ORIGINAL RESEARCH ARTICLE OPEN ACCESS

Chemical Weed Control in Aerobic Rice

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*Received: 28th August, 2016; Accepted 20th October, 2016

Abstract

Aerobic rice is subject to much higher weed pressure with a broader weed spectrum than flood-irrigated rice. In tropics, average rice yield losses from weeds is 35%, while in direct seeded aerobic rice, yield penalty is as high as 50-91% Chemical control, is the most effective, economic and practical way of weed management and a study was conducted in *Kharif* 2012 and 2013, Mechanical weeding at 15, 35 and 55 days after sowing (DAS) and different chemical herbicides *viz.,* (Pendimethalin+Bispyribac sodium (15-20DAS), Pendimethalin + 2,4 D, Na-salt, Pendimethalin + Ethoxysulfuron, Pendimethalin (within 3-4 DAS) + (Chorimuron + Metsulfuronmethyl), Butachlor + Bispyribac sodium, Butachlor + 2,4-D, Na-salt, Butachlor + Ethoxysulfuron, Butachlor + (Chorimuron + Metsulfuronmethyl) were tested against Need based hand weeding and Unweeded control) in randomized block design with three replications. The study identified mechanical weeding, sequential herbicide application as alternatives to manual weeding. Mechanical weeding using push weeder three times or sequential application of pendimethalin @ 1 kg/ha at 3-4 DAS followed by (fb) bispyribac sodium 35 g/ha at 2-4 leaf stage of weeds or chlorimuron + metsulfuronmethyl 40 g at 25-30 DAS are promising with higher weed control efficiency and weed index in controlling the weed flora and helpful in realizing higher grain yields and in closer comparison to need based hand weeding.

Key Words: Aerobic rice, Chemical herbicides, Weed Pressure, Weed control efficiency, Weed Index

Introduction

Rice is the most important staple food crop in Asia, where it provides 35–60% of total calorie intake (IRRI, 1997). Rice (*Oryza sativa* L.) consumes about 90% of the fresh water resources in Asia used for agriculture (Barker *et al*., 1999). The estimated world demand for rice in 2025 will be 140 million tones (Singh, 2004). This projected demand can only be met by maintaining steady increase in production over years, but the per capita availability of fresh water is declining continuously and could reach alarming levels in most Asian countries by the year 2025. To match with ever increasing food grain demand with less water, the term aerobic rice was coined by IRRI. Aerobic rice has its own advantages and disadvantages, as water use seems to be 60% less than that of flooded rice, requires less labour (55%) and can be highly mechanized than low land rice (Wang *et al.*, 2002). Aerobic way of growing rice saves water by eliminating continuous seepage and percolation, reducing evaporation and eliminating wet land preparation. But yields of aerobic rice said to be 20-30% lower than that flooded rice (Belder *et al.*, 2005). Weeds are one of the severest constraints to aerobic rice production system. The aerobic soil dry-tillage and alternate wetting &drying conditions are conducive to the germination and growth of weeds causing grain yield losses of 50-91%**.** High weed pressure in direct seeded rice lowers the economic return, and in extreme cases rice cultivation results in a losing concern (Juraimi *et al.,* 2013).Weeding must be done in the critical period so that they do not hinder crop growth. Aerobic rice is subject to much higher weed pressure with a broader weed spectrum than flood-irrigated rice. In tropics, average rice yield losses from weeds is 35%, while in direct seeded aerobic rice, yield penalty is as high as 50-91% Chemical control, is the most effective, economic and practical way of weed management In China, aerobic rice cultivation is completely dependent on herbicides (Wang *et al.*, 2002). Till now herbicide is a cost effective tool to fight against weeds, and therefore, weed management system using herbicides probably will continue. Zhao *et al.* (2006) studied cultivar - weed competitiveness in aerobic rice and reported that the strong association observed between early vigor and yield under both weedy and weed-free conditions, as well as the high negative correlation of the trait with weed biomass. Since the concept of aerobic rice is new, weed management issue is yet to be addressed properly considering the different weed management approaches. With this back ground, a study was proposed to evolve an economic and effective weed control approach for aerobic rice adoption.

