

Original Research Article

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Weed Dynamics of Aerobic Rice (*Oryza sativa* L.) under Chemical and Non-Chemical Weed Management Practices in Irrigated Ecosystem

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ABSTRACT

Keywords

Aerobic rice,
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A field experiment was conducted during kharif season of 2014 at Dr. N. E. Borlaug Crop Research Centre, Pantnagar to assess the effect of different chemical and non-chemical methods of weed control on the weed dynamics of aerobic rice under irrigated ecosystem. Lowest weed density as well as weed dry matter at 25 days stage was found in plots treated with pendimethalin @ 1.25 kg/ha + hand weeding (HW) at 25 days after sowing (DAS) followed by wheat mulch straw (4t/ha) followed by (fb) fenoxaprop @ 60 g a.i/ha. Weed management practices along with pendimethalin @ 1.25 kg /ha fb HW (25 DAS) achieved significant control of weeds, high weed control efficiency (WCE) of 93.3 %. Among non - chemical methods of weed control, Sesbania co-culture fbconoweeder (25 DAS) fb HW (50 DAS) reported WCE (92.3 %).

Introduction

India is having the largest area (43.95 m ha) under rice in the world and in case of production (106.65 MT), it is next to China, however, productivity of India remains (2.4 t/ha) low (Ministry of Agriculture, 2015). Weeds pose a serious threat to the direct seeded rice crop by competing for nutrients, light, space and moisture throughout the growing season. High weed infestation is a major constraint for broader adoption of DSR (Rao *et al.*, 2007). Yield reduction due to weeds is more critical in direct seeded rice than in transplanted rice (Karim *et al.*, 2004). DSR approach demands a weed management strategy that is selective, efficient and cost

effective with little or no adverse ecological effects.

Chemical weed control has expanded manifold in DSR and is likely to increase further in response to labour scarcity, rising wages and increased adoption of direct seeding. Unfortunately, indiscriminate use of herbicides is driving the agro-ecosystems towards declining species diversity and, in many situations to herbicide resistance. It was found that continuous use of a single herbicide can produce quantitative changes in weed community composition in just five years (Singh *et al.*, 2009). Presently available

rice herbicides have narrow spectrum activity and limited efficacy when used alone, and hence rarely provide season long weed control. Variation in weed flora composition and their pattern of emergence during growing season is also key factor influencing level of weed control achieved with herbicides (Khaliq *et al.*, 2012 and Kumar *et al.*, 2002). Therefore, present research was carried out to study the effect of chemical and non-chemical weed management practices on weed dynamics of aerobic rice and also its yield potential.

Materials and Methods

A field experiment was carried out at N.E. Borlaug Crop Research Centre, G.B.P.U.A & T, Pantnagar during kharif 2014 in a Randomized Block Design with ten treatments and three replications. Ten treatments viz. weedy check; wheat straw mulch (4t/ha) fb one hand weeding (25 DAS); wheat straw mulch (4t/ha) fb fenoxaprop @ 60 g a.i/ha; Sesbania co-culture fb conoweeder (25 DAS) fb one hand weeding (50 DAS); pendimethalin @ 1.25 kg a.i/ha fb one hand weeding (25 DAS); pendimethalin @ 1.25 kg a.i/ha fb conoweeder (25 DAS); Sesbania co-culture fb pendimethalin @ 1.25 kg a.i/ha fb 2, 4-D @ 0.5 kg a.i/ha; bispyribac sodium @ 20 g a.i/ha; tank mix of fenoxaprop @ 60 g and 2, 4- D @ 0.5 kg /ha and weed free are used in experiment. Variety of rice and Sesbania was Sarjoo-52 and Pant Ses-1 respectively. Observations on weed density were recorded at 25, 50, 75, 100 days after sowing (DAS) and at maturity by randomly placing a quadrat of 50 cm×50 cm at five places in each plot. The weeds inside each quadrat were uprooted, cleaned and dried. After drying, weight was taken and weed control efficiency was calculated by using the formula,

$$\text{WCE (\%)} = \frac{\text{WDC} - \text{WDT}}{\text{WDC}} \times 100$$

Where,

WDC = Weed dry weight in control plot (g/m²)

WDT = Weed dry weight in treated plot (g/m²)

