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YIELD OF AROMATIC RICE AS INFLUENCED BY HERBICIDAL WEED CONTROL

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ABSTRACT

The experiment was conducted at the Agronomy field, Sher-e-Bangla Agricultural University (SAU), Dhaka-1207, Bangladesh during July to December 2018 to find out the performance of modern aromatic rice as influenced by herbicidal weed control. Weed control *viz*., W_0-No herbicide used (Control), W_1-Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 15 g ha^{-1}, W_2-Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 20 g ha^{-1} and W_3-Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 25 g ha^{-1} and 30 days old seedlings of V_1-BRRI dhan70, V_2-BRRI dhan79 and V_3-BRRI dhan80 were transplanted under present study as treatment. The experiment was laid out in a split plot design with three replications where herbicidal weed control was placed along the main plot and variety in the sub plot. The results revealed that different herbicidal treatments had significant effect on crop growth parameters, yield and yield contributing characters of three aromatic rice varieties. The highest effective tillers $hill^{-1}$ (18.87), longest panicle (35.81 cm), maximum total grains $panicle^{-1}$ (97.97), maximum filled grains $panicle^{-1}$ (86.46), highest 1000-grain weight (29.24 g), highest grain yield (6.24 t ha^{-1}) and maximum days to weed emergence (24.33) were obtained from the combination Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 20 g ha^{-1} in BRRI dhan70 compared to that of other herbicidal treatments in other two rice varieties.

Keywords: 1000-grain weight, pre-emergence, weed species and fragrant rice.

INTRODUCTION

Rice (*Oryza sativa* L.) is the most important cereal crop in Bangladesh as it is our staple food. Approximate 75% of the total cultivated land covering about 11.58 million ha produces approximate 30 million tons of rice annually (BBS, 2018). The average yield of rice in our country is around 4.57 t ha^{-1}, which is less than the world average (7.48 t ha^{-1}) (FAO, 2019). The one of the causes of lower yield is weed infestation. In a rice field, variety of weed grown that are generally classified into three groups namely, grasses, sedges and broadleaf weed according to their morphological characters. Weed infestation and interference is a serious problem in rice fields that significantly decreases yield. Weed infestation management plays an important role in crop production having a great influence on growth, yield and yield contributing characters of transplanted *aman* rice (Hossen *et al.*, 2015). Weed control in transplanted *aman* rice by mechanical and cultural methods is expensive (Mitra *et al.*, 2005). In contrast, chemical weed control is easier and cheaper but it leads to environmental pollution and negative impact on public health (Phuhong *et al.,* 2005). In large-scale production, herbicide-based weed management has become the smartest and most viable options as scarcity and high cost of labor. So the vegetation community consisting of rice crop and weed should be seen and regarded as a competitive and cooperative system that has to be managed appropriately applying appropriate herbicidal composition. Besides, sufficient study on the competitive ranking of different varieties against weeds has not yet been done in Bangladesh. Hoque *et al*. (2003) reported variable effects in BRRI dhan33, BRRI dhan34, BRRI dhan39, Binashail and Naizershail rice varieties regarding weed infestation. Therefore, based on the above facts, the present study was aimed to determine suitable dose of Metsulfuron methyl 10% + Chlorimuron ethyl 2% for optimum growth and yield of transplanted *aman* rice varieties, to compare the yield performance and weed tolerance of three modern *aman* rice varieties and to differentiate the weed flora in aromatic and non-aromaticrice field.