Materials and Methods

The study was conducted in *Kharif* 2012 and 2013, at Research farm of Directorate of Rice Research, Rajendranagar, Hyderabad. The treatments comprised

of Mechanical weeding at 15, 35 and 55 days after sowing (DAS) and different chemical herbicides viz., (Pendimethalin (30EC) @1.0 kg /ha (within3-4 DAS) + Bispyribac sodium (10%SC) @ 35 g/ha (15-20 DAS), Pendimethalin (30EC) @ 1.0 kg /ha (within3-4 DAS)+ 2,4 D, Na-salt (80WP) @ 0.06 kg a.i /ha (20-25 DAS), Pendimethalin (30EC) @ 1.0 kg. a.i /ha (within3-4 DAS)+ Ethoxysulfuron (15WSG) @ 15 g a.i/ha (25-30 DAS), Pendimethalin (30EC) @ 1.0 kg a.i /ha (within3-4 DAS)+ (Chorimuron + Metsulfuronmethyl) (20 WP) @ 40 g. a.i/ha (25-30DAS), Butachlor (50 EC) @ 1.5 kg /ha (3-4 DAS) + Bispyribac sodium (10% SC) @ 35 g a.i/ha (15-20 DAS), Butachlor (50 EC) @1.5 kg a.i/ha (3-4 DAS) + 2,4-D, Na-salt (80 WP) @ 0.06 kg a.i/ha (20-25 DAS), Butachlor (50 EC) @1.5 kg a.i /ha (3-4 DAS)+ Ethoxysulfuron (15 WSG) @ 15 g a.i/ha (25-30 DAS), Butachlor (50 EC) @ 1.5 kg a.i/ha (3-4 DAS) + (Chorimuron + Metsulfuronmethyl) (20 WP) @ 40 g a.i/ha (25-30 DAS) were tested against Need based hand weeding and Unweeded control) in Randomized Block Design with three replications. The crop was raised by following recommended package of practices of aerobic rice. The test variety used in this study was MTU1010, a medium duration high yielding variety @ 25kg seed/ha. The sowing was done on a well ploughed and leveled field in 20 cm rows by dibbling method at 2-3cm depth. The Fertilizer schedule followed was 120-50-50 kg (Nitrogen-Phosphorus and Potassium (NPK)/ Ha. Entire dose of Phosphorus and 50% Potassium were applied basally at last ploughing. Half of the nitrogen was applied at 15 days after rice emergence and remaining nitrogen in two equal splits at maximum tillering and booting stage. Half of the Potassium also was applied at booting stage. Iron deficiency was notice in the initial stage and Ferrous sulphate spray @1.5% along with little citric acid was done on foliage twice at weekly intervals Irrigation was given at hairline cracks in the field to meet the field capacity. Other plant protection measures were taken up as per the necessity. The weed population and weed biomass were recorded at maximum tillering stage of rice. The yield attributes and grain yield were recorded at harvesting stage of rice and statistically analysed.

Results and Discussion

In this study, different combinations of effective commercial herbicide products and/or combinations were aimed at controlling weeds during the predetermined critical period of weed competition of first two months after seeding. The herbicides when used in the combination and sequential application as pre-emergence application fb early-postemergence application fb postemergence application or pre-emergence application fb postemergence application of broad spectrum herbicide or mechanical weeding resulted in higher WCE when compared with group specific herbicides application. These results are in line with that of Sunil *et al*. (2010). Earlier studies have similarly documented that improved agronomic practices can effectively suppress weed growth and increase herbicide efficacy (Blackshaw *et al*, 2005, Donovan 2001).

All the yield attributes responded significantly to weed control treatments. The yield attributes and grain yield were significantly higher in treatments of mechanical weeding, Sequential application of Pendimethalin @ 1 kg a.i./ha at 3-4 DAS fb Bispyribac sodium 35 g a.i./ ha at 2-4 leaf stage of weeds and superior over others (Table 1). The weed biomass and weed index were significantly lower and weed control efficiency was significantly higher in the above treatments of mechanical weeding, Sequential application of Pendimethalin @ 1 kg a.i./ha at 3-4 DAS fb Bispyribac sodium 35 g a.i./ha at 2-4 leaf stage of weeds, respectively (Table 2). These findings are in agreement with those of Sunil *et al*. (2010), who observed that all the yield attributes of aerobic rice were significantly influenced by weed control treatments. The increase in rice grain yield by increasing WCE has also been reported by others (Anwar *et al* 2012, Jaya Suria *et al* 2011) and concluded that maintaining weed free condition by using pre-emergence chemical herbicides in first one month can be an useful criterion in success of aerobic rice.



