WEED MANAGEMENT IN AEROBIC RICE UNDER SOUTH GUJARAT CONDITIONS

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ABSTRACT

A field experiment was conducted during kharif 2010 to 2012 at Main Rice Research Centre, Navsari Agricultural University, Navsari, Gujarat. The study consisted of 8 treatments viz., Un weeded control, Hand weeding and followed interculturing at 20 & 40 DAS, Pendimethalin @ 1.0 kg a.i./ha, as pre emergence, 2,4-D amine salt @ 1.0 kg a.i./ha, as post emergence at 20 DAS, Bispyribac sodium 10% sc, 10 ml/10 litter water (45g a.i./ha) as post emergence at 20 DAS, Only green manuring of dhaincha, Dhaincha + 2,4- D amine salt @ 1.0 kg a.i./ha as post emergence (30 DAS) and Weed free up to panicle initiation were tested in randomized block design with three replications. The study identified application of Pendimethalin @ 1.0 kg a.i./ha as pre emergence or one hand weeding and followed by interculturing at 20 and 40 DAS or Bispyribac sodium 10% sc, 10 ml/10 liter water (45g a.i,/ha) as post emergence at 20 DAS, as effective treatments for weed control and realizing higher net income.

KEY WORDS: Aerobic rice, economics, weed density, weed management

INTRODUCTION

Aerobic rice (*Oryza sativa L.*) is a new concept of growing rice in non pudled aerobic soils under irrigation just like an irrigated upland crop such as wheat or maize without standing water. Early experiments of growing aerobic rice in China and Brazil suggest that water inputs were more than 50 per cent lower (only 470-650 mm), water productivity 64-88 per cent higher and labour use 55 per cent lower in aerobic rice (Bouman *et al.*, 2002). Aerobic systems are subject to much higher weed pressure than conventional puddled transplanting systems (Rao *et al.*, 2007). Aerobic soil dry-tillage and alternate wetting and drying conditions, on the other hand, are conducive to the germination and growth of weeds causing grain yield losses of 50-91 per cent (Rao *et al.*, 2007). In tropics, average rice yield losses from weeds is 35 per cent, while in direct seeded aerobic rice yield penalty is as high as 50-91 per cent. Thus, weeds are the most severe constraint to aerobic rice production and timely weed management is crucial to increasing the productivity of aerobic rice. Most upland and aerobic rice growers in Asia mechanically weed their crops two or three times per season, investing up to 190 person days/ha in hand weeding (Roder, 2001). Herbicides are considered to be an alternative/ supplement to hand weeding. Both pre-emergence and post-emergence herbicides can be used in aerobic rice fields and they are

effective, if properly used (Singh *et al.*, 2006).

Since, the concept of aerobic rice is new growing rice under aerobic conditions on raised beds or on flat land would require suitable, effective and economic weed-control methods; development of new improved herbicides for aerobic dry-seeded rice is also needed. The increasing cost of labour threatens the sustainability of transplanted rice. Direct-seeding is cost effective, can save water through either rice crop establishment and allows early sowing of wheat (Ladha *et al.*, 2003). However, this type of research works are less carried in our context. Therefore, the present experiment was conducted to develop effective and economical integrated weed management practices for dry direct-seeded rice.

MATERIALS AND METHODS

A field experiment was conducted during *kharif* 2010 to 2012 at Main Rice Research Centre, Navsari Agricultural University, Navsari. The soil of the experimental field was clayey in texture and PH was high (8.0). The soil was low in available nitrogen (252 kg/ha), medium in available phosphorus (41 kg/ha) and high in available potassium (592 kg/ha). Experiment consisting of 8 treatments *viz*., T_1 : Un weeded control, T_2: Hand weeding followed by interculturing and at 20 & 40 DAS, T_3 : Pendimethalin @ 1.0 kg a.i/ha as pre emergence, T_4 : 2,4-D amine salt @ 1.0 kg a.i/ha as post emergence at 20 DAS, T_5 : Bispyribac sodium 10% sc 45 gm a.i/ha as post emergence at 20 DAS, T_6 : Only green manuring of dhaincha, T_7 : Dhaincha + 2,4- D amine salt @ 1.0 kg a.i./ha as post emergence at 30 DAS and T_8 : Weed free up to panicle initiation. These treatments were replicated three times in a randomized block design. Field was prepared by ploughing followed by passing the harrow and leveler. The seeds of NAUR-1, popular medium duration variety was sown (40 kg/ha) at the spacing of 30 cm between rows. The recommended dose of fertilizer 80: 30:00 kg NPK/ha was applied. Full dose of P_2O_5 and K_2O was applied at the time of sowing by using Single Super Phosphate and Murate of Potash, respectively. The 30 per cent of nitrogen was applied as a basal, 30 per cent at tillering and remaining 40 per cent at panicle initiation stage.