Results and Discussion

Different weed species of the experimental field were collected, identified and classified into grassy, sedges and broad leaf weeds (BLWs). Thirteen weed species (Grasses- 3, Sedges- 4 and BLWs- 6) were recorded in the experimental field. Among these weed species *Echinochloa crus-galli*, *Echinochloa colona*, *Leptochloa chinensis*, *Cyperus rotundus*, *Cyperus iria*, *Cyperus difformis* and *Fimbristylis milliacea* were dominant. Similar trend was observed by number of workers Tomar *et al.*, (2002); Kathiresan and Manoharan (2002). The total number of weeds owing to different weed control practices was influenced significantly at all the stages 25, 50, 75, 100 and at maturity stage of rice. Among the various treatments, highest total weed density was found in weedy check followed by Sesbania co-culture fb conoweeder (25 DAS) fb hand weeding (50 DAS) at 25 days stage while at 50, 75, 100 and maturity stage, highest total weed density was recorded in weedy check followed by wheat straw mulch (4 t/ha) fb fenoxaprop @ 60 g/ha (Table 1). No weed density was found in weed free plots during all the stages of crop growth. This was in accordance with Singh *et al.*, 2002.

Among treated plots, lowest total weed density at 25 days stage and at maturity, was found in pendimethalin @ 1.5 kg/ha fb HW (25 DAS) and at 50 days stage, lowest total weed density was recorded in tank mixture of fenoxaprop @ 60 g /ha and 2, 4- D (38 EC) @ 0.5 kg /ha.

Table.1 Effect of treatments on total weed density and total dry matter accumulation by weeds at various stages of crop growth

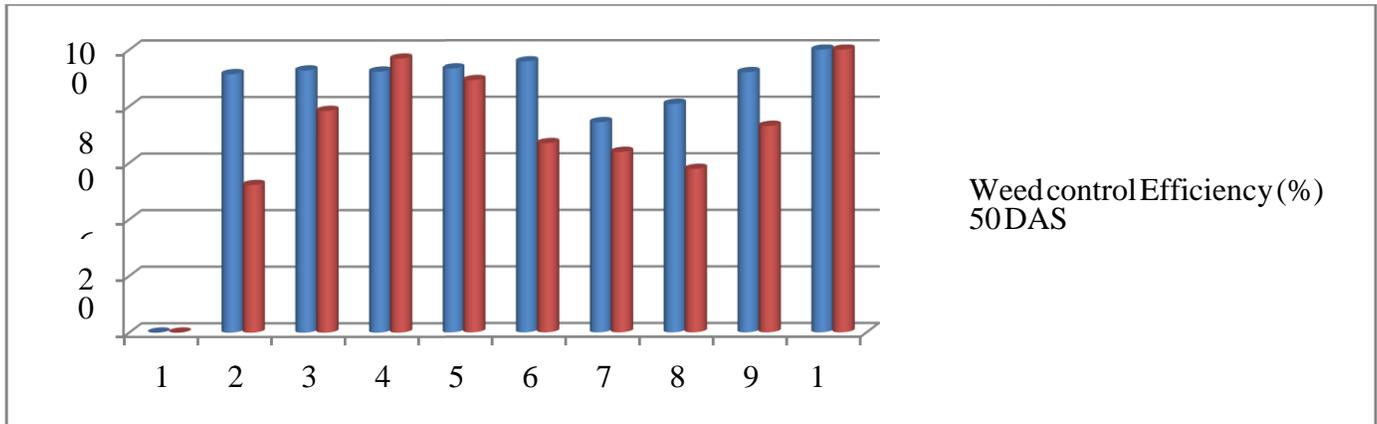
S.No	Treatments	Total weed density					Total dry matter accumulation				
		25 DAS	50 DAS	75 DAS	100 DAS	At maturity	25 DAS	50 DAS	75 DAS	100 DAS	At maturity
T ₁	Weedy Check	13.19 (173.0)	15.74 (246.7)	13.67 (186.0)	13.67 (186.0)	12.82 (163.3)	5.13 (25.3)	37.0 (1365.5)	36.8 (1360.0)	34.1 (1160.8)	33.6 (1126.7)
T ₂	WS fb HW (25 DAS)	9.43 (88.0)	9.09 (81.7)	8.43 (70.0)	7.83 (60.3)	7.00 (48.0)	4.15 (16.7)	10.9 (117.2)	25.5 (650.1)	25.0 (625.8)	22.9 (523.8)
T ₃	WS fb FP @ 60 gai/ha	5.83 (33.0)	11.93 (141.3)	11.03 (120.7)	11.70 (136.0)	11.00 (120.0)	2.34 (4.53)	10.0 (99.1)	17.2 (293.7)	19.5 (379.9)	18.3 (333.3)
T ₄	Sesfb CW(25 DAS) fb HW (50 DAS)	11.27 (126.0)	8.62 (73.3)	6.03 (35.3)	6.73 (44.0)	6.22 (37.7)	4.53 (19.5)	10.3 (105.0)	6.5 (41.4)	22.2 (490.6)	21.4 (455.3)
T ₅	Pendi @1.25 kg/ha fb HW(25 DAS)	5.17 (26.0)	7.46 (54.7)	6.27 (38.3)	6.95 (47.0)	6.22 (37.7)	1.97 (2.9)	9.6 (91.9)	12.1 (146.4)	13.1 (170.5)	11.5 (131.3)
T ₆	Pendi @1.25 kg/ha fb CW(25 DAS)	8.87 (77.7)	8.50 (71.3)	6.00 (35.0)	5.80 (32.7)	5.45 (28.7)	3.86 (13.9)	7.7 (57.6)	21.2 (449.7)	19.8 (391.4)	19.6 (383.7)
T ₇	SesfbPendi @ 1.25 kg/ha fb 2,4-D @ 0.5 kg ai /ha	6.22 (37.7)	9.42 (87.7)	8.31 (68.0)	7.55 (56.0)	6.98 (47.7)	3.07 (8.4)	18.8 (351.2)	22.2 (492.0)	24.0 (574.9)	22.0 (484.3)
T ₈	BS @ 20 g ai/ha	10.49 (109.0)	9.66 (92.3)	9.45 (88.3)	8.14 (65.3)	7.87 (61.0)	6.71 (44.0)	16.2 (262.0)	23.9 (573.6)	24.1 (580.4)	22.8 (517.0)
T ₉	Tank mix of FP @ 60 g ai/ha and 2,4-D @ 0.5 kg ai/ha	10.65 (112.3)	6.38 (39.7)	8.64 (73.7)	7.23 (51.3)	6.66 (43.3)	5.15 (25.6)	10.5 (109.3)	19.2 (367.0)	24.2 (585.4)	23.2 (535.7)
T ₁₀	Weed free	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)
	SEm+	0.14	0.11	0.08	0.08	0.06	0.11	0.11	0.12	0.11	0.08
	CD at 5%	0.42	0.33	0.23	0.25	0.17	0.33	0.31	0.35	0.32	0.25

