Effect of Pretilachlor 50% EC on Weed Control of Transplanted Rice under Alluvial Soil of West Bengal, India

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ABSTRACT

Field experiments were conducted at Regional Research Station of Bidhan Chandra Krishi Viswavidyalaya, Gayeshpur, West Bengal during winter season of 2014 and 2015 to evaluate the bio-efficacy against weeds & phytotoxicity of pretilachlor 50% EC on transplanted rice. The experiment was tested under randomized complete block design with three replicates. Among the herbicides, highest weed control index was recorded in pretilachlor 50% EC @ 2 kg a.i.ha^{-1}which imparted phytotoxic symptoms in rice plants resulting in yield reduction. However, the highest grain yield (3.59 t ha-1) was obtained with the application of pretilachlor 50% EC @ 1.2 kga.i.ha^{-1}which was statistically at par with twice hand weeding. From these findings it can be concluded that the application of pretilachlor 50% EC@ 1.2 kga.i.ha^{-1}can be recommended for effective weed management in transplanted rice in the study area.

Keywords:Pretilachlor, transplanted rice, weed management, hand weeding, phytotoxicity

1. INTRODUCTION

"Rice (*Oryza sativa* L.) is the staple food over more than halfof the world's population. It is the predominant dietary energy source for 17 countries in Asia and the Pacific, 9 countries in North and South America and 8 countries in Africa,providing almost 39% of calories"[1]."In India, rice is cultivated in wide ranges of ecosystems from irrigated to shallow lowlands, mid-deep lowlands, deep water to uplands. In the rice agro-ecosystems, ideal environment conditions provided for optimal rice productivity are exploited by the associated weeds.The losses in grain yield due to weed competition for first 30, 60 and 90 days have been reported to the tune of 17.7 %, 11.8% and 5.0 % respectively" [2]. "Rice yield losses due to uncontrolled weed growth and weed competition were least (12%) in transplanted rice"[3]."Besides yield reduction, weeds remove a large amount of plant available nutrients from the soil. An estimate shows that weeds can deprive the crops by 47%N, 42%P, 50%K, 39% Ca and 24% Mg of their nutrient uptake as well as reduce the yield potential by harbouring number of crop pests"[4]. "Among the various measures taken in weed control, application of herbicides is the most common practice as it is easier, time and labour saving and economical compared to hand weeding"[5]. Among the herbicides pretilachlor is widely used in transplanted rice crop. In this context an experiment is conducted to evaluate the performances of new formulation of pretilachlor in terms of thebio-efficacy against weed flora and phytotoxicityin transplanted rice.

2. MATERIALS AND METHODS

2.1. Experimental site

The experiment was conducted during the two consecutive winter season of 2014 and 2015 at theRegional Research Station(RRS), in New Alluvial Zone of West Bengal under Bidhan Chandra Krishi Viswavidyalaya, Gayeshpur, Nadia, West Bengal.The climate during the experimentation was subtropical humid. The soil of the experimental field was typical Gangetic alluvial soil (Entisol) having clay loam texture with moderate fertility (available N 288.43 kg ha^{-1}, available P 20.16 kg ha^{-1}, available K 167.20 kg ha^{-1})having neutral soil reaction (pH 6.65).

2.2. Treatments details

Ten treatments were replicated thrice in a randomized block design (RBD) with a net plot size of 5.0 m x 4.0 m each. The treatments T_1 to T_6consisted of six different doses (0.5,0.75,1.0,1.2,1.5,2.0kg a.i.ha^{-1} respectively) of new pretilachlor [*51218-49-6 2-Chloro-N-(2,6-diethylphenyl)-N-(2-propoxyethyl)acetamide*] formulationsupplied by Mahamaya Lifesciences Pvt. Ltd., Gurgaon, Indiaalong with one commercial formulated pretilachlor i.e. (T_7) @ 0.75 kg a.i.ha^{-1}. Butachlor (T_8) @ 1.25 kg a.i.ha^{-1} along with two hand weeding (T_9) at 20 and 40 days after transplanting (DAT) were also used besides unweeded control(T_{10}).The treatments were allocated randomly to different plots with the help of random number table [6].

