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# WEED CONTROL STRATEGIES AFFECTING YIELD POTENTIAL OF AROMATIC RICE

I.F. Chowdhury[1*], M.H. Ali, M.F. Karim, S.M. Masum and A. Rahman


## ABSTRACT

*A field experiment was conducted at Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during aman season with a view to find out the yield potential of transplant aromatic rice varieties under different weed control strategies. The experiment was carried out with four varieties i.e. BRRI dhan34, BRRI dhan37, BRRI dhan50 and Chinigura in the main plot and five weed controlstrategies viz. control (no weeding), one hand weeding at 15DAT, two hand weeding 15DAT + 40DAT, Topstar® 400SC (Oxadiargyl 400 g L$^{-1}$) @ 100 g ha$^{-1}$ as post-emergence and Sunrice® 150WG (Ethoxysulfuron 150 g kg$^{-1}$) @ 185 ml ha$^{-1}$ as pre-emergence herbicide in the sub plot in split plot design. The result showed that BRRI dhan34 gave highest (3.16 t ha$^{-1}$) and BRRI dhan50 produced lowest grain yield (1.88 t ha$^{-1}$). Sunrice® 150WG as pre-emergence herbicide controlled weeds very successfully which performed better in response of yield contributing characters of rice. Application of Sunrice® 150WG achieved highest grain yield which was 50.73%, 32.07%, 11.95% and 5.25% higher than the yield obtained from control, one hand weeding, two hand weeding and Topstar® 400SC treated plots, respectively. The interaction of BRRI dhan34 in combination with Sunrice® 150WG produced the highest grain yield (4.10 t ha$^{-1}$) while lowest grain yield (1.44 t ha$^{-1}$) was obtained from BRRI dhan50 in control treatment.*


**Key words:** Aromatic rice, weed control strategies, pre-emergence herbicide, post-emergence herbicide.

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## INTRODUCTION

Rice (*Oryza spp.*) is the staple food for nearly half of the world's population. However, more than 90% of this rice is consumed in Asia, where it is a staple food for a majority of the population including 560 million hungry people (Mohanty, 2013). The people in Bangladesh

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depend on rice and have tremendous influence on agrarian economy of Bangladesh. In Bangladesh, rice is grown under three distinct seasons namely *aus*, *aman* and *boro* in irrigated, rainfed and deep water conditions. The majority of rice area is covered by *aman* (autumn) rice, 5.58 million hectares with the total production of 12.80 million metric tons and the average yield is 2.29 metric tons per hectare (AIS, 2013).

Aromatic rice contains natural ingredient 2-acetyl-1-pyrroline which is responsible for their fragrant taste and aroma (Gnanavel *et al.* 2010) and had 15 times more 2-acetyl-1-pyrroline content than non-aromatic rice (0.14 and 0.009 ppm, respectively) (Singh *et al.,* 2000). In addition, there are about 100 other volatile compounds, including 13 hydrocarbons, 14 acids, 13 alcohols, 16 aldehydes, 14 ketones, 8 esters, 5 phenols and some other compounds, which are associated with the aroma development in rice (Singh *et al.,* 2000). Most of the aromatic rice varieties in Bangladesh are traditional photo-period sensitive types and are grown during *aman* season (Baqui *et al.,* 1997). Cultivation of fine as well as aromatic rice has been gaining popularity in Bangladesh over the recent years, because of its huge demand both for internal consumption and export (Das and Baqui, 2000). Aromatic rice varieties have occupied about 12.5% of the total transplant *aman* rice cultivation (BBS, 2009).

