Indian Journal of Weed Science **48**(2): 152–154, 2016
DOI: 10.5958/0974-8164.2016.00038.1

Integrated weed management in aerobic rice

P. Saravanane*, S. Mala and V. Chellamuthu
Department of Agronomy, Pandit Jawaharlal Nehru College of Agriculture & Research Institute, Karaikal, Puducherry 609 603

Received: 25 April 2016; Revised: 6 June 2016

ABSTRACT

Field experiment was carried out to study the effect of integrated weed management in aerobic rice (*Oryza sativa* L.) for consecutive two *Kharif* seasons in 2011 and 2012 at Karaikal, Puducherry Union Territory with seven treatments in three replications. Grassy weeds dominated the weed flora, with *Echinochloa colona* as the major weed. Weed free condition maintained throughout the crop growth recorded significantly lower weed density, dry weight and higher weed control efficiency. Though the highest gross monetary returns (₹ 56,000/ha) and net returns (₹ 25,360/ha) was recorded in weed free condition, maximum B: C ratio (1.94) was recorded in pre-emergence application of pendimethalin 1.0 kg/ha along with a hand weeding at 30 days after sowing (DAS). Uncontrolled weeds accounted for 86.3% yield loss in aerobic rice under coastal ecosystem of Puducherry UT, India.

Key words: Aerobic rice, B:C ratio, Coastal ecosystem, IWM, Yield loss

Rice is the world's most important irrigated crop. The looming global water crisis threatens the sustainability of irrigated rice, which is the biggest water user in Asia. Aerobic rice is the new concept of growing rice in non-puddled and non-flooded aerobic soil. Aerobic system of rice production saved irrigation water by more than half compared to flooded system and can possibly mitigate water scarcity in future (Singh *et al*. 2008). However, weeds are one of the main constraints in aerobic rice cultivation. Yield loss from 50 to 100% has been reported in aerobic rice (Mishra and Singh 2007).

Nowadays, the use of herbicides is gaining popularity in rice fields due to their rapid effects and the lower costs compared with the traditional methods. But continuous use of herbicides alone at higher dose may lead to the problems of residual toxicity, besides causing a shift in weed flora. Dependence on manual weed control alone is time consuming and costly. Hence, integrated weed management practices offers most practical and cost effective means of reducing weed competition in aerobic rice (Mahajan and Chauhan 2013). Considering the above facts, a field experiment was conducted to study the effect of integrated weed management in aerobic rice under coastal ecosystem of Puducherry UT, India.

MATERIALS AND METHODS

Field experiment was conducted during *Kharif* (June to September) 2011 and 2012 at Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, (11° 56' N latitude,79° 53' E longitude, 8 m above mean level), Puducherry (Union Territory), India. The soil of the experimental field was sandy clay loam in texture, near neutral in reaction (pH: 6.94), low in available N (119 kg/ha) and high in available P (24 kg/ha) and K (366 kg/ha).

The experiment was laid out in randomized block design with seven treatments in three replications. The treatments were *viz*. butachlor 1.25 kg/ha +1 hand weeding at 30 DAS, pendimethalin 1.0 kg/ha + 1 hand weeding at 30 DAS, pretilachlor with safener 0.45 kg/ha + 1 hand weeding at 30 DAS, anilophos 0.4 kg/ha +1 hand weeding at 30 DAS, hand weeding twice at 15 and 30 days after sowing (DAS), weed free throughout and unweeded control. The rice cultivar '*PMK 3*' was sown on 3rd June, 2011 and 5th June, 2012 with 20 cm spacing between rows. Recommended dose of fertilizers and irrigations were given uniformly. Herbicides for concerned treatments were applied with knapsack sprayer with a spray volume of 500 l/ha. Rest of the management practices were in accordance with the recommended package of practices for individual crop.