2.3. Field trial

The rice variety used in this experiment was Satabdi (IET 4786). Ricecrop was transplanted on 2ndFebruary, 2014with a spacing of 20 cm x 10 cm and fertilizer dose of 120 kg N, 60 kg P_2O_5 and 60 kg K_2O per hectare were applied in the form of Urea, SSP and MOP, respectively. Half of the total N andfull doses of $P_2O_5$and K_2O were applied as basal and rest amount of N was top dressed into two equal splits, one at 21 DAT and another at 42 DAT. The herbicides were applied as pre-emergence at 3DAT with knapsack sprayer with flat jet nozzle. The crop was protected against the incidence of pests and diseases by employing effective plant protection measures as and when necessary.

2.4. Observations

"Observations on weed density (countm^{-2}), weed dry weight (g m^{-2}), effective tiller(m^{-2}), panicle length (cm), panicle weight (g),grainyield (t ha^{-1}) and straw yield (t ha^{-1}) were recorded. Weed control index of different treatments was obtained by using the following formula" [7] –

$$\text{Weed Control index (\%)} = \frac{WDW_C - WDW_T}{WDW_C} \times 100$$

Where, WDW_C = Weeds dry weight (gm^{-2}) in unweeded plot

WDW_T = Weeds dry weight (gm^{-2}) in treated plot

Phytotoxic effect of herbicides on crop in terms ofyellowing, stunting and necrosis were recorded at 7, 14, 21, 28 DAT and the crop response was rated in the scale of 0-10 as shown in Table 1.

Table 1. Quantitative description of treatment effects on crops in the visual scoring scale of 0-10

Rating	Effect	Verbal description
0	None	No injury, normal
1	Slight	Slight stunting, injury or discolouration
2		Some stand loss, stunting and discolouration
3		Injury more pronounced but not present
4	Moderate	Moderate injury recovery possible
5		Injury more persistent, recovery doubtful
6		Near severe injury, no recovery possible
7	Severe	Severe injury, stand loss.
8		Almost destroyed, a few plants surviving
9		Very few plants alive
10	Complete	Complete destruction

2.5. Statistical Analysis

The data were analyzed by analysis of variance (ANOVA) using standard variance techniques suggested by Gomez and Gomez (1984) [8]and ranked by using the critical differences (CD) at 5% level.

3. RESULTS AND DISCUSSION

3.1.Predominant weed species

Various categories of weeds as observed in the experimental field included *Echinochloacolona*, *Echinochloacrusgalli, Panicum repens, Leersiahexandra, Monochoriavaginalis, Ludwigiaparviflora, Lemna minor, Ammaniabaccifera*, *Aeschynomeneindica, Hydrillaverticulata, Cyperusiria*and *Cyperusdifformis,* etc. The dominant weed species were *Echinochloacolona, Echinochloacrusgalli*(Grasses), *Monochoriavaginalis, Commelinabenghalensis, Marsileaquadrifolia*(Broad Leaves)and *Cyperus difformis, Fimbristylis*

Table 2. Total weed density, total weed dry weight and weed control index at different growth stagesas influenced by different weed-control treatments (*Two years pooled data*)

