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EFFECTIVENESS OF DIFFERENT WEED CONTROL METHODS ON THE PERFORMANCE OF TRANSPLANTED RICE

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ABSTRACT

An experiment was conducted on transplanted (T) 'aman' rice at the Sher-e-Bangla Agricultural University Farm, Dhaka, Bangladesh during Aman season (July-November) of 2006. There were 8 different weed control treatments viz. W_1= No weeding, W_2 = One hand weeding at 30 DAT (Days after transplanting), W_3= Two hand weeding at 30 and 45 DAT, W_4= One mechanical weeding with BRRI rice weeder at 30 DAT, W_5= One hand weeding at 30 DAT and one mechanical weeding with BRRI rice weeder at 45 DAT, W_6= Clear® 500 EC (pretilachlor 500 g a.i. L^{-1}) @ 1.5 L ha^{-1}, W_7= Clear® 500 EC (pretilachlor 500 g a.i. L^{-1}) @ 1.5 L ha^{-1} and one hand weeding at 30 DAT, W_8= Clear® 500 EC (pretilachlor 500 g a.i. $l.^{-1}$) @ 1.5 L ha^{-1} and one mechanical weeding with BRRI rice weeder at 45 DAT. In T aman rice, 16 different weed species were observed where *Sagittaria guyanensis* and *Sphenoclea zeylanica* were the most dominant species. Weed density and weed dry matter, plant height, tillers $hill^{-1}$, effective tillers $hill^{-1}$, panicles $hill^{-1}$, fertile grains $panicle^{-1}$ and grain yield were significantly affected by different weeding treatment. Weed density and weed dry matter were most effectively reduced by W_7 and W_8. The highest seed yield (5.2 t ha^{-1}) was observed in Clear® 500 EC (pretilachlor 500 g a.i. l^{-1}) @ 1.5 L ha^{-1} and one hand weeding at 30 DAT where unweeded conditions produced the lowest seed yield (2.4 t ha^{-1}).

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INTRODUCTION

In Bangladesh, majority of food grains come from rice (*Oryza sativa* L.). About 80% of cropped area of this country is used for rice production, with annual production of 25.18 million tons from 10.29 million ha of land (IRRI, 2006). The average yield of rice in Bangladesh is 2.45 t ha^{-1} (BRRI, 2007). This average yield is almost less than 50% of the world average rice grain yield. Infestation of weed is one of the most important causes for low yield of rice. In Bangladesh, weed infestation reduces the grain yield by 70-80% in Aus rice (early summer), 30-40% for Transplanted (T) Aman rice (late summer) and 22-36% for modern Boro rice cultivars (winter rice) (BRRI, 2006; Mamun, 1990). Production cost of rice increased due to increases in weed control cost. The prevailing climatic and edaphic conditions are highly favorable for luxuriant growth of numerous species of weeds that strongly compete with rice crop. The present weed management system which is done manually, is laborious, time consuming expensive and can not be done on time due to various reason (Ahmed *et al.*, 2005). Mechanical weeding and herbicides are the alternative to hand weeding. Japanese rice weeders are in use in some areas of the country. But due to some disadvantages to its use, it has not gained widespread popularity actions are available in the market. These herbicides are effective in controlling weeds alone or in combination with hand weeding (Ahmed *et al.* 2005). In Bangladesh, few studies have attempted to establish the most suitable and economic integrated weed management system in T Aman rice. Thus this study was conducted to find out the effective weed management practices in T Aman rice.

MATERIALS AND METHODS

An experiment was conducted on Transplanted (T) aman rice at the Sher-e-Bangla Agricultural University farm Dhaka ($90^0 33'$ E longitude and $23^0 77'$ N latitude), Bangladesh during Aman season (July-November) of 2006. The soil of the experimental site was clay loam with a pH of 5.47-5.63. The experiment was laid out in a Randomized Complete Block Design (RCBD) with 3 replications comprising eight different weeding treatments viz. W_1= No weeding, W_2 = One hand weeding at 30 days after transplanting (DAT), W_3= Two hand weedings at 30 and 45 DAT, W_4= One mechanical weeding with BRRI rice weeder at 30 DAT, W_5= One hand weeding at 30 DAT and one mechanical weeding with BRRI rice weeder at 45 DAT, W_6= Clear™ 500 EC (pretilachlor 500 g a.i. L^{-1}) @ 1.5 L ha^{-1}, W_7= Clear™ 500 EC (pretilachlor 500 g a.i. L^{-1}) @ 1.5 L ha^{-1} and one hand weeding at 30 DAT, W_8= Clear™ 500 EC (pretilachlor 500 g a.i. L^{-1}) @ 1.5 L ha^{-1} and one mechanical weeding with BRRI rice weeder at 45 DAT. The seeds of rice variety BRRI dhan 38 were

