International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; SP6: 121-123

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(Special Issue -6)
3rd National Conference
On
PROMOTING & REINVIGORATING AGRI-HORTI, TECHNOLOGICAL INNOVATIONS [PRAGATI-2019]
(14-15 December, 2019)

Chemicals weed control management in aerobic rice

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Abstract
Rice is the staple food for the 2/3rd population of the world. In India rice is predominantly grown by transplanting in puddle soil with continuous flooding. This method requires very huge amount of water, labor and energy for land preparation, nursery raising, transplanting and weeding leading to high cost of cultivation. Furthermore mechanized puddling also affects soil health due to the indiscriminate dispersion of soil particles, soil becoming compact and making tillage operations difficult requiring more energy in succeeding crops such as wheat. An alternative to this method of crop establishment is aerobic direct seeding because it requires very less water, labor and capital inputs. One most important benefit of this method is that crop matures 7-10 days earlier than the transplanted crop and it was beneficial for cultivation of next season crops *viz*. potato and wheat. Irrigated "aerobic rice" is a new system being developed for the cultivation of rice in water scarcity area of the U.P. and other parts of the country. The major constraint of this crop establishment technique is high weed pressure than conventional puddled transplanting systems (Rao *et al.,* 2007). In aerobic condition dry tillage and alternate wetting and drying conditions create conducive environment for the germination and growth of weeds resulted in grain yield loss of 50-90%. Thus, weeds are the most severe constraint to aerobic rice production and timely weed management is very crucial for increasing the productivity of aerobic rice. Upland and aerobic rice growers of India use mechanically weeding of their crops two or three times per season, investing upto 190 person days/ha in hand weeding. Chemical weed control i.e. use of herbicides is one of the prominent option to control the weed menace in the aerobic rice. Both pre-emergence and post-emergence herbicides can be used in aerobic rice fields and they are effective, if properly used (De Datta *et al.,* 1996 and Singh *et al.,* 2006). In view of the above observations herbicides and their combinations were evaluated to control the weeds in the aerobic rice production system.

Keywords: Aerobic, weed, herbicides

Introduction

Material and Methods

A field experiment was conducted during Kharifseason of 2017 and 2018 at the Crop Research Station, Masodha (Anduat), Ayodhya (U.P.). The soil texture of the experimental plot is sandy loam with the pH of 7.5. Soil is poor in organic carbon (0.40%) and medium in available nitrogen (208 kg/ha), medium in available phosphorus (24.0 kg/ha) and high in available potassium (235 kg/ha). The experiment was laid out in randomized block design with three replication. Ten weed management practices *viz*. T_1-, T_2-, T_3-, T_4-, T_5-, T_6-, T_7-, T_8-, T_9- and T_{10}- Non weeded control were adopted to evaluate weed control efficacy of the herbicidal formulations and their combinations. The test variety "Shushk Samrat" was sown in line on Kharif 2017-18 in the respective wet seasons. The weed management practices were imposed

as per the treatments and recommended agronomic Package and practices and plant protection measures were adopted to raise the crop. Recommended dose of fertilizers were applied for the proper growth of the crop. The Macro nutrient requirement of the crop i.e. requirement of NPK was met by the use of Urea, DAP and MOP while the zinc requirement of the crop was met by the basal application of the Zinc Sulphate @ 10kg/ha. Nitrogen @ 80 kg/ha was applied in three splits i.e. 50% as basal and rest 50% of the Nitrogen applied in two equal splits at maximum tillering and panicle initiation stage. Phosphorus and potassium were applied as basal at the time of sowing. Knapsack sprayer were used for the application of herbicides for uniform spraying in the target area. Data in respect of yield and ancillary characters were recorded. Weed density in the experimental plots were recorded at periodical intervals. The weed samples brought in paper bags were air dried in shade initially followed by oven drying at 80^0C for 24 hours to determine its dry matter till constant weight and expressed in g m^{-2}. Weed control efficiency by Mani *et al.* (1973) [5] and weed index by Gill and Kumar (1969) [1] were calculated as per the standard procedure.

$$WCE\ (\%) = \frac{DMC - DMT}{DMC}$$

Where,
WCE = weed control efficiency (%)
DMC = dry matter of weeds in un-weeded plot (g/0.25 m^{-2})
DMT = dry matter of weeds in treated plot (g/0.25 m^{-2})

Results and Discussion

Weed Flora: Weed flora of the experimental field aregrasses, sedges and broad leaves weeds. Among these *Echinochloa crus galli*, *E. colona*, *Cyprus iria*, *Fimbristylis licence*, *Cyperus iria*, *Cyperus difformis* and *Fimbristylis dichotoma* were major economic weeds. These weed sare abundantly observed in the unweeded (control) plot. Weed density, weed index and weed control efficiency was recorded at critical crop growth stages and presented in table-1and 2. Significant variation in the total weed density was observed in the treatments. Lowest weed density was observed in the treatment need based hand weeding. Among the chemical weed control measures lowest weed density was observed in the experimental plot treated with Pendimethalin (30EC) @1.00 kg a.i./ha (3-4 DAS) + Bispyribac-sodium (10%SC) @35 g.a.i./ha (15-20 DAS). This treatment has highest weed control efficiency of 75.55 % among the chemical weed control measures followed Butachlor 50EC@1.5 kg/a.i./ha(3-4DAS) + Bispyribac- sodium (10%SC)@35 g.a.i./ha at 15-20DAS (70.72%).