Treatments	Treatment details	Dose kg a.i. ha^{-1}	Time of application	Total weed density (count m^{-2})			Total weed dry weight (g m^{-2})			Weed control index (%)		
				20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT
T_1	Pretilachlor	0.5	Pre-emergence	9.11	24.99	47.55	1.74	10.34	14.12	55.61	30.51	47.06
T_2	Pretilachlor	0.75	Pre-emergence	9.05	21.01	33.88	1.7	9.08	13.37	56.63	38.98	49.87
T_3	Pretilachlor	1	Pre-emergence	9.01	18.55	33.1	1.66	8.88	12.9	57.65	40.32	51.63
T_4	Pretilachlor	1.2	Pre-emergence	8.4	17.33	32.55	1.49	8.49	12.69	61.99	42.94	52.42
T_5	Pretilachlor	1.5	Pre-emergence	8.33	16.66	29.88	1.36	7.99	12.37	65.31	46.3	53.62
T_6	Pretilachlor	2	Pre-emergence	7.78	12.54	25.32	1.27	6.46	9.99	67.6	56.59	62.54
T_7	Pretilachlor (commercial)	0.75	Pre-emergence	9.67	35.1	56.1	1.98	11.65	14.34	49.49	21.71	46.23
T_8	Butachlor	1.25	Pre-emergence	10	40.25	62	2.05	11.8	15.85	47.7	20.7	40.57
T_9	Twice hand weeding	-	20 & 40 DAT	12.99	5.67	13.34	3.85	2.09	4.54	1.79	85.95	82.98
T_{10}	Unweeded control	-	-	13.67	51.67	98	3.92	14.88	26.67	-	-	-
	SEm±			0.121	3.989	2.399	0.121	0.383	0.241	-	-	-
	CD (5%)			0.463	7.767	7.087	0.363	1.161	0.732	-	-	-

Table 3. Phytotoxicity rating in rice plant as influenced by different weed-control treatmentsas influenced by different weed-control treatments (*Two years pooled data*)

Treatments	Tretament details	Dose kg a.i. ha^{-1}	Time of application	7 DAT			14 DAT			21DAT			28DAT		
				R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3
T_1	Pretilachlor	0.5	Pre-emergence	0	0	0	0	0	0	0	0	0	0	0	0
T_2	Pretilachlor	0.75	Pre-emergence	0	0	0	0	0	0	0	0	0	0	0	0
T_3	Pretilachlor	1	Pre-emergence	0	0	0	0	0	0	0	0	0	0	0	0
T_4	Pretilachlor	1.2	Pre-emergence	0	0	0	0	0	0	0	0	0	0	0	0
T_5	Pretilachlor	1.5	Pre-emergence	1	1	1	1	1	0	0	0	0	0	0	0
T_6	Pretilachlor	2	Pre-emergence	4	4	4	1	1	1	1	1	1	1	1	0
T_7	Pretilachlor (commercial)	0.75	Pre-emergence	0	0	0	0	0	0	0	0	0	0	0	0
T_8	Butachlor	1.25	Pre-emergence	0	0	0	0	0	0	0	0	0	0	0	0
T_9	Twice hand weeding	-	20 & 40 DAT	0	0	0	0	0	0	0	0	0	0	0	0
T_{10}	Unweeded control	-		0	0	0	0	0	0	0	0	0	0	0	0

Table 4. Yield attributes and yield of transplanted rice as influenced by different weed-control treatments (Two years pooled data)

Treatments	Treatment details	Dose kg a.i. ha^{-1}	Time of application	Effective tillers m^{-2}	Panicle length (cm)	Panicle weight (g)	Filled grains panicle^{-1}	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1	Pretilachlor	0.5	Pre-emergence	318	20.17	2.08	138	3.13	5.08
T_2	Pretilachlor	0.75	Pre-emergence	319	20.18	2.08	143.3	3.26	5.09
T_3	Pretilachlor	1	Pre-emergence	329	22.52	2.1	146	3.47	5.13
T_4	Pretilachlor	1.2	Pre-emergence	315.67	22.88	2.11	147	3.59	5.22
T_5	Pretilachlor	1.5	Pre-emergence	302.1	20.1	1.95	136.5	2.95	5.2
T_6	Pretilachlor	2	Pre-emergence	295.6	20.03	1.86	135.1	2.71	5.08
T_7	Pretilachlor (commercial)	0.75	Pre-emergence	323.33	21.89	2.06	133.3	3.15	5.1
T_8	Butachlor	1.25	Pre-emergence	322	22.26	2.07	140.3	3.21	5.08
T_9	Twice hand weeding	-	20 & 40 DAT	339	23.77	2.25	150.7	3.61	5.25
T_{10}	Unweeded control	-		268	19.73	1.56	134.3	2.68	5.21
	SEm±			**1.676**	**0.332**	**0.031**	**3.421**	**0.032**	**0.22**
	CD (5%)			**4.921**	**1.032**	**0.082**	**8.882**	**0.101**	**0.69**

miliaceae(Sedges). Datta *et al.* (2017) [9] observed similar types of weed flora in rice field at Nadia, West Bengal.

