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PERFORMANCE OF SOME PRE EMERGENCE HERBICIDES AGAINST WEEDS IN WINTER RICE

Rakiba Shultana[1], Md. Abdullah Al-Mamun[1], Saleque Ahmed Rezvi[2], and Mst. Selima Zahan[1]

ABSTRACT

An experiment was conducted at Bangladesh Rice Research Institute, Gazipur, during winter season 2009 to evaluate the weed control efficiency of some pre-emergence herbicides in transplanted rice. Among the treated herbicides, four were from pretilachlor, two from butachlor, one from oxadiazon and one from bensulfuron methyl + acetachlor group. One herbicide from pretilachlor and one from oxadiazon group were used for standard comparison as well. No phytotoxic effects were observed on the treated plots. Echinochloa crusgalli was found as the most dominating weed in all the treated rice plots and the most prevalent weed was Scirpus maritimus. Among the evaluated herbicides, Rigid 50 EC (pretilachlor) @ 1L, Alert 18WP (bensulfuron + acetachlor) @ 400g, Kildor 5G (butachlor) @ 25kg, Bigboss 500EC (pretilachlor) @ 1L, Rifit 500EC (pretilachlor) @ 1L, Ravchlor 5G (butachlor) @ 25kg, Succour 50EC (pretilachlor) @ 1L and Topstar 80WP (oxadiazon) @75g ha^{-1} showed above 80% weed control efficiency. Similarly, the grain yields were above 4 t ha^{-1} in the aforesaid treatments which were comparable to the standard check; however, weed free plots gave the highest grain yield as anticipated.

Key words: Herbicides, performance, weed control, weeds, winter rice.

INTRODUCTION

Rice is the vital food for more than two billion people in Asia and four hundred million people in Africa and Latin America (IRRI, 2006). The people in Bangladesh depend on rice as staple food and have tremendous influence on agrarian economy of Bangladesh. Rice alone constitutes 95% of the food grain production in Bangladesh (Julfiquar *et al.*, 1998). Among different groups of winter season rice, (Boro or winter season) covers about 43.6% of the total rice area and it contributes to 61.3% of the total rice production in Bangladesh (BBS, 2008). Boro covers the second largest area of 4.61 million hectares with a production of 17.72 million metric tones and the average yield is about 3.84 t ha^{-1} (BBS, 2008). The average rice yield

[1] Agronomy Division, Bangladesh Rice Research Institute, Gazipur, Sonali Bank Limited
Corresponding author: aamamunbrri@yahoo.com

in Bangladesh is 50% of world's average (BRRI, 2006). Weed infestation and interference is a serious problem in rice fields that significantly decreases yield. In Bangladesh weed infestation reduces rice grain yield by 70-80% in Aus rice, 30-40% in transplanted aman rice and 22-36% for modern boro rice cultivars (BRRI, 2006; Al-Mamun, 1990). Production cost of rice increased due to increase in weed control cost. The prevailing climate and edaphic conditions are highly favorable for luxuriant growth of numerous species of weeds that strongly compete with rice crop. In Bangladesh the traditional method of weed control practices include preparatory land tillage and hand weeding. Usually two or three hand weedings are done for growing a rice crop depending upon the nature of weeds, their intensity of infestation and the nature of crop grown. Weed control in transplanted rice by mechanical and cultural means is an expensive method. Specially, at the peak period of labor crisis sometimes weeding becomes late causing drastic losses in grain yield. In contrast, chemical weed control is sufficient to control the weeds. Nowadays use of herbicides is gaining popularity in rice culture due to their rapid effects and less cost involvement compared to traditional methods (Karim, 2008). The available herbicides for weed control in rice are of overseas origin. The country depends on multinational companies for supply of the herbicides, but usually the companies do not supply the same brand of herbicides for long time. Thus, continuous evaluation of the available herbicides in rice is necessary for the benefit of the farmers of this country. Therefore the objective of this study was to examine the performance of different pre emergence herbicides in comparison with manual weeding and a standard herbicide for the control of weeds in boro/winter rice.