Weed counts (monocots and dicots) were recorded at flowering stage with the help of 50 x 50 cm quadrates at two random places in each plot. The data on weed density and dry weight was transformed using $\sqrt{x+0.5}$ to normalize their distribution before analysis. The weed control efficiency and weed index was calculated by using the standard

***Corresponding author:** psaravanane@rediffmail.com

formulae. For economic study, prevailing market prices was used for different inputs and outputs. The experimental data were subjected to statistical scrutiny as per the procedures given by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Weed flora

Important weeds observed in experimental field were *Echinochloa colona* L., *Leptochloa chinensis* L., *Panicum repens* L., *Dactyloctenium aegyptium* Beauv., *Cynodon dactylon* L. Pers., *Cyperus rotundus* among monocots; *Commelina benghalensis* L., *Aeschynomene indica* L., *Trianthema portulacastrum* L., *Eclipta alba* L., and *Cleome viscosa* L., among dicot weeds.

Weed biomass

Weed free treatment recorded lowest monocot, dicot, total weed biomass as 27.2, 5.5 and 32.7 no./ m^2, respectively and dry weight 7.1, 0.6 and 7.7 g/ m^2, respectively during both the years (Table 1). It was followed by hand weeding twice, integrated weed management under pendimethalin and pretilachlor with safener. Chauhan and Yadav (2013) observed that pendimethalin has been found to be effective against *Echinochloa* spp., *D. aegyptium* and *L. chinensis*. The herbicidal effect of pendimethalin might be due to the inhibition of cell division by tubulin inactivation and thus curtailed the seed germination of weeds (Das and Duary 1998). Better weed control under pre-emergence application of pendimethalin and pretilachlor with safener in aerobic rice was earlier observed by Ramesh *et al.* (2009). Application of other pre-emergence herbicides like butachlor and anilophos was found ineffective in controlling weed germination and its growth under non-flooded condition of aerobic rice. Unweeded control produced significantly higher number of weeds (357.7 no./m^2) as well as dry weight (430.3 g/ m^2).

Weed control efficiency

Pre-emergence application of butachlor and anilophos along with a hand weeding in non-flooded soil resulted in weed control efficiencies of 42.9 and 47.3%, respectively. Lower weed control efficieny under these treatments were due to ineffective weed control (Jhon *et al.* 2012). However, maintaining weed free condition throughout the crop period in aerobic rice recorded highest weed control efficiency of 98.2%.

Effect on crop

Uncontrolled weeds cause stunted crop growth with reduced plant height (53.1 cm), productive tillers (4.8), filled grain percentage (50.6), rice grain yield (0.4 t/ha) and yield reduction to the magnitude of 86.3% due to severe weed competition. However, all the weed management treatments improved the growth, yield parameters and grain yield over unweeded control (Table 2). Significantly higher rice grain yield was recorded with weed free condition (2.93 t/ha). It was followed by the hand weeding twice at 15 and 30 DAS and pendimethalin1.0 kg/ha + 1 hand weeding at 30 DAS (2.52 and 2.51 t/ha, respectively). Singh *et al.* (2005) observed that effective weed control by the use of herbicides during critical weed competition period results in better availability of resources for the growth and development of rice crop.

Table 1. Effect of weed management practices on weed density and dry weight in aerobic rice (pooled data of two years)

Treatment	Monocot weed density (no./m^2)	Dicot weed density (no./m^2)	Total weed density (no./m^2)	Monocot weed dry weight (g/m^2)	Dicot weed dry weight (g/m^2)	Total weed dry weight (g/m^2)	Weed control efficiency (%)
Butachlor 1.25 kg/ha+ 1 HW	13.8 (178)	7.0 (51.3)	15.4 (230)	15.4 (224)	3.8 (21.0)	16.1 (245)	42.9
Pendimethalin 1.0 kg/ha + 1 HW	12.5 (151)	3.2 (8.3)	12.8 (160)	11.7 (136)	3.3 (13.0)	12.4 (149)	65.3
Pretilachlor with safener 0.45 kg/ha + 1 HW	13.2 (163)	5.4 (38.8)	14.5 (202)	12.9 (168)	1.5 (3.6)	13.1 (172)	60.0
Anilophos 0.4 kg/ha + 1 HW	13.0 (159)	7.9 (60.5)	15.2 (220)	13.6 (182)	4.6 (44.2)	15.5 (227)	47.3
Hand weeding twice (15 and 30 DAS)	11.5 (123)	5.0 (31.2)	12.8 (154)	12.6 (149)	0.8 (0.2)	12.6 (149)	65.3
Weed free	5.1 (27)	2.3 (5.5)	5.7 (32)	2.5 (7)	0.8 (0.6)	2.5 (8)	98.2
Unweeded control	17.9 (307)	7.0 (50.3)	19.3 (358)	19.7 (374)	5.7 (56.2)	20.9 (430)	0.0
LSD (P=0.05)	2.42	3.10	2.64	2.56	2.62	2.75	-