collected from Bangladesh Rice Research Institute and sown in seed bed on June 22, 2006. Thirty days old seedlings were transplanted on July 22, 2006. The planting distance was maintained at 25 cm (row-row) × 15 cm (hill-hill). Fertilizers at 65:10:28:8:1 NPKSZn kg ha^{-1} were applied. Fifty percent N and all PKS were applied before transplanting and remaining 50% N was top-dressed at maximum tillering stage of rice plants. Herbicide (Clear® 500 EC) was sprayed with a hand sprayer in the mid-morning at 4 DAT. Intercultural operations such as gap filling, irrigation, insect and disease management were carried out as required. Data on weed species intensity, weed density and weed biomass were recorded at 40 and 60 DAT. Weed plant number of each species was expressed as percent of the weed plant number in the unweeded control plots. At harvest, plant characters and yield data were recorded. The collected data were analyzed using MSTST-C statistical package. Mean were compared with LSD test.

RESULTS AND DISCUSSION

Weed control

The rice crop was infested with different weed species and their infestation frequency was also different (Table-1). At 40 DAT, 11 weed species of different families were observed in unweeded plots. Among the weed species, *Sagittaria guyanensis* was the most dominant species (40.1%) followed by *Sphenoclea zeylanica* (20.1%), *Ludwigia octovalvis* (9.6%), *Enhydra fluctuans* (6.3%), *Echinochloa colona* (8.6%) and *Alternanthera sessilis* (6%). At 60 DAT, five new weed species such as *Monochoria vaginalis, Leersia hexandra, Polygonum hydropiper, Pistia stratiotes,* and *Cynodon dactylon* emerged in the field but their frequency was low.

Weed density was significantly greater in the unweeded plots than other treatments both at 40 and 60 DAT (Table-2). Similar results were also observed by Mitra *et al.* (2005) and Ahmed *et al.* (1997). There was no significant difference in weed density at 30 DAT between one hand weeding (W_1) and two hand weedings (W_2) because at that stage second hand weeding was not performed. But, at 60 DAT, two hand weedings had lower weed density than one hand weeding (Table-2). One hand weeding at 30 DAT (W_1) more effectively reduced weed number than one mechanical weeding with BRRI rice weeder at 30 DAT (W_3). The lowest weed density was observed in the treatment W_2 (Clear® 500 EC at 4 DAT and one hand weeding at 30 DAT) and W_5 (Clear® 500 EC and one mechanical weeding with BRRI rice weeder at 45 DAT). The weed density was reduced by 97-98% with W_2 compared to unweeded plots. In the unweeded plots, greater weed biomass could be attributed to the greater density of weed species (Table-2). Alam *et al.* (1996) and Singh *et al.* (1992) also found similar results. In the unweeded plots, the weed biomass was 13.01 g m^{-2} and 32.16 g m^{-2} at 40 and 60 DAT, respectively. The lower dry matter of weed was observed with W_2 (Clear® 500

EC and one hand weeding at 30 DAT) because this treatment controlled the weed most effectively. Hence, weed control efficacy was also the highest with W_7 treatment at both the growth stages of 40 DAT and 60 DAT (97 and 95%) followed by W_8 (Clear[®] 500 EC and one mechanical weeding with BRRI rice weeder at 45 DAT). Among the weed control treatments, weed control efficacy was the lowest in one hand weeding at 30 DAT (W_2).