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MATERIALS AND METHODS

The field experiment was conducted at the research field of Sher-e-Bangla Agricultural University Farm, Dhaka-1207, Bangladesh during the period from June to November, 2018. Soil of the experimental site was silty clay loam belonging to Tejgaon series under Agro-Ecological Zone of Madhupur tract (AEZ No. 28). The experimental area was under the subtropical climate and characterized by high temperature, high humidity and heavy precipitation with occasional gusty winds and scanty rainfall associated with moderately low temperature prevailed during the period from March to August. The experiment consisted of two factors *viz*., factor A: Herbicide (W_0: No herbicide used, W_1: Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 15 g ha^{-1}, W_2: Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 20 g ha^{-1} and W_3: Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 25 g ha^{-1}) and factor B: Variety (V_1: BRRI dhan70, V_2: BRRI dhan79 and V_3: BRRI dhan80). The experiment was laid out in a split plot design with three replications. The size of the individual plot was 4.0 m × 2.5 m. Herbicidal weed control treatment was placed in main plot and variety in the sub-plot. Healthy seeds were selected by specific gravity method. Seeds were then immersed in water in bucket for 24 hours. Then seeds were taken out of water and kept thickly in gunny bags. The seeds started sprouting after 48 hours and were sown after 72 hours. A piece of high land was selected in the research field for raising seedlings. The land was fertilized with urea, triple super phosphate, muriate of potash, gypsum and zinc sulphate at 250, 120, 120, 100 and 10 kg ha^{-1}, respectively (BRRI, 2016), which supplied 115 kg N, 55.20 kg P_2O_5, 72 kg K_2O, 18.50 kg S and 2.30 kg Zn ha^{-1}. The whole amount of triple super phosphate, muriate of potash, gypsum and zinc sulphate was applied at the time of final land preparation. Urea was applied in three equal splits at 15, 30 and 45 days after transplanting (DAT). The twenty-eight (28) days old seedlings were transplanted in the experimental plots, which were puddled further with spade on the day of transplanting seedlings maintaining 25 cm×15 cm spacing. All the intercultural operations and phytosanitary measures were taken as per needed. For crop analysis, the data on number of effective tillers $hill^{-1}$, panicle length, number of total grains $panicle^{-1}$, number of filled grains $panicle^{-1}$, weight of 1000-grain and grain yield were recorded following conventional data recording procedures. For weed analysis, the data on days to weed emergence and number of weed species were taken as follows:

Weed emergence

After transplanting of rice seedling, the emergence of weed was carefully observed twice in a day (morning and afternoon) until 30 days after transplanting (DAT).

Number of weed species

Data on weed population were collected from each plot at harvesting time of the rice plants. Weeds grown in the quadrate (1 m×1 m) were identified and the quadrate was placed randomly at three places in each plot following Cruz *et al*. (1986) method. The weeds within the quadrate were counted species-wise and converted to number m^{-2} by the average number of three sampling area. The species were identified with the help of 'Bangladesher Agacha Parichiti' (Karim and Kabir, 1995). Frequency of different weeds was determined and density of each species was calculated according to Odum (1971).

Weed species (Number m^{-2}) = Total number of weeds/Total surveyed unit area

The recorded data were compiled and subjected to statistical analysis. Analysis of variance following a split plot design was done with the help of MSTAT−C (Russell, 1986). The significant differences among the treatment means were compared by Least Significant Difference (LSD) test at 5% level of probability.

RESULTS AND DISCUSSION

Number of effective tillers hill^{-1}

Herbicide treatments exhibited significant variation on the number of effective tillers hill^{-1} in three rice varieties (Table-1). The highest effective tiller (18.87) was obtained from the combination Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 20 g ha^{-1} with BRRI dhan70 (W_2V_1). On the other hand, the lowest number of effective tillers (6.75) was found from the combination of no herbicide with BRRI dhan79 (W_0V_2).

Panicle length

The panicle length varied significantly due to weed control treatments in three rice varieties (Table-1). The longest (35.81 cm) panicle was observed from the combination Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 20 g ha^{-1} with BRRI dhan70 (W_2V_1). Second highest panicle length (33.66 cm) was obtained from the combination of Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 15 g ha^{-1} with BRRI dhan70 (W_1V_1) and the shorter (20.53 cm) was found from the combination no weed control and BRRI dhan79 (W_0V_2).