Data subjected to $\sqrt{x+0.5}$ transformation. Figures in parentheses are original values. HW=Hand weeding

Table 2. Effect of weed management practices on growth, yield and economics in aerobic rice (pooled data of two years)

Treatment	Plant height (cm)	Productive tillers (no)	Filled grain (%)	Rice yield (t/ha)	Weed index	Gross returns ($x10^3$ `/ha)	Net returns ($x10^3$ `/ha)	B:C ratio
Butachlor 1.25 kg/ha+1 HW	86.1	6.7	67.6	1.33	54.4	27.00	3.69	1.14
Pendimethalin 1.0 kg/ha+1 HW	91.4	8.6	78.3	2.51	14.3	48.03	23.10	1.94
Pretilachlor with safener 0.45 kg/ ha + 1 HW	85.6	6.5	75.2	1.92	34.3	38.35	13.43	1.49
Anilophos 0.4 kg/ha + 1 HW	84.4	7.1	70.7	1.38	52.7	27.81	4.69	1.18
Hand weeding twice (15&30 DAS)	90.5	9.1	78.5	2.52	14.1	48.13	22.81	1.92
Weed free	93.0	10.7	79.1	2.93	-	56.00	25.36	1.84
Unweeded control	53.1	4.8	50.6	0.40	86.3	8.83	-11.18	0.40
LSD (P=0.05)	8.67	1.6	10.3	0.32	-	-	-	-

Economics

Higher gross and net returns was realized with maintaining weed free condition throughout crop growth (₹56,000 and ₹25,360/ha, respectively). However, integration of pre-emergence pendimethalin 1.0 kg/ha application with a hand weeding at 30 DAS resulted in higher B: C ratio (1.94) followed by two hand weeding at 15 and 30 DAS (1.92) compared to other treatments (Table 2).This was possible because of the lesser cultivation cost under these treatments when compared to maintaining weed free condition throughout the crop growth.

It was concluded that pre-emergence application of pendimethalin 1.0 kg/ha integrated with one hand weeding at 30 DAS was effective in reducing weed growth and increase rice yield with better benefit-cost ratio in coastal ecosystem of Karaikal, Puducherry UT.

REFERENCES

Chauhan BS and Yadav A. 2013.Weed management approaches for dry-seeded rice in India: a review. *Indian Journal of Weed Science* **45**(1): 1-6.

Das TK and Duary B. 1998. Pendimethalin; An excellent herbicide for weed control in crops. *Intensive Agriculture* **36**(5-6): 18-20.

John DPS, Poonguzhalan R, Mohan R and Suburayalu E. 2012.Weed management for enhanced production of aerobic rice. *Indian Journal of Weed Science* **44**(4): 270–273.

Mahajan G and Chauhan BS. 2013. The role of cultivars in managing weeds in dry-seeded rice production systems. *Crop Protection* **49**: 52–57.

Mishra JS and Singh VP. 2007. Integrated weed management in zero till direct seeded rice (*Oryza sativa* L.)-wheat (*Triticum aestivum* L.) cropping system. *Indian Journal of Agronomy* **52**:198-203.

Panse VG and SukhatamePU . 1967. *Statistical Methods for Agricultural Workers.* ICAR, New Delhi.

Ramesh T, Sathiya K, Padmanaban PK and James Martin G. 2009. Optimization of nitrogen and suitable weed management practice for aerobic rice. *Madras Agricultural. Journal* **96**(7-12): 344-348.

Singh S, Ladha JK, Gupta RK, Bushan L and Rao AN. 2008.Weed management in aerobic rice systems under varying establishment methods, *Crop Protection* **27**(3-5): 660-671.

Singh VP, Singh G, Singh RK, Singh SP, Kumar A, Dhayani VC, Kumar M and Sharma G. 2005. Effect of herbicides alone and in combination on direct seeded rice. *Indian Journal of Weed Science* **37**(3&4): 197–201.