Weeds grow in the crop fields throughout the world. Since weeds and crops largely use the same resources for their growth, they will compete when these resources are limited (Zimdahl, 1980). Weeds are the most competitors in their early growth stages than the later and hence the growth of crops slows down and grain yield decreases (Jacob and Syriac, 2005) and can cause grain yield reduction up to 76% under transplanted conditions in India (Singh *et al*., 2004). In Bangladesh the traditional weed control methods are normally practiced to control weeds. Usually two or three hand weeding is normally done for growing a rice crop. Hand weeding is highly labor-intensive (as much as 190 person day's $ha^{-1}$) (Roder, 2001) whether weed control in transplant *aman* rice by mechanical and cultural methods is expensive (Mitra *et al.*, 2005). In contrast, chemical weed control is easier and cheaper. This issue needs to examine whether weed management practices help keeping lower weed population and better control in aromatic rice. So, the vegetation community consisting of rice crops and weeds should be seen and regarded as a competitive and cooperative system that has to be managed appropriately. Therefore, the study was undertaken to fulfill the objectives to compare the performance of different aromatic rice varieties (modern and local) and to evaluate the performance of aromatic rice under different weed control methods.

## MATERIALS AND METHODS

The field experiment was conducted at the Agronomy field, Sher-e-Bangla Agricultural University, during *aman* season (July to December, 2011). The soil was silty-loam, low in organic matter and nitrogen content. The experiment was laid out a in split plot design with three replications having four varieties *i.e*. BRRI dhan34 ($V_1$), BRRI dhan37 ($V_2$), BRRI dhan50 ($V_3$) and Chinigura ($V_4$) in the main plot and five weed management strategies viz. control (no weeding) ($W_0$), one hand weeding at 15DAT ($W_1$), two hand weeding 15DAT + 40DAT ($W_2$), Topstar® 400SC (Oxadiargyl 400 g $L^{-1}$) @ 100 g $ha^{-1}$ as post-emergence ($W_3$) and Sunrice® 150WG (Ethoxysulfuron 150 g $kg^{-1}$) @ 185 ml $ha^{-1}$ as pre-emergence herbicide ($W_4$) in the sub plot. The field was fertilized with nitrogen, phosphate, potash, sulphur and zinc at the rate of 150, 100, 70, 60 and 10 kg $ha^{-1}$ respectively in the form of urea, triple super phosphate, muriate of potash, gypsum and zinc sulphate. The whole amount of all the fertilizers except urea were applied at the time of final land preparation and thoroughly incorporated with the soil. Urea was top dressed in three equal splits on 15, 30, and 45DAT (BRRI, 2000b). Twenty five days old seedling was transplanted using two seedlings $hill^{-1}$ maintaining the spacing with 25cm×15 cm on the well puddle plots on 08 August, 2011. Intercultural operations were done as and when necessary. Maturity of crop was determined when 90% of the grainsbecome golden yellow in color. Three square meters at centre of each plot was harvested, dried, threshed and adjusted at 12% moisture content to estimate the grain yield. The yield contributing characters *viz.* number of effective tillers $hill^{-1}$, number of grains $panicle^{-1}$ and 1000-grain weight was recorded from plant samples. The data were analyzed statistically using the MSTST-C computer package program. The mean differences among the treatments were compared by Duncan's Multiple Range Test (DMRT) at 5% level of significance.

## RESULTS AND DISCUSSION

### Yield and yield contributing characters

### Panicle length

Significantly longer panicle length (26.52 cm) was observed with BRRI dhan37 ($V_2$) and the shortest panicle length (19.97 cm) was measured from BRRI dhan50 ($V_3$) (Table-1). Panicle length of varieties differed due to their differences in genetic make-up. This confirms the report of Ahmed *et al.* (1997) and Idris and Matin (1990) who showed variable panicle length due to different varieties.

It was observed that the longest panicle (25.62 cm) was observed from the treatment $W_4$ (Sunrice® 150WG) and the shortest (23.51 cm) was observed from control treatment ($W_0$) which was statistically similar with $W_1$, $W_2$ and $W_3$ (Table 1). In weed free condition, competition of weeds with crop plants for growth factors was absent or negligible and thus their panicle length was increased. This confirms the report of Khan and Tarique (2011) and Hasanuzzaman *et al.* (2008) who observed that panicle length differed due to different weed control treatments. Longest panicle (29.91 cm) was observed from the combination of BRRI dhan37 with Sunrice® 150WG ($V_2W_4$) and shortest (18.97 cm) was found from the combination of BRRI dhan50 with no weeding ($V_3W_0$) which may be due to the application of herbicides providing favorable environment for better growth (Table 1).