Number of total grains panicle^{-1}

Number of total grains panicle^{-1} varied significantly due to the application of different herbicides in three aromatic rice varieties (Table -1). Number of total grains panicle^{-1} varied significantly due to the varieties in aromatic rice field (Data not shown). Significant variation was obtained in the number of total filled grain panicle^{-1} due to the interaction effect of herbicide and variety (Table-1). Interaction effect of Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 20 g ha^{-1} with BRRI dhan70 (W_2V_1) gave maximum total filled grain panicle^{-1} (97.97). On the other hand, the minimum total filled grain panicle^{-1} (73.57) was found from the interaction effect of no herbicide used with BRRI dhan79 (W_0V_2).

Number of filled grains panicle^{-1}

Significant variation was found in filled grains panicle^{-1} due to the application of different herbicides in the three aromatic rice varieties (Table- 1). The maximum number of filled grain panicle^{-1} (86.46) was recorded from the interaction effect of W_2V_1 (Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 20 g ha^{-1} with BRRI dhan70) treatment followed by (79.49) W_3V_1 (Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 25 g ha^{-1} with BRRI dhan70) treatment. On the other hand, the minimum number of filled grain panicle^{-1} (41.89) was obtained from W_0V_2 (no weed control with BRRI dhan79) treatment. These results were in agreement with the findings of Salam *et al.* (2010) who showed that the increased yield in *Boro* rice (Binadhan-5) is due to the application of herbicide contributed mainly from increasing the number of panicles hill^{-1} and number of grain panicle^{-1}.

Weight of 1000-grains

Herbicidal weed control showed significant variation in weight of 1000-grain in three aromatic rice varieties (Table-1). The highest weight of 1000-grain (29.24 g) was found from the interaction effect of Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 20 g ha^{-1} with BRRI dhan70 (W_2V_1). The second highest weight of 1000-grain (28.29 g) was obtained from the interaction effect of Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 25 g ha^{-1} with BRRI dhan70 (W_3V_1) which was statistically identical with W_2V_3 (27.83 g). The lowest weight of 1000-grain (18.34 g) was found with the interaction effect of no weed control with BRRI dhan79 (W_0V_2). This result supports the findings of Hassan *et al.* (2010) who reported that weight of 1000-grains varied significantly due to various weed control treatments in transplanted *aman* rice cv. BRRI dhan41.

Table 1. Combined effect of herbicide and variety on effective tillers hill^{-1}, panicle length and total grains panicle^{-1}, filled grains panicle^{-1}, and weight of 1000-grain of transplanted *aman* rice

Treatment Combination	Effective tillers hill^{-1} (no.)	Panicle Length (cm)	Total grains panicle^{-1} (no.)	Filled grain panicle^{-1} (no.)	Weight of 1000-grain (g)
W_0V_1	9.92 g	30.66 e	86.67 f	62.32 e	21.61 e
W_0V_2	6.75 i	20.53 j	73.57 j	41.89 i	18.34 g
W_0V_3	9.01 h	29.36 g	76.56 i	49.03 h	21.05 ef
W_1V_1	12.57 d	33.66 b	94.20 b	74.85 c	25.83 c
W_1V_2	10.17 g	25.20 i	76.84 i	51.23 g	20.98 f
W_1V_3	12.05 e	30.14 f	80.87 h	57.62 f	23.36 d
W_2V_1	18.87 a	35.81 a	97.97 a	86.46 a	29.24 a
W_2V_2	12.55 d	27.69 h	87.47 e	69.87 d	25.49 c
W_2V_3	15.34 b	31.70 d	91.67 c	76.69 c	27.83 b
W_3V_1	13.24 c	33.24 c	94.67 b	79.49 b	28.29 b
W_3V_2	9.98 g	25.24 i	83.17 g	60.85 e	21.54 ef
W_3V_3	10.67 f	30.24 f	88.93 d	69.83 d	23.29 d
LSD $_{(0.05)}$	0.37	0.28	0.57	2.03	0.58
CV (%)	6.80	7.54	7.39	8.81	8.40

In a column, means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 level of probability. W_0 – No herbicide used , W_1 – Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 15 g ha^{-1}, W_2 – Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 20 g ha^{-1} and W_3 – Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 25 g ha^{-1}. V_1 – BRRI dhan70, V_2 – BRRI dhan79 and V_3 – BRRI dhan80.