The observation on plant height, numbers of tillers per square meter, effective tillers per square meter, panicle length, grain and straw yields, weed density and weed dry weight were recorded at harvest. Since the data on weed density and weed dry weight showed high variation, the data were subjected to square root transformation and the statistical analysis was done. Weed index and weed control efficiency were calculated as per the standard formulae.

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

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

RESULTS AND DISCUSSION

Effect on weeds

The major weeds infesting the experimental field were *Echinochola colonum* L., *Digitaria sanguinalis*, *Cynodon dactylon* L., *Desmostachya bipinnata*, *Eclipta alba*, *Portulaca oleracea* and *Cyperus rotundus* L. The weed count and weed dry weight was taken during all the years and results are presented in Table 1. In three years pooled results, significantly lower weed density and weeds dry weight were registered in treatment weed free up to panicle initiation than rest of the treatments, but which was remained at par with Bispyribac sodium 10% sc 45 g a.i/ha as post emergence at 20 DAS and Pendimethalin @ 1.0 kg a.i/ha as pre emergence, whereas un weeded check recorded significantly higher weed density and weed dry weight. Higher weed control efficiency was recorded with Bispyribac sodium 10% sc, 45g a.i./ha as post emergence at 20 DAS, which was followed by Pendimethalin @ 1.0 kg a.i/ha as pre emergence and Hand weeding, followed interculturing at 20 & 40 DAS. The results are in line with the findings of Thakur and Bassi (1994), who observed the application of pendimethalin @ 1.0 kg a.i./ ha followed by one hand weeding at 30 DAS were most effective in minimizing the weed dry weight (215 g/m2 and 133 g/m2) as compared to weedy check (414 g/m2) in direct sown rainfed rice. Lower weed index was recorded with interculturing and hand weeding at 20 & 40 DAS followed by Bispyribac sodium 10% sc, 10 ml/10 lit water (45 gm a.i/ha) as post emergence at 20 DAS and Pendimethalin @ 1.0 kg a.i/ha as pre emergence. This was mainly due to better control of weeds growth even up to harvest resulting in lower dry weight of weeds.

Effect on crop growth

The weed free treatment up to panicle initiation stage recorded higher plant height, more number of tillers per square meter, more number of effective tillers per square meter and higher panicle length, but it was which remained at par with treatment T_2, T_5 and T_3 (Table 2). Among the herbicides, Bispyribac sodium 10% sc 10 ml/ 10 lit water (45 gm a.i/ha) as post emergence at 20 DAS (T_5) recorded higher plant height, more number of tillers per square meter and panicle length, but on par with Pendimethalin @ 1.0 kg a.i/ha as pre emergence. Singh *et al.* (2006) and Bhurer *et al.* (2013) reported similar results with the use of Pendimethalin in dry direct seeded rice.

Effect on yield and yield attributes

The results revealed that different weed management treatments had significant effect on yield attributes and grain yield of aerobic rice. The significantly higher grain yield (Tables 2) was recorded with treatment T_8 *i.e.*, weed free up to panicle initiation, which was at par with treatments T_2, T_5 and T_3. Among the herbicides, Bispyribac sodium 10% sc, 45 gm a.i/ha as post emergence at 20 DAS (T_5) showed superiority over other herbicides applied as post emergence, but it was at par with Pendimethalin @ 1.0 kg a.i/ha as pre emergence (T_3). Treatments T_8, T_2, T_3 and T_5 were at par with each other, but were significantly superior over rest of the treatments. In case of straw yield, the maximum straw yield was recorded with treatment T_8, but it remained at par with T_3 and T_5 during the year 2010, 2011 and 2012 and T_2, T_3 and T_5 in the pooled analysis. On pooled basis, treatment T_8, T_5 and T_2 registered 6042, 5361 and 5458 kg/ha of paddy straw yield. Singh *et al.* (2006) and Bhurer *et al.* (2013)

reported similar results with the use of Pendimethalin in dry direct seeded rice.

Economics

The different weed management treatments recorded varying net income realized due to paddy. The net realization of Rs. 34998/ha with CBR of 1:2.73 was recorded with treatment T_3 (Pendimethalin @ 1.0 kg a.i/ha as pre emergence) followed by T_5 (Bispyribac sodium 10% sc, 45 gm a.i/ha as post emergence at 20 DAS) with CBR of 1:2.51 (Table 2). This was mainly due to effective weed control and higher grain and straw yield in these treatments. Similar findings were reported by Bhurer *et al.* (2013) in aerobic rice.