Effective tillers hill$^{-1}$

Highest number of effective tillers (11.01) was observed with BRRI dhan37 ($V_2$) and the lowest effective tillers (8.69) was obtained from BRRI dhan50 ($V_3$) (Table 1). Similar results were observed by Jones *et al.* (1996) who observed varietal variation for effective tillers hill$^{-1}$.

Weed control by Sunrise® ($W_4$) produced the highest effective tiller (12.36) (Table 1) and no weeding ($W_0$) produced the lowest effective tiller (6.56). The minimum number of tillers hil$^{-1}$ in the control plot was the result of higher competition for nutrient, air space, light and water between crop plants and weeds. These results were in similar to the findings of Hasanuzzaman *et al.* (2008) and Raju *et al.* (2003) who stated that use of weedicide (Ronstar 25 EC, Safener and Butachlor) gave the highest effective tillers.

The highest effective tillers (13.37) was obtained from the combination of BRRI dhan34 with Sunrice® ($V_1W_4$) which was at par with $V_2W_4$ and the lowest (6.60) was found from the combination BRRI dhan34 with no weeding ($V_1W_0$) was at par with $V_2W_0$, $V_3W_0$ and $V_4W_0$ (Table 1). This might be due to the facts that severe weed infestations in the control plots that failed to produce more effective tillers. Similar findings were reported by Khan and Tarique (2011), Hassan *et al.* (2010) and Ashraf *et al.* (2006) who observed variable effective tillers hill$^{-1}$ due to different varieties and weed control methods.

**Filled grains panicle$^{-1}$**

Significant variation was observed in filled grain due to the effect of variety shown in Table-1. The highest filled grain (141.10) was found in Chinigura ($V_4$) and the lowest filled grain (78.19) was obtained from BRRI dhan50 ($V_3$). Chinigura produced 80% more filled grain than BRRI dhan50. These results were in agreement with Ahmed *et al.* (1997) who reported that percent filled grain was the highest in Nizersail (a local variety) followed by BR25 and the lowest in BR11 and BR23.

The effect of Sunrice® 150WG ($W_4$) obtained the highest filled grain (120.50) which was identical with one hand weeding ($W_1$), two hand weeding ($W_2$) and Topstar® 400 WG ($W_3$) (Table-1). It might be due to the least crop weed competition that ensured sufficient nutrients and other growth resources, which enhanced higher filled grain formation. Sunrice® 150WG ($W_4$) gave 14% more filled grain than no weeding ($W_0$). This result supports the findings of Hasanuzzaman *et al.* (2008) and Salam *et al.* (2010) who showed that application of herbicide contributed mainly increasing the number of grain panicle$^{-1}$.

Variation was observed for filled grain due to the interaction effect of variety and weed control (Table-1). The highest filled grain (149.70) was obtained from the interaction effect of Chinigura and Sunrice® 150WG ($V_4W_4$) and the lowest filled grain (76.73) was found from the interaction effect of BRRI dhan50 and no weeding ($V_3W_0$). The experimental result showed that no weeding affect the filled grains panicle$^{-1}$ of different cultivar.These results were in agreement with the findings of Salam *et al.* (2010) who showed that the increased yield in *boro* rice (Binadhan-5) was due to the application of herbicide which mainly contributed number of grains panicle$^{-1}$.

**Unfilled grains panicle$^{-1}$**

Data revealed that BRRI dhan50 ($V_3$) produced highest unfilled grain (33.02) and lowest unfilled grain (15.93) was recorded from Chinigura ($V_4$) (Table-1). BRRI dhan50 produced 51.76% higher unfilled grain than Chinigura. Similar findings were reported by Ahmed *et al.* (1997).