Grain yield

Grain yield (t ha^{-1}) of three rice varieties were varied significantly due to the application different herbicides in the aromatic rice field (Table-2). The highest grain yield (6.24 t ha^{-1}) was recorded from Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 20 g ha^{-1} and BRRI dhan70 combination (W_2V_1) treatment whereas, the lowest grain yield (4.11 t ha^{-1}) was recorded from no weed control and BRRI dhan78 combination (W_0V_2) treatment which was the statistically similar with W_3V_2 (4.32 t ha^{-1}), W_0V_3 (4.37 t ha^{-1}) and W_0V_1 (4.38 t ha^{-1}). This result is in agreement with Al-Mamun *et al.* (2011) and, Mukhopadhyay and Ghosh (1981) who reported that the highest grain yield (6.96 t ha^{-1}) was obtained from Surjamoni when treated with Bouncer 10WP @ 150 g ha^{-1}, which was 49% higher than control.

Days to weed emergence

Significant variations in three aromatic rice varieties were found in days to weed emergence due to herbicidal weed control treatments (Table-2). The maximum weed emergence (24.33 days) was observed from Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 20 g ha^{-1} with BRRI dhan70 (W_2V_1). On the other hand, the minimum weed emergence (10.00 days) was obtained from the interaction of no weed control with BRRI dhan70 (W_0V_1) which was statistically similar with W_0V_3 (11.33 days) and W_0V_2 (12.00 days).

Number of weed species m^{-2}

Profound variation was observed on weed density throughout the growing period of three aromatic rice varieties for different weed control treatments (Table-2). The maximum no. of weed population (18.86 m^{-2}) was recorded from the combinations of no weeding and BRRI dhan80 (W_0V_3) which was second maximum

population (17.52 m^{-2}) was recorded from W_0V_2. On the other hand, the minimum no. of weed density (3.52 m^{-2}) was observed from the combinations of Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 20 g ha^{-1} and BRRI dhan79 (W_2V_2). This result was similar with the findings of Gnanavel and Anbhazhagan (2010) who observed that pre-emergence application of Metsulfuron methyl 0.25 kg ha^{-1} followed by post-emergence application of bispyribac sodium 0.05 kg + metsulfuron methyl @ 0.01 kg ha^{-1} recorded the least weed count (11.00 m^{-2}) in transplanted aromatic basmati rice.

Table 2. Combined effect of herbicide and variety on grain yield, days to weed emergence and number of weed species m^{-2} in transplanted *aman* rice

Treatment Combination	Grain yield (t ha^{-1})	Days to weed emergence	Number of weed species (m^{-2})
W_0V_1	4.38 fg	10.00 f	16.75 c
W_0V_2	4.11 g	12.00 e	17.52 b
W_0V_3	4.37 fg	11.33 ef	18.86 a
W_1V_1	5.52 c	16.33 d	12.10 e
W_1V_2	4.49 ef	15.33 d	11.56 e
W_1V_3	4.79 de	16.67 d	14.51 d
W_2V_1	6.24 a	24.33 a	5.25 h
W_2V_2	4.84 d	22.00 b	3.52 i
W_2V_3	5.89 b	22.00 b	7.75 g
W_3V_1	5.78 bc	19.00 c	9.72 f
W_3V_2	4.32 fg	18.33 c	7.97 g
W_3V_3	4.72 de	18.33 c	9.87 f
$LSD_{(0.05)}$	0.33	1.49	0.67
CV (%)	8.82	8.01	6.42

In a column, means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 level of probability. W_0 – No herbicide used W_1 – Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 15 g ha^{-1}, W_2 – Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 20 g ha^{-1} and W_3 – Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 25 g ha^{-1}. V_1 – BRRI dhan70, V_2 – BRRI dhan79 and V_3 – BRRI dhan80.

CONCLUSION

The Metsulfuron methyl 10% + Chlorimuron ethyl 2% @ 20 g ha^{-1} may be applied to control weeds in the three rice varieties studied for yield maximization.

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