WS- Wheat straw mulch (4 t/ha), FP- Fenoxaprop-p-ethyl (9.3 EC), Pendi- Pendimethalin (30 EC), CW- Conoweeder, HW- Hand weeding, BS- Bispyribac sodium (10 SC), 2,4-D- 2,4 dichlorophenoxy acidic acid (38 EC), Ses- Sesbania co-culture, fb- followed by, DAS-days after sowing.

Table.2 Effect of treatments on yield and yield attributing characters

S.No.	Treatments	No of panicle / m ²	Panicle length(cm)	No of grains / panicle	1000-grain weight(g)	Grain yield kg/ha	Straw yield kg/ha	Grain: Straw ratio	biological yield	Harvest Index %
T ₁	Weedy Check	14.0	25.7	63.7	20.6					
T ₂	WS fb HW(25 DAS)	162.0	26.3	130.0	21.6	209	983	0.21	1192	17.52
T ₃	WS fb FP @ 60 g ai/ha	199.0	26.2	136.7	22.4	945	6099	0.65	10043	39.27
T ₄	Sesfb CW(25 DAS) fb HW (50 DAS)	187.3	27.3	139.3	22.5	4125	5830	0.71	9955	41.43
T ₅	Pendi @1.25 kg/ha fbHW(25 DAS)	302.0	26.7	125.0	24.9	4694	6495	0.72	11189	41.96
T ₆	Pendi @1.25 kg/ha fb CW(25 DAS)	223.7	26.8	134.7	23.4	5139	5992	0.86	11131	46.08
T ₇	SesfbPendi @ 1.25 kg/ha fb 2,4-D @ 0.5 kg ai /ha	222.0	26.5	109.3	21.3	4736	5809	0.81	10545	44.91
T ₈	BS @ 20 g ai/ha	176.7	27.3	137.7	23.8	3417	4092	0.84	7509	45.53
T ₉	Tank mix of FP @ 60 g ai/ha and 2,4-D @ 0.5 kg ai/ha	204.0	25.1	100.7	21.3	4833	5907	0.82	10740	44.98
T ₁₀	Weed free	311.0	27.8	157.0	25.4	3667	4588	0.80	8255	44.39
SEm+		1.29	0.74	1.42	0.54	5695	6661	0.85	12355	46.16
CD at 5%		3.82	NS	4.22	1.60	219	255	0.01	472	0.20