MATERIALS AND METHODS

An experiment was conducted at Bangladesh Rice Research Institute, Gazipur, during winter season (Boro season) 2009 to evaluate the weed control efficiency of eight pre emergence herbicides in transplanted rice. The experiment was carried out with 12 different weed management treatments viz. the herbicides of pretilachlor group were: Rigid 50 EC @ 1 L, Bigboss 500 EC @ 1 L, Rifit 500 EC @ 1 L, and Succour 50 EC @ 1 L ha^{-1}; whereas those of butachlor group were Kildor 5 G @ 25 kg, and Ravchlor 5G @ 25 kg ha^{-1}, of oxadiazon group was Topstar 80 WP @ 75 g ha^{-1}, of bensulfuron + acetachlor group were Alert 18 WP @ 400g, Ronstar 25 EC @ 2 L (standard check), Rifit 500 EC @ 2 L ha^{-1} (standard check), a weed free, and an unweeded control. The experiment was laid out in randomized complete block design (RCBD) having three replications. The rice variety BRRI dhan29 was used in this study. A common procedure was followed for raising seedling in seed bed. Seedlings of 35 days old were transplanted according to treatments in the well puddled experimental plots. Spacings were given 15cm x 20 cm. A fertilizer dose of 80-50-50-10 kg ha^{-1} of N, P_2O_5, K_2O and S were applied in the field as urea, TSP, MOP and gypsum. One third urea and full dose of TSP, MOP and Gypsum as basal dose during final land preparation and incorporated well into the soil. Rest two third of Urea was applied in two equal splits at 30 and 55 days after transplanting. All intercultural operations were done carefully. Hand weedings were done as per treatments. All herbicides were applied at 6 days after transplanting (DAT).

Data regarding weeds were recorded at 50 days after transplanting (DAT). Dry weight of weeds were taken by drying them in electric oven (Perkin-Elmer Corporation, USA) at 60^oC for 72 hours followed by weighing by digital balance (Kaifeng Group Co. Ltd., China). Weed control efficiency (WCE %) was calculated using the formula according to Rao (1985). The grain and straw weights for each plot were recorded after proper sun drying and then converted into t ha^{-1}. The grain yield was adjusted at 12% moisture level. The data were analyzed following analysis of variance (ANOVA) technique and mean differences were depicted by multiple comparison test (Gomez and Gomez, 1984) using the statistical program MSTAT-C (Russell, 1986). The contribution of an individual weed species to the weed community was determined by its two-factor summed dominance ratio (SDR) (Janiya and Moody, 1989). This was calculated using relative weed density (RD) and relative dry weight (RDW), as following:

$$\text{RD (\%)} = \frac{\text{Density of individual weed species in the community x 100}}{\text{Total density of all weed species in the community}}$$

$$\text{RDW (\%)} = \frac{\text{Dry weight of a given oven dried weed species x 100}}{\text{Dry weight of all oven dreid weed species}}$$

$$\text{SDR (\%)} = \frac{\text{RD + RDW}}{2}$$

RESULTS AND DISCUSSION

Weed infestation

In this study the rice field was infested with different types of weeds. The relative density of these weed species was also different (Table-1). Eight different weed species were observed in unweeded (control) plot where most dominating weeds were grasses. Among the infesting different categories of weeds, four were grasses, two sedges and two broadleaves. Among the weed species maximum relative weed density was observed for *Scirpus maritimus* (20%) and higher importance value was observed for *Echinochloa crusgalli* (21.40%). In this study it was also observed that broad leaf and sedges were less dominating weed species.

Table-1. Importance value and relative density of infesting weed vegetation.

Weed vegetation	Family	Types of weed	Importance value (%)	Relative density (%)
Echinochloa crusgalli	Poaceae	Grass	21.40	13.00
Monochoria vaginalis	Pontederiaceae	Broadleaf	20.52	16.98
Cynodon dactylon	Poaceae	grass	18.60	17.84
Scirpus maritimus	Cyperaceae	Sedge	13.34	20.00
Cyperus difformis	Cyperaceae	Sedge	8.55	10.41
Leersia hexandra	Poaceae	Grass	8.53	11.40
Marsilea minuta	Marsiliaceae	Broadleaf	5.22	5.70
Leptochloa chinensis	Poaceae	Grass	3.84	4.71

Weed ranking

Summed dominance ratio (SDR) is an important indicator of showing ranking of weeds. Here SDR of infesting weeds are showing in Figure 1. The most dominating weed species were *Monochoria vaginalis*, *Cynodon dactylon, Echinochloa crusgalli* and *Scirpus maritimus*. *Leersia hexandra* and *Cyperus difformis* were medium dominating weeds. Among the infesting weed *Marsilea minuta* and *Leptochloa chinensis* were the least dominating weeds. Though individually *Monochoria vaginalis* was the top most infesting weed however as a group the most prevalent weeds were grasses (SDR 18.22-4.27%) followed by sedges (SDR 16.67-9.48%). This is due to higher frequency of grassy weeds in low land ecosystem. Besides less prevalent weeds were broad leaf ones (SDR 18.75-5.46%). Al-Mamun *et al.* (2010) also found that broad leaf weeds were not dominating weed species in low land ecosystem.