3.2. Weed density anddry weight

Significant differences were observed among the treatments at all the observations in terms ofdensity and dry weight of weed flora (Table 2).The lowest weed density and dry weight was recorded with twice hand weeded plots (T_9) at 40 and 60 DAT whereasunweeded control (T_{10}) resulted in highest weed density and dry weight in all the observations.This is in conformity with findings of Prashanth *et al*. (2015) [10] and Ehsanullah *et al*. (2009) [11]. Among the chemical treatments, new formulation of pretilachlor 50 % EC @ 2.0 kg a.i.ha^{-1}(T_6) recorded the lowest weed count and dry biomass in all the observations which was followed by the lower doses of pretilachlor 50 % EC *viz.* 1.5 kg a.i.ha^{-1}(T_5) and 1.2kg a.i.ha^{-1}(T_4).Similar result was also observed by Mondal *et al.* (2019) [12]. This is may be due to suppression of the germinating weeds through preemergence application of pretilachlor by interfering with the Acetyl-CoA carboxylase (ACCase) enzyme which plays a crucial role in fatty acid synthesis.

3.3. Weed control index

Weed control index (WCI) was observed highest under the twice hand weeded plots (T_9). Among the herbicidal treatments,pretilachlor 50% EC @2.0 kg ha^{-1}(T_6)recorded highest weed control indexwhich is closely followed by pretilachlor 50% EC@1.5 kg ha^{-1}(T_5).Since WCI is derived from the weed dry weight thus the treatments which recorded lower weed dry weight resulted higher WCI.

3.4. Phytotoxicity rating of different doses of herbicide on rice plant

Among the different treatments,there was no phytotoxicity effect on rice plants except with pretilachlor 50% EC when applied at the rate of 1.5 and 2.0 kga.i.ha^{-1} (Table 3). Pretilachlor 50% EC @ 1.5 kga.i.ha^{-1} (T_5) showed slight stunting and discoloration of leaf at 7 DAT and 14 DATand thereafter, no visual phytotoxicity symptoms were observed. Pretilachlor 50% EC @ 2.0 kga.i.ha^{-1}(T_6)showed moderate injurybut recovered initially after 7 DAT. Later, it showed slight stunting and discoloration of the leaf. However, visually phytotoxicity symptoms continued up to 28 DAT. Similar result was observed by Suganthi*et al.* (2010) [13].

3.5. Yield attributes and yield

The highest yield attributing characters*viz.* filled grains panicle^{-1}, effective tillers m^{-2} and grain yield were found with twice hand weeding(T_9)(Table 4). This result is in agreement with the findings of Tripathi *et al*.(2000) [14].Among the herbicide treatments, highest yield attributing characters and grain yield were observed withpretilachlor 50% EC@1.2 kg a.i.ha^{-1}

(T_4)followed by pretilachlor 50% EC @ 1.0 kga.i.ha^{-1}(T_3).This result is in line with the finding of Suganthi *et al.* (2010) [13].This is due to greater WCI and minimum crop-weed competition which resulted better yieldattributes higher grain and straw yield in rice.

4. CONCLUSION

The grain yield of pretilachlor 50% EC@1.2 kg a.i.ha^{-1} was statistically at par withtwice hand weeding(T_9).Therefore, it can be concluded that the laborious, time consuming, costly and cumbersome hand weeding practice can economically be replaced by pretilachlor 50% EC @ 1.2 kg a.i.ha^{-1} which is safer for the crop and environment.

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