Effect of weeding showed significant variation in unfilled grain (Table-1). No weeding ($W_0$) gave highest unfilled grain (27.04) and the lowest unfilled grain (20.78) was obtained from Sunrice® 150WG ($W_4$) which was statistically at par with Topstar® 400SC ($W_3$). No hand weeding ($W_0$) produced 23.15% higher unfilled grain than Sunrice® 150WG ($W_4$). Weed severity and environmental conditions were perhaps, the main reasons for such variation in unfilled grains panicle$^{-1}$ in different weed control methods were observed.

It was evident from Table-1 that interaction effect of BRRI dhan50 with one hand weeding ($V_3W_0$) gave highest unfilled grain (35.50) and the lowest unfilled grain (14.57) was found from the interaction effect of Chinigura with Sunrice® 150WG ($V_4W_4$).

**1000-grain weight (TGW)**

1000-grain weight was also significantly affected by the varieties due to variation in genetic make-up (Table-1). BRRI dhan50 produced highest 1000-grain weight (17.33 g) which was 38.89% higher than the lowest obtained from BRRI dhan34 (10.59 g). Similar findings were reported by Hossain *et al.* (2007).

Effect of weeding showed significant variation in 1000-grain weight (Table-1). Sunrice® 150WG ($W_4$) gave the highest 1000-grain weight (14.04 g) which was statistically similar with Topstar® 400SC ($W_3$) and two hand weeding ($W_2$) (Table-1). The lowest 1000-grain weight (13.00 g) was found from no weeding ($W_0$). This finding was in agreement with Khan and Tarique (2011) and Hassan *et al.* (2010) who showed significant effect of weeding regime on 1000-grain weight.

Interaction effect of variety and weeding showed significant variation in 1000-grain weight (Table-1). The highest 1000-grain weight (17.82 g) was found from the interaction effect of BRRI dhan50 and Sunrice® 150WG ($V_3W_4$) and the lowest grain weight (10.25 g) was found with the interaction effect of BRRI dhan34 with no weeding ($V_1W_0$). 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 transplant *aman* rice cv. BRRI dhan41.

**Grain yield**

It was evident from Fig. 1 that the highest grain yield (3.16 t ha$^{-1}$) was recorded with BRRI dhan34 ($V_1$) which was statistically similar with BRRI dhan37 ($V_2$) producing 3.15 t ha$^{-1}$. The lowest grain yield (1.88 t ha$^{-1}$) was recorded from BRRI dhan50 ($V_3$). This result was similar with Franje *et al.* (1992) who found that yields of modern cultivars improved with increased weeding while yields of traditional cultivars did not.

Grain yield increased with the application of herbicidal weed control methods (Figure 5). Sunrice® 150WG ($W_4$) produced the highest grain yield (3.43 t ha$^{-1}$) which was 50.73% higher than the lowest yield (1.69 t ha$^{-1}$) recorded from no weeding treatment ($W_0$). It may be due to maximum control of weeds and minimum competition between weed and crop. Similar findings were reported by Al-Mamun *et al.* (2011), Bhuiyan *et al.* (2011) and Khan and Tarique (2011) who observed that application of chemical herbicides significantly increased grain yield of rice.

The grain yield varied significantly due to different varietal and weed control treatments (Table 2). The highest grain yield (4.10 t ha$^{-1}$) was recorded from BRRI dhan34 and Sunrice® 150WG combination ($V_1W_4$) and the lowest grain yield (1.44 t ha$^{-1}$) obtained in weedy check with BRRI dhan50 ($V_3W_0$). This happened due to severe infestation of weeds in the BRRI dhan50 and lead to reduction of all yield components and finally the grain yield. This result is in agreement with Al-Mamun *et al.* (2011) 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.

BRRI dhan29 also produced the highest grain yield when treated with same treatment, which was 37% higher than control.

**Straw yield**

Significant variation was observed for straw yield due to varietal variation (Figure 2). BRRI dhan34 ($V_1$) recorded the highest straw yield (5.97 t $ha^{-1}$) which was 27.97% higher than the lowest (4.30 t $ha^{-1}$) recorded from BRRI dhan50 ($V_3$). Similar findings were also reported by Hassan *et al.* (2010).