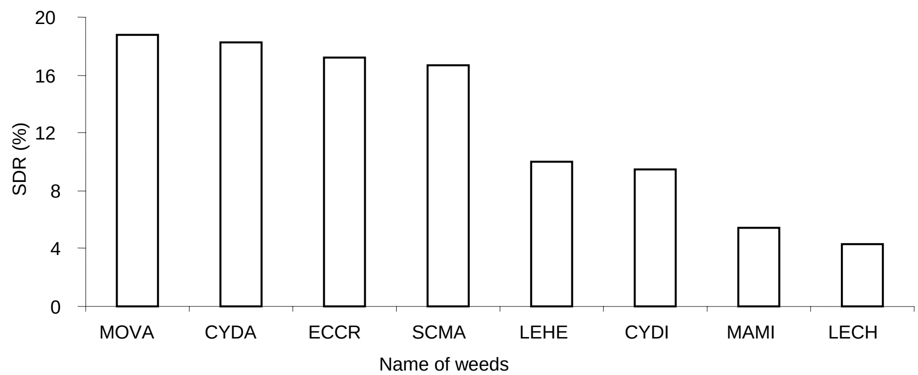

Figure 1. Ranking of different weeds infesting the experimental site.

[MOVA=*Monochoria vaginalis*, CYDA= *Cynodon dactylon,* ECCR= *Echinochloa crus-galli,* SCMA=*Scirpus maritimus*, LEHE= *Leersia hexandra*, CYDI=*Cyperus difformis,* MAMI= *Marsilea minuta*, LECH= *Leptochloa chinensis*]

Weed biomass

Weed biomass was significantly affected by different weeding treatments (Fig 2). Highest grain yield was observed in weed free plots whereas lowest weed biomass was found in Rigid 50 EC @1l/ha. Maximum weed infestation occurred in control plots which suppressed the growth of rice plants and ultimately reduced grain yield. These results were supported by Hasanuzzaman *et al.* (2008).

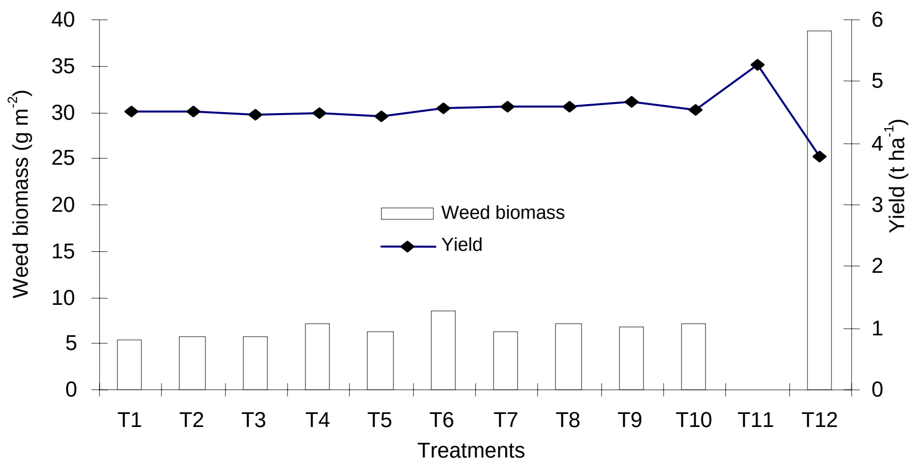

Figure 2. Effect of weed biomass production on grain yield.

[T1=Rigid 50 EC @1l/ha; T2=Alert 18WP @400g/ha; T3= Kildor 5G @ 25kg/ha; T4=Bigboss500EC @ 1l/ha; T5= R-fit 500EC @ 1l/ha; T6=Ravchlor5G @25kg/ha;

T7=Succour 50EC @1L/ha; T8= Topstar 80WP @75g/ha; T9= Ronstar 25EC @2l/ha; T10= Rifit 500Ec @1l/ha; T11= WF; T12= Control (no weeding)]

Yield and yield components

Significantly highest number of panicles m^{-2} was found in weed free plots (Table-2). Among the herbicidal treatments higher number of panicles m^{-2} was found in T9 which is statistically similar with T1, T2, T7 and T8. Higher number of grains $panicle^{-1}$ was found in T2 (127) and the lowest was found in T11 (weed free plot) (113). In this study, 1000-grain weight was not significantly affected by weeding treatments. However, highest 1000-grain weight was observed in T7 (20.48) and lowest with control plot (18.21). Significantly highest grain yield was found in weed free plots (5.39 t ha^{-1}). Among the herbicidal treatments highest grain yield was observed in T9 which is statistically identical with other herbicidal treatments. It might be due to more panicles m^{-2}. The herbicidal treatments T1, T2, T3, T4, T5, T6, T7 and T8 produced 19.89, 19.63, 18.57, 18.83, 17.51, 21.22, 22.02 and 21.75% higher grain yield respectively over the unweeded (control). These findings are supported by Hasanuzzaman *et al*. (2008).