Fig.1 Effect of weed management practices on weed control efficiency at 50 and 75 days stage of crop growth



1-Weedy, 2- WS fb HW, 3- WS fb FP, 4- Sesfb CW fb HW, 5- Pendifb HW, 6- Pendifb CW, 7- Ses fbPendifb 2,4-D, 8- BP, 9- tank mix of FP and 2,4-D, 10 -weed free

This might be due to efficient hand weeding which restrict the growth of weeds in the field of aerobic rice. This was also reported by Khaliq and Matloob (2011) and Khaliq *et al.*, (2012). At 75 and 100 days stage, lowest total weed density was recorded in pendimethalin (30 EC) @1.25 kg/ha fb conoweeder (25 DAS) which was statistically at par with Sesbaniaco-culture fb conoweeder (25 DAS) fb HW (50 DAS). Application of different pre emergence herbicides like pendimethalin has been found to control weed satisfactorily in direct seeded rice. This was also in line with Pellern and Webster (2004) and Baloch *et al.*, (2005).

Dry matter accumulation of total weeds varied due to different weed control practices significantly at all the stage of crop growth. Highest total weed dry matter accumulation at 25 days stage of crop growth was recorded in plots treated with bispyribac sodium (10 SC) @ 20 g /ha while at 50, 75, 100 and maturity stage, highest total weed dry matter accumulation was recorded in weedy check (Table 1). Among treatments, lowest total dry matter accumulation at 25, 50,100 and maturity stage was found in plots treated with pendimethalin (30 EC) @ 1.25 kg/ha fb HW

(25 DAS) while at 75 days stage, in plots treated with Sesbania co-culture fbconoweeder (25 DAS) fb hand weeding (50 DAS). This might be due to application of pendimethalin along with one hand weeding done at 25 DAS which effectively reduced the weed growth as well as weed dry matter accumulation in direct -seeded rice. Similar findings were in line with Rao *et al.*, (2008).

Weed control practices had significant effect on WCE at 50 and 75 days stage of the crop growth. 100 percent WCE was recorded in the weed free plots at both the stages while among treated plots, highest WCE of 95.8 % and 96.9 % at 50 DAS and 75 DAS respectively was found in plots treated with pendimethalin (30 EC) @ 1.25 kg/ha fb conoweeder (25 DAS) and Sesbania co-culture fb conoweeder (25 DAS) fb HW (50 DAS) respectively (Fig 1).

This might be due to application of pre-emergence herbicide viz. pendimethalin (30 EC) @ 1.25 kg/ha followed by cono weeding at 25 DAS which had great impact against weeds present in plots and recorded highest WCE of 95.8 % at 50 DAS. Similar trend was also observed by (Rao *et al.*, 2008).

Yield and yield attributing characters

All weed control treatments applied plots produced significantly higher number of panicles/m², 1000 grain weight, number of grains/panicle, grain yield, straw yield, biological yield, grain: straw ratio and harvest index than weedy check except panicle length which was found non-significant. The highest number of panicles/m², 1000 grain weight, grain yield and grain: straw ratio was obtained in weed free treatment which was statistically at par with pendimethalin (30 EC) @ 1.25 kg/ha fb hand weeding (25 DAS) and also highest number of grains/panicle and biological yield were obtained in weed free treatment which was statistically at par with Sesbania co-culture fb conoweeder (25 DAS) fb hand weeding (50 DAS) (Table 2). This might be due to effectiveness of hand weeding at 25 DAS which effectively controlled the weeds but has been restricted due to several economical and technological factors. Similar findings were in line with Khaliq and Matloob (2011), Dixit and Bhan (2001). High yield of rice due to application of pre emergence herbicide pendimethalin (30 EC) @ 1.25 kg/ha fb hand weeding (25 DAS) might be due to inhibition of weed dry weight as well as reduced crop weed competition, ultimately increased the grain yield. Similar results were given by Singh *et al.*, (2005).

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