Data revealed that Sunrice® 150WG ($W_4$) produced 33.84% higher straw yield (5.97 t $ha^{-1}$) than the control treatment ($W_0$) (3.95 t $ha^{-1}$) (Fig. 6). Due to no crop weed competitions in weed free condition, plant height and tillers $hill^{-1}$ were increased notably, which were mainly responsible for the increase of straw yield. This result was in agreement with the findings of Khan and Tarique (2011) and Salam *et al.* (2010) who revealed that weeding had significant variation on straw yield of rice.

The straw yield varied due to interaction effect of variety and weed control treatments (Table-2). The highest straw yield (6.85 t $ha^{-1}$) was obtained from the combination BRRI dhan34 and Sunrice® 150WG ($V_1W_4$) and the lowest (3.27 t $ha^{-1}$) was found from the combination of BRRI dhan50 and no weeding ($V_3W_0$). Due to the severe weed infestation in the control plots, plants failed to develop more tillers that resulted in poor straw yield. This result was similar to the findings of Salam *et al.* (2010) who stated that the highest straw yield (7.37 t $ha^{-1}$) were found due to application of Machete 5G @ 25 kg $ha^{-1}$ in *boro* rice (BINA dhan5).

**Biological yield**

Significant biological yield was observed with BRRI dhan34 ($V_1$) (9.13 t $ha^{-1}$) and the lowest biological yield (6.17 t $ha^{-1}$) was recorded from BRRI dhan50 ($V_3$) (Fig. 3).

Weeds controlled by Sunrice® 150WG ($W_4$) gave the highest biological yield (9.40 t $ha^{-1}$) and no weeding ($W_0$) treatment gave the lowest biological yield (5.64 t $ha^{-1}$) (Figure 7). This variation may be due to the severity of weed infestation and climatic conditions. Higher weed infestation not only reduced and finally influenced straw yield as well as biological yield.

The highest biological yield (10.95 t $ha^{-1}$) was obtained from the combination of BRRI dhan34 and Sunrice® 150WG ($V_1W_4$) and the lowest biological yield (4.71 t $ha^{-1}$) was found from the combination of BRRI dhan50 and no weeding ($V_3W_0$) (Table-2). This result was similar to the findings of Salam *et al.* (2010) who stated that the highest grain yield (7.15 t $ha^{-1}$) and straw yield (7.37 t $ha^{-1}$) were found due to application of Machete 5G @ 25 kg $ha^{-1}$.

**Harvest index (HI)**

Data showed that BRRI dhan37 ($V_2$) recorded the highest harvest index (36.65%) whereas BRRI dhan50 ($V_3$) recorded the lowest (30.37%) (Fig. 4).

The highest harvest index (36.07%) was found due to the effect of Sunrice® 150WG ($W_4$) which was statistically similar with Topstar® 400SC ($W_3$) and two hand weeding treatment ($W_2$) (35.66 and 35.16%, respectively) (Fig. 8). No weeding ($W_0$) gave the lowest harvest index (30.03%). Similar findings were observed by Manish *et al.* (2006) who stated that weeding had significant variation on HI.

Interaction effect of BRRI dhan37 and Topstar® 400SC ($V_2W_3$) showed the highest harvest index (40.08%) which was at par with $V_2W_4$ and the lowest (27.45%) was obtained from the interaction of BRRI dhan34 andno weeding ($V_1W_0$) (Table-2).