Table-2. Effect of herbicide treatments on yield and yield components of rice.

Treatments	Panicles m^{-2}	Grains $panicle^{-1}$	1000-grain weight	Grain yield (t ha^{-1})
T1	200 bcde	124	19.91	4.52b
T2	215 bc	127	19.98	4.51b
T3	179e	114	20.25	4.47b
T4	195cde	118	19.26	4.48b
T5	180 e	124	20.59	4.43b
T6	190de	127	20.45	4.57b
T7	213bc	115	20.48	4.60b
T8	209bcd	118	20.02	4.59b
T9	219ab	122	18.93	4.67b
T10	194.33cde	125	18.95	4.55b
T11	238a	113	18.85	5.27a
T12	203bcd	116	18.21	3.77c
LSD	19.26	NS	NS	0.4148

Means separation in columns with the same letters are not significantly different at p=0.05

T1=Rigid 50 EC @1l/ha; T2=Alert 18WP @400g/ha; T3= Kildor 5G @ 25kg/ha; T4=Bigboss500EC @ 1l/ha; T5= R-fit 500EC @ 1l/ha; T6=Ravchlor5G @25kg/ha; T7=Succour 50EC @1L/ha; T8= Topstar 80WP @75g/ha; T9= Ronstar 25EC @2l/ha; T10= Rifit 500Ec @1l/ha; T11= WF (HW); T12= Control (no weeding)]

Harvest / weed indices and weed control efficiency

In this study different treatment effects were insignificant in terms of harvest index (Table-3). The highest harvest index was found in weedfree plots (49.41) and lowest in control plots (45.89) however all of them were statistically at par. Similarly, highest weed index was found in control plots (45.32%) and lowest weed index (17.58%) in weed free plots. Among the herbicidal treatments lowest weed index (17.58) was found in Ronstar 25EC @2l/ha which is statistically similar with the rest of the herbicidal treatments. Significantly highest weed control efficiency was found in Rigid 50 EC @1l/ha (86.01%) which is statistically similar with T2, T4, T5, T8, T9 and T10 (Table-3). Al-Kothayri and Hassam (1990) reported that all herbicidal treatments reduced weed population significantly compared with weedy check. Similar result also observed by Hasanuzzaman *et al*. (2008).

CONCLUSION

Most of the evaluated herbicides showed above 80% weed control efficiency without showing any phytotoxicity symptom on rice crop and grain yield was above 4 t ha^{-1} which is comparable to the standard herbicidal checks but weed free plots gave the highest grain yield (5.27 t ha^{-1}). It can be concluded that application of herbicides could be an alternative option for controlling weeds without sacrificing rice yield.

Table-3. Harvest index, weed index and weed control efficiency of weed control options.

Treatments	Harvest index (%)	Weed index (%)	Weed control efficiency (%)
T1	46.58	21.53b	86.01b
T2	46.45	21.31b	85.30b
T3	48.02	22.48b	85.39b
T4	49.12	22.19b	81.90bc
T5	46.97	23.58b	83.85bc
T6	46.95	19.66b	77.73c
T7	46.71	18.74b	84.00bc
T8	46.96	19.13b	81.60bc
T9	46.76	17.58b	82.62bc
T10	48.54	20.26b	81.65bc
T11	49.41	-	100a
T12	45.89	45.32a	-
LSD	NS	11.12	6.534

Means separation in columns with the same letters are not significantly different at p=0.05 [T1=Rigid 50 EC @1l/ha; T2=Alert 18WP @400g/ha; T3= Kildor 5G @ 25kg/ha; T4=Bigboss500EC @ 1l/ha; T5= R-fit 500EC @ 1l/ha; T6=Ravchlor5G @25kg/ha; T7=Succour 50EC @1L/ha; T8= Topstar 80WP @75g/ha; T9= Ronstar 25EC @2l/ha; T10= Rifit 500Ec @1l/ha; T11= HW; T12= Control (no weeding)]

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