Crop characters

At both the stages, the weed infestation in the unweeded plots was severe resulting in intense competition with crop plants. The shortest plant height was observed with W_1 (no weeding) and the tallest (145.26 cm) was observed in W_7 (Clear[®] 500 EC and one hand weeding at 30 DAT) which was statistically similar to W_8 (Clear[®] 500 EC) and one mechanical weeding with BRRI rice weeder at 45 DAT. Uremis *et al.* (2005) also found that the duration of weed infestation significantly affected the plant height. Tiller number is an important crop character which contributes to yield. Due to weed infestation the tiller number was greatly reduced in this experiment (Table-3). The lowest number of tillers hill^{-1} (13) was observed in the unweeded plots (W_1) which was due to a high weed infestation and weed biomass. The weed competition affected the production of new tillers at early vegetative stage. The highest tiller number was observed in treatment W_7 which was statistically similar to W_8. The higher weed control efficiency in treatments W_7 and W_8 resulted in greater tiller production. These results conform to those of Bajpai and Singh (1992).

Yield components and yield

Yield components of T aman rice were significantly affected by weed control methods (Table-4). Effective tillers hill^{-1}, panicles hill^{-1} and fertile grains panicle^{-1} were significantly influenced by different treatments. Maximum number of effective tillers hill^{-1} (12) were observed in W_7 (Clear® 500 EC) and one hand weeding at 30 DAT where lowest number of effective tillers hill^{-1} (5) was observed in W_1 (no weeding). Panicles hill^{-1} were also the highest in treatment W_7 while unweeded condition gave the minimum number of panicles hill^{-1}.

Weeds always compete with crop for resources like light, water, nutrient which are needed for crop plant to produce a healthy grains (Antigua *et al.*, 1988). In this study, greater weed infestation in the unweeded plots resulted in the lowest number of filled grain panicle^{-1} (81). The treatment W_7 produced the maximum number of filled grain panicle^{-1} (115) which was statistically superior to any other treatment (Table-4) mainly due to weed-free conditions in this treatment. These results corroborated with the results of Ahmed *et al.* (2003) and Smith and Moody (1979). Weight of 1000 grain

weight was not significantly affected by weed control methods as it is primarily a genetically controlled character.

Among the weed control methods, the highest grain yield (5.20 t ha $^{-1}$) of rice was observed in treatment W_7 (Clear® 500 EC and one hand weeding at 30 DAT) which was statistically similar to W_8 (Clear® 500 EC and one mechanical weeding with BRRI rice weeder at 45 DAT). The highest yield with W_7 was due to maximum yield contributing characters such as effective tillers hill $^{-1}$, panicles hill $^{-1}$, fertile grain panicle $^{-1}$, 1000-grain weight and the highest weed control efficiency in that treatment. The lowest seed yield was observed in the unweeded plots (W_1). Ahmed *et al.* (2005) also found similar results. Harvest index (%) in T aman rice was not affected by different weed control methods (Table-4).

Cost of weed control

Different weed control methods involved different amounts of cost which affect the total cost of cultivation of T aman rice. The hand wedding is laborious and generally more expensive. In this study, the weed control cost was maximum for treatment W_3 (two hand weeding at 30 and 45 DAT) and the lowest for W_1 (Clear® 500 EC) (Fig.-1). Similar results on the weed control costs were as also observed by Ahmed *et al.* (2005) and Alam *et al.* (1996).

Table-1. Relative density (%) of different weed species in the untreated control at two different stages after transplanting in Dhaka, Bangladesh in 2006

Weed species	Infestation rate (%)	
	40 DAT	60 DAT
Sagittaria guyanensis	40.06	12.91
Sphenoclea zeylanica	20.10	18.66
Ludwigia octovalvis	9.56	10.35
Enhydra fluctuans	6.30	7.66
Alternanthera sessilis	6.00	8.11
Echinochloa colona	8.65	11.55
Cyperus difformis	3.66	3.05
Commelina benghalensis	1.22	2.55
Fimbristylis miliacea	1.25	1.50
Monochoria vaginalis	0.00	8.21
Leersia hexandra	0.00	1.21
Scirpus maritimus	2.11	5.66
Cyperus iria	1.09	1.02
Polygonum hydropiper	0.00	1.88
Pistia stratiotes	0.00	4.66
Cynodon dactylon	0.00	1.02

Table-2. Weed density, weed dry matter and weed control efficiency as affected by different weed control methods in Dhaka, Bangladesh in 2006