Table 1: Effect of weed control treatment on weed population in aerobic rice.

Treatment	Weed Population (no./m^2)		
	Grasses	Sedges	BLW
Pendimethalin (30EC)@1.00 kg a.i./ha(3-4 DAS) + Bispyribac- sodium (10%SC)@35 g.a.i./ha (15-20 DAS)	7.50	3.00	5.25
Pendimethalin (30EC)@1.00 kg a.i./ha(3-4 DAS) +2,4 D,Na salt (80WP) @0.06 kg.a.i /ha (20–25 DAS)	9.00	5.50	6.50
Pendimethalin (38.7 EC) @ 1.00 kg a.i./ha (3-4 DAS) + Straw mulching @ 4 t/ha	9.50	5.85	6.55
Pendimethelin (30EC) @ 1.00 kg a.i./ha (3-4 DAS) + (Chorimuron + Metsulfuronmethyl) 20WP @ 40 g.a.i./ha (25-30 DAS)	8.25	4.10	6.80
Butachlor (50EC)@1.5 kg/a.i./ha (3-4DAS) + Bispyribac-sodium (10%SC)@35 g.a.i./ha (15-20DAS)	8.00	4.25	6.50
Butachlor (50EC)@1.5 kg/a.i./ha (3-4DAS) + 2,4-D,Na salt (80WP) @ 0.06 kg.a.i /ha (20–25 DAS)	11.55	6.90	5.80
Butachlor (50EC) @ 1.5 kg/a.i./ha (3-4 DAS) + Straw mulching @ 4t/ha	12.00	7.00	4.40
Mechanical weeding/weeders at 20 & 45 DAS	4.80	3.45	5.05
Need based hand weeding	4.60	3.00	4.50
Unweeded control	70.00	22.50	45.00

Table 2: Chemical Weed Control Management in Aerobic Rice during WS 2017-18 (Mean Value).

S.L. No.	Treatment	Panicle no./m^2	Panicle wt. (g)	Grain yield (t/ha)	WCE (%)	Weed Index (%)	
T_1	Pendimethalin (30EC)@1.00 kg a.i./ha (2-4 DAS) +	115	1.33	3.70	49.33	75.55	20.34
	Bispyribac- sodium (10%SC)@35 g.a.i./ha (15-20 DAS)						
T_2	Pendimethalin (30EC)@1.00 kg a.i./ha (2-4 DAS) +2,4	91	1.20	3.10	68.33	66.13	35.01
	D,Na salt (80WP) @0.06 kg.a.i/ha (20–25 DAS)						
T_3	Pendimethalin (38.7 EC) @ 1.00 kg a.i./ha (2-4 DAS) +	52	1.23	3.00	70.5	65.05	37.11
	Straw mulching @ 4 t/ha						
T_4	Pendimethelin (30EC) @ 1.00 kg a.i./ha (2-4 DAS) +	30	1.18	3.15	62.67	68.93	33.96
	(Chorimuron + Metsulfuronmethyl) 20WP @ 40 g.a.i./ha						
	(25-30 DAS)						
T_5	Butachlor (50EC)@1.5 kg/a.i./ha (3-4DAS) + Bispyribac-	95	1.18	3.23	58.67	70.92	32.29
	sodium (10%SC)@35 g.a.i./ha (15-20DAS)						
T_6	Butachlor (50EC)@1.5 kg/a.i./ha (3-4DAS) + 2,4-D,Na	54	1.27	2.75	83	58.85	42.35
	salt (80WP) @ 0.06 kg.a.i /ha (20–25 DAS)						
T_7	Butachlor (50EC) @ 1.5 kg/a.i./ha (3-4 DAS) + Straw	24	1.15	2.77	93.33	53.73	41.93
	mulching @ 4t/ha						
T_8	Mechanical weeding/weeders at 20 & 45 DAS	55	1.08	4.24	42.33	79.02	11.11
T_9	Need based hand weeding	62	1.17	4.77	32	84.14	0.00
T_{10}	Unweeded control	32	1.17	0.97	199.72	0.00	79.66

$$\text{Weed Index (\%)} = \frac{X - Y}{x} \times 100$$

x = Grain yield of weed free plot
y = Grain yield from the treatment plot for which the weed index has to be worked out

Effect on yield and yield attributing traits: The weed free treatment produced maximum yield (4.77 t/ha) of aerobic rice (Need based hand weeding). This might be attributed to the better plant growth on account of reduced weed competition at critical crop growth stages for available nutrients, water and light. All the weed control treatments significantly increased the number of panicles/m^2, panicle weight, filled grains/panicle and thousand grain weight and ultimately the yield over unweeded control. Among the herbicidal treatments, the use of Pendimethalin (30EC) @ 1.00 kg a.i./ha (2-4 DAS) + Bispyribac- sodium (10%SC) @ 35 g.a.i./ha at 15-20 days after sowing produced maximum number of panicles/m^2 and panicle weight (1.33 g), filled resulted in higher grain yield (3.70 t/ha) which comparable with need based hand weeding treatment (Non-weeded treatment).

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