**Table-1.** Interaction effect of variety and weed control methods on yield contributing characters of aromatic *T. aman rice*

| Treatments | Panicle length (cm) | Effective tillers hill$^{-1}$ | Filled grains panicle$^{-1}$ | Unfilled grains panicle$^{-1}$ | 1000-grain weight (g) |
|---|---|---|---|---|---|
| Effect of variety | | | | | |
| $V_1$ | 25.66 ab | 10.21 b | 119.5 b | 20.49 c | 10.59 d |
| $V_2$ | 26.52 a | 11.01 a | 104.4 c | 25.17 b | 14.80 b |
| $V_3$ | 19.97 c | 8.69 c | 78.19 d | 33.02 a | 17.33 a |
| $V_4$ | 24.93 b | 10.02 b | 141.10 a | 15.93 d | 11.29 c |
| SE | 0.39 | 0.12 | 4.08 | 1.31 | 0.17 |
| Effect of weed control methods | | | | | |
| $W_0$ | 23.51 b | 6.56 e | 105.10 b | 27.04 a | 13.00 c |
| $W_1$ | 23.95 b | 9.41 d | 107.30 ab | 25.07 ab | 13.27 bc |
| $W_2$ | 24.04 b | 10.52 c | 108.80 ab | 23.81 ab | 13.53 a-c |
| $W_3$ | 24.23 b | 11.06 b | 112.20 ab | 21.57 b | 13.66 ab |
| $W_4$ | 25.62 a | 12.36 a | 120.50 a | 20.78 b | 14.04 a |
| SE | 0.43 | 0.13 | 4.56 | 1.47 | 0.19 |
| Interaction effect of variety and weed control methods | | | | | |
| $V_1W_0$ | 25.21 b | 6.60 h | 114.00 c-e | 26.27 a-f | 10.25 e |
| $V_1W_1$ | 25.62 b | 8.57 g | 116.40 b-e | 21.10 b-g | 10.35 e |
| $V_1W_2$ | 25.64 b | 11.40 b-d | 116.60 b-e | 18.73 d-g | 10.52 e |
| $V_1W_3$ | 25.81 b | 11.20 cd | 121.80 a-e | 18.50 d-g | 10.69 de |
| $V_1W_4$ | 26.00 b | 13.37 a | 128.70 a-d | 17.83 e-g | 11.16 de |
| $V_2W_0$ | 25.59 b | 6.767 h | 95.00 ef | 29.37 a-c | 13.95 c |
| $V_2W_1$ | 25.60 b | 10.90 de | 99.03 d-f | 28.00 a-d | 14.53 bc |
| $V_2W_2$ | 25.70 b | 11.80 bc | 103.00 d-f | 27.37 a-e | 15.08 bc |
| $V_2W_3$ | 25.80 b | 12.20 b | 103.40 d-f | 20.87 b-g | 15.12 bc |
| $V_2W_4$ | 29.91 a | 13.30 a | 121.40 a-e | 20.27 c-g | 15.32 b |
| $V_3W_0$ | 18.97 c | 6.10 h | 76.73 f | 35.50 a | 16.80 a |
| $V_3W_1$ | 19.95 c | 8.07 g | 76.87 f | 34.13 a | 17.13 a |
| $V_3W_2$ | 20.09 c | 8.80 g | 77.57 f | 33.60 a | 17.33 a |
| $V_3W_3$ | 20.19 c | 10.80 de | 77.63 f | 31.40 a | 17.55 a |
| $V_3W_4$ | 20.64 c | 9.67 f | 82.13 f | 30.47 ab | 17.82 a |
| $V_4W_0$ | 24.25 b | 6.77 h | 134.80 a-c | 17.03 fg | 11.00 de |
| $V_4W_1$ | 24.62 b | 10.13 ef | 136.80 a-c | 17.03 fg | 11.08 de |
| $V_4W_2$ | 24.75 b | 10.27 ef | 138.10 a-c | 15.53 g | 11.20 de |
| $V_4W_3$ | 25.10 b | 10.97 ef | 145.90 ab | 15.50 g | 11.27 de |
| $V_4W_4$ | 25.93 b | 11.97 bc | 149.70 a | 14.57 g | 11.87 d |
| SE | 0.87 | 0.26 | 9.12 | 2.94 | 0.39 |
| CV (%) | 6.20 | 14.44 | 18.24 | 25.97 | 12.46 |