Treatment	Weed density m^{-2}		Weed dry matter (g m^{-2})		Weed control efficiency (%)	
	40 DAT	60 DAT	40 DAT	60 DAT	40 DAT	60 DAT
W_1	129	135	13.0	32.2	0	0
W_2	12	27	8.0	18.9	38.0	41.0
W_3	14	10	4.1	10.2	68.4	68.2
W_4	21	28	4.9	14.8	62.1	53.7
W_5	16	15	3.1	8.1	75.5	74.7
W_6	8	12	2.6	6.4	79.8	80.0
W_7	2	3	0.4	1.5	96.7	95.1
W_8	3	6	1.1	3.1	91.3	90.3
$LSD_{0.05}$	3.14	3.55	0.61	1.89	4.01	3.81
CV (%)	8.78	9.28	10.21	7.88	8.22	6.35

Table-3. Plant characters of Transplanted aman rice as affected by weed control methods in Dhaka, Bangladesh during 2006

Treatment	Plant height (cm)	Tillers hill^{-1}
W_1	120.2	13
W_2	131.3	18
W_3	135.0	22
W_4	133.0	19
W_5	136.7	23
W_6	142.1	25
W_7	145.3	25
W_8	143.1	25
$LSD_{0.05}$	2.31	1.1
CV (%)	10.2	6.4

Table-4. Yield contributing characters and yield of Transplanted aman rice as affected by different weed control methods in Dhaka, Bangladesh during 2006

Treatment	Effective tillers hill^{-1}	Panicles hill^{-1}	Fertile grain panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Harvest Index (%)
W_1	5	15	81	22.09	2.40	0.46
W_2	9	16	99	22.16	4.28	0.47
W_3	10	18	102	22.45	4.50	0.47
W_4	10	17	101	22.40	4.34	0.47
W_5	10	19	109	22.66	4.66	0.47
W_6	11	25	110	22.90	5.08	0.48
W_7	12	39	115	23.02	5.20	0.48
W_8	11	38	112	22.98	5.11	0.48
$LSD_{0.05}$	0.78	1.56	2.51	NS	0.27	NS
CV (%)	8.11	9.06	10.47	7.52	8.25	5.36

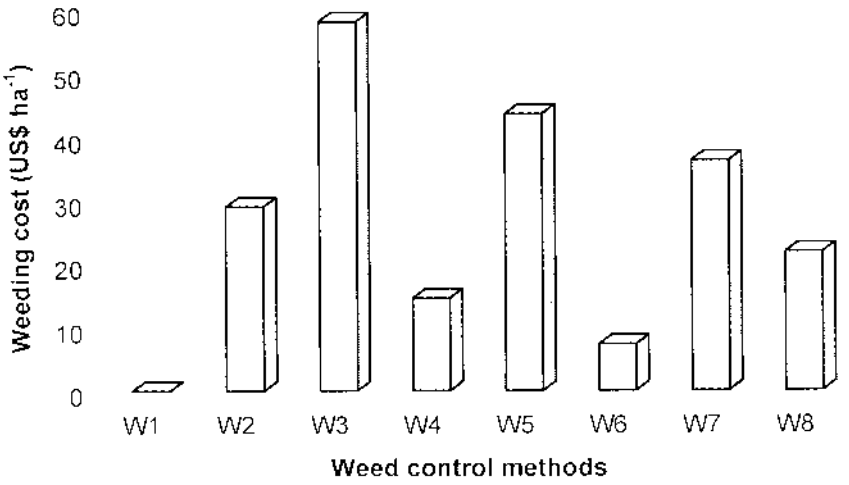

Fig.-1. Cost of weed control for different weed control methods

CONCLUSIONS

Results from this study suggest that different weed control methods greatly affected the weed control efficacy, crop characters, yield contributing characters and grain yield of T aman rice. Among the weed control treatments, Clear® 500 EC and one hand weeding at 30 DAT controlled weeds more effectively in T aman rice and produced 117% higher grain yield than the unweeded control. But the weed control cost was the minimum for chemical weeding. Application of Clear® 500 EC and one mechanical weeding with BRRI rice weeder at 40 DAT was also an effective weed control method which was more economic and effective than other treatments.

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