CONCLUSION

Looking to the experimental results, significantly higher grain yield and net realization (Rs. 36770/ha) was recorded with treatment T_8 (weed free upto panicle initiation). However, considering the CBR, T_3 (pendimethalin @ 1.0 kg *a.i.* /ha as pre emergence) emerged out as the best treatment followed by T_5 (Bispyribac sodium 10% *sc*, as post emergence at 20 DAS) with net realization of Rs.34988/ha. The next in order was treatment T_5 with net realization of Rs. 34913/ha with CBR value 2.51. Taking into consideration the problem of availability of labour during weeding operation and convenience of farmers, the treatment T_3 (pendimethalin @ 1.0 kg a.i./ha as pre emergence) was found more viable.

Recommendation for the farmers

The farmers of South Gujarat heavy rainfall zone (AES III) growing irrigated drilled paddy (aerobic rice) are advised to apply pendimethalin @ 1.0 kg a.i./ha as pre emergence for effective weed control or hand weeding followed by interculturing at 20 and 40 DAS or Bispyribac sodium 10% sc 10ml/10 liter water as post emergence at 20 DAS for effective weed control and realizing higher net income.

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Table 1: Effect of weed management treatments on weed parameters

Treatments		Weed density (No./ m^2)	Weed dry weight (g/m^2)	Weed index	Weed control efficiency
T_1	Un weeded control	5.775(24.917)	7.061(52.538)	62.1	_
T_2	Hand weeding followed by interculturing at 20 & 40 DAS	4.881(24.667)	4.400(21.522)	6.17	59.03
T_3	Pendimethalin @ 1.0 kg a.i/ha as pre emergence	4.231(19.583)	4.146(21.110)	9.8	59.81
T_4	2,4-D amine salt @ 1.0 kg a.i/ha as post emergence at 20 DAS	4.636(23.083)	5.314(32.548)	25.39	38.04
T_5	Bispyribac sodium 10% sc, 10 ml/10 lit water (45 gm a.i/ha) as post emergence at 20 DAS	3.975(17.250)	3.714(15.843)	6.9	69.84
T_6	Only green manuring of dhaincha	4.750(23.333)	5.744(36.106)	22.18	31.27
T_7	Dhaincha + 2,4- D amine salt @ 1.0 kg a.i./ha as post emergence at 30 DAS	4.570(21.500)	5.326(31.232)	26.24	40.55
T_8	Weed free up to panicle initiation	3.554(13.000)	3.637(14.265)	-	72.84
S. Em ±		0.25	0.41	-	-
C.D. at 5 %		0.72	1.26		
C.V. (%)		19	20		
Y x T					
S. Em ±		0.43	50		
C.D. at 5 %		NS	1.41		
C.V. (%)		19	20		

Note: - Figures in the brackets are original value, whereas outside brackets are square root transform values.

Table 2: Effect of weed management treatments on growth, yield and economics of aerobic rice (Pooled of three years)

Treatments		Plant height(cm)	Number of tillers /m^2	Effective tillers / m^2	Panicle length (cm)	Grain Yield (kg/ha)	Straw Yield (kg/ha)	Net profit (Rs./ha)	CBR
T_1	Un weeded control	96	103	94	24.1	1662	2847	5290	1:1.28
T_2	Hand weeding followed by interculturing at 20 & 40 DAS	105	213	206	25.8	4115	5458	33722	1:2.41
T_3	Pendimethalin @ 1.0 kg a.i/ha as pre emergence	105	208	199	25.6	3956	5194	34988	1:2.73
T_4	2,4-D amine salt @ 1.0 kg a.i/ha as post emergence at 20 DAS	99	172	161	24.5	3272	4438	26521	1:2.37
T_5	Bispyribac sodium 10% sc, 10 ml/10 lit water (45 gm a.i/ha) as post emergence at 20 DAS	105	210	201	25.7	4083	5361	34913	1:2.51
T_6	Only green manuring of dhaincha	103	176	166	24.8	3413	4618	24458	1:2.04
T_7	Dhaincha + 2,4- D amine salt @ 1.0 kg a.i./ha as post emergence at 30 DAS	102	179	169	24.5	3235	4514	21691	1:1.91
T_8	Weed free up to panicle initiation	108	217	210	26.1	4386	6042	36770	1:2.48
S.Em $\pm$		1.34	6.3	5.6	0.24	161	315	-	
C.D. at 5 %		3.4	19	17	0.68	489	954		
C.V. (%)		5	7	7	3	9	9		

Note- Paddy grain: Rs.12.00/kg, Straw: Rs. 1.50/kg, N: Rs.39.70/kg, P: Rs.26.25/kg, Pendimethalin: Rs.450/1 lit, Bispyribac sodium (Adora): Rs.370/40 ml and 2,4-D amine salt (Zura): Rs.150/400 ml

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