$V_1$= BRRI dhan34, $V_2$= BRRI dhan37, $V_3$ = BRRI dhan50, $V_4$ = Chinigura, $W_0$= No weeding, $W_1$= One hand weeding, $W_2$= Two hand weeding, $W_3$= Topstar® 400SC, $W_4$= Sunrice® 150WG

**Table-2.** Interaction effect of variety and weed control methods on yield and harvest index of aromatic T. *aman* rice

| Treatment Interactions | Yield and harvest index | | | |
|---|---|---|---|---|
| | Grain yield (t $ha^{-1}$) | Straw yield (t $ha^{-1}$) | Biological yield (t $ha^{-1}$) | Harvest index (%) |
| $V_1W_0$ | 1.74 h | 4.60 ef | 6.34 i | 27.45 i |
| $V_1W_1$ | 2.53 e | 5.47 d | 8.00 f | 31.67 fg |
| $V_1W_2$ | 3.45 c | 6.27 b | 9.72 c | 35.61 cd |
| $V_1W_3$ | 3.98 ab | 6.67 a | 10.65 ab | 37.41 bc |
| $V_1W_4$ | 4.10 a | 6.85 a | 10.95 a | 37.44 bc |
| $V_2W_0$ | 1.80 h | 4.03 gh | 5.84 j | 30.91 gh |
| $V_2W_1$ | 2.57 e | 4.77 ef | 7.33 gh | 35.03 de |
| $V_2W_2$ | 3.52 c | 5.70 d | 9.22 d | 38.16 b |
| $V_2W_3$ | 3.90 b | 5.83 cd | 9.73 c | 40.08 a |
| $V_2W_4$ | 4.00 ab | 6.23 bc | 10.23 b | 39.09 ab |
| $V_3W_0$ | 1.44 i | 3.27 i | 4.71 k | 30.65 gh |
| $V_3W_1$ | 1.73 h | 4.12 gh | 5.85 j | 29.56 h |
| $V_3W_2$ | 1.97 g | 4.40 fg | 6.37 i | 30.91 gh |
| $V_3W_3$ | 2.07 fg | 4.78 ef | 6.85 h | 30.16 gh |
| $V_3W_4$ | 2.17 f | 4.92 e | 7.08 gh | 30.59 gh |
| $V_4W_0$ | 1.77 h | 3.92 h | 5.69 j | 31.13 gh |
| $V_4W_1$ | 2.47 e | 4.93 e | 7.40 g | 33.35 ef |
| $V_4W_2$ | 3.13 d | 5.58 d | 8.72 e | 35.95 cd |
| $V_4W_3$ | 3.03 d | 5.63 d | 8.67 e | 35.00 de |
| $V_4W_4$ | 3.47 c | 5.87 b-d | 9.33 cd | 37.14 bc |
| SE | 0.05 | 0.14 | 0.16 | 0.63 |
| CV(%) | 3.22 | 4.54 | 3.57 | 3.20 |

$V_1$= BRRI dhan34, $V_2$= BRRI dhan37, $V_3$= BRRI dhan50, $V_4$= Chinigura, $W_0$= No weeding, $W_1$= One hand weeding, $W_2$= Two hand weeding, $W_3$= Topstar® 400SC , $W_4$= Sunrice® 150WG

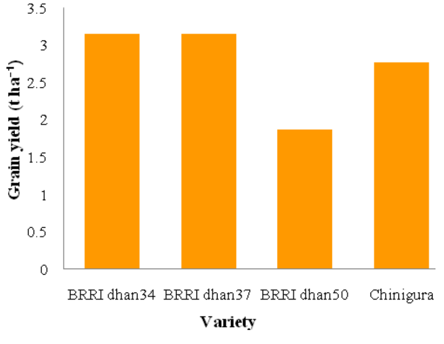


Figure 1. Effect of variety on grain yield (t $ha^{-1}$) of aromatic rice (SE= 0.02)

