pretilachlor (6.6 GR) @ 0.06+0.60 kg/ha (pre-mix formulation) applied at 3 DAS alone. These weed management methods were found to be promising to control weeds in aerobic rice and would play an important role in areas where labour is too expensive and time is a constraint.

REFERENCES

Bouman, B. A. M. (2001). Water-efficient management strategies in rice production. *Int. Rice Res. Notes* **26** : 17-22.

Mishra, J. S. and V. P. Singh. 2007. Integrated weed management in zero till direct seeded rice (*Oryza sativa* L.)-wheat (*Triticum aestivum*) cropping system. *Ind. J. Agron.* **52** : 198-203.

Singh, V. P., Govindra Singh and Mahendra Singh. 2005. Effect of bensulfuron-methyl (Londox 60 DF) on sedges and weeds in transplanted rice. *Ind. J. Weed Sci.* **37** : 40-44.