Table 1: Influence of weed management on yield attributes and yield of aerobic rice

Treatment	Grain Yield (t/ha)	Panicle / m^2 (No.)	Panicle Weight (g)
Pendimethalin 30EC @ 1.00 kg/ha3-4DAS fb 2,4 D,Na salt (80WP) @0.06 kg /ha (20–25 DAS)	4.86	344	2.19
Pendimethalin (30EC) @1.00 kg/ha (3-4 DAS) fb Bispyribacsodium (10% SC) @35 g/ha (15-20 DAS)	5.27	365	2.2
Pendimethalin 30EC @ 1.00 kg/ha at 3-4 DAS + residue mulching @ 5 t/ha	4.34	340	2.24
Pendimethelin (30EC) @ 1.00 kg/ha at 3-4 DAS + (Chorimuron + Metsulfuronmethyl) 20WP @ 4 g/ha at 25-30 DAS	4.75	356	2.17
Butachlor 50EC@1.5 kg/ha 3-4DAS fb 2,4-D Na salt (80WP) @ 0.06 kg/ha at 20–25 DAS	4.58	340	2.14
Butachlor 50EC @ 1.5 kg/ha at 3-4 DAS fb Bispyribac sodium 10% SC @ 35 g/ha at 15-20 DAS	5.06	359	2.28
Butachlor 30EC @ 1.00 kg/ha 3-4 DAS + residue mulching @ 5 t/ha at 25-30 DAS	4.11	337	2.14
Butachlor (30EC) @ 1.00 kg /ha (3-4 DAS) + (Chorimuron + Metsulfuronmethyl) 20WP @ 4 g.a.i./ha (25-30 DAS)	4.73	347	2.09
Mechanical weeding using push weeder at 15, 35 & 55DAS	5.14	366	2.19
Need based hand weeding (3 times at 15, 35 and 55 DAS)	5.53	387	2.05
Un weeded	2.89	262	1.63
C.D. (0.05)	0.28	20	0.51
C.V (%)	11.35	8.54	7.59

Table 2: Influence of weed management treatments on weed parameters

Treatment	Weed dry weight (g/m^2)	Weed Index (%)	Weed Control Efficiency (%)
Pendimethalin fb 2,4 D,Na salt (20–25 DAS)	37.89	12.12	65.33
Pendimethalin (3-4DAS) fb Bispyribac sodium	29.73	4.70	72.80
Pendimethalin 3-4 DAS + residue mulching @ 5 t/ha	38.5	21.52	64.78
Pendimethelin 3-4 DAS+ (Chorimuron + Metsulfuronmethyl) 25-30 DAS	32.86	14.10	69.94
Butachlor 3-4DAS fb 2, 4-D,Na salt 20–25 DAS	47.93	17.18	56.15
Butachlor 3-4DAS fb Bispyribacsodium 15-20DAS	27.12	8.50	75.19
Butachlor 3-4 DAS +residue mulching @ 5 t/ha	48.21	25.68	55.89
Butachlor (3-4 DAS)+(Chorimuron+Metsulfuronmethyl) (25-30 DAS)	37.43	14.47	65.75
Mechanical weeding using push weeder at 15, 35 & 55DAS	32.19	7.05	70.55
Need based hand weeding (3 times at 15, 35 and 55 DAS)	20.53	-	81.22
Un weeded	109.3	47.74	-
C.D. (0.05)	4.89	NA	
C.V (%)	10.64		

Conclusion

The study identified mechanical weeding, sequential herbicide application as alternatives to manual weeding. Mechanical weeding using push weeder three times or Sequential application of Pendimethalin @ 1 kg a.i./ha at 3-4 DAS fb Bispyribac sodium 35 g a.i./ha at 2-4 leaf stage of weeds or Chlorimuron + Metsulfuronmethyl 40 g at 25-30 DAS) are promising with higher Weed Control Efficiency and Weed Index in controlling the weed flora and helpful in realizing higher grain yields and in closer comparison to need based hand weeding.

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