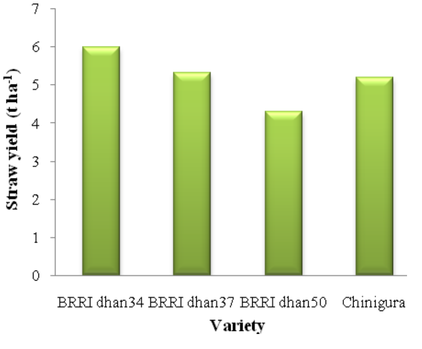


Figure 2. Effect of variety on straw yield (t $ha^{-1}$) of aromatic rice (SE= 0.06)

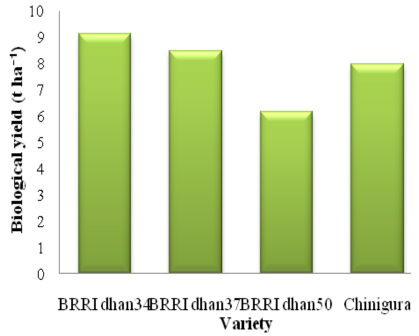


Figure 3. Effect of variety on biological yield (t ha$^{-1}$) of aromatic rice (SE= 0.07)

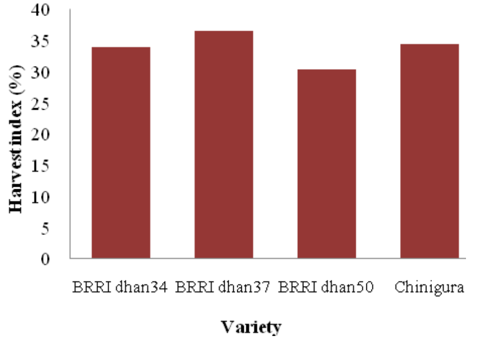


Figure 4. Effect of variety on harvest index (%) of aromatic rice (SE= 0.28)

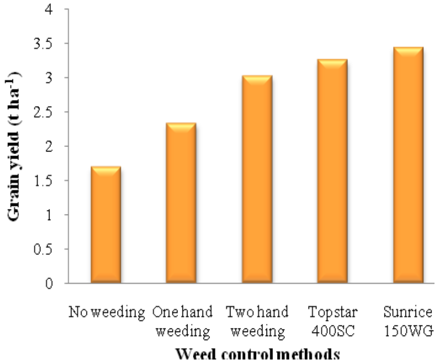


Figure 5. Effect of weed control methods on grain yield (t ha$^{-1}$) of aromatic rice (SE= 0.03)

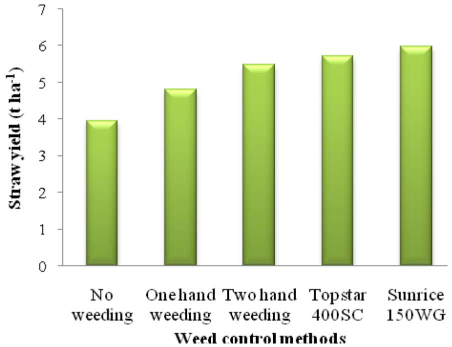


Figure 6. Effect of weed control methods on straw yield (t ha$^{-1}$) of aromatic rice (SE= 0.07)

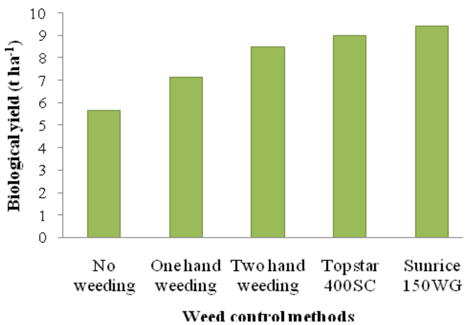


Figure 7. Effect of weed control methods on biological yield (t ha$^{-1}$) of aromatic rice (SE= 0.08)


Figure 8. Effect of weed control methods on harvest index (%) of aromatic rice (SE= 0.31)

## CONCLUSION

Application of pre and post emergence herbicide had a significant effect on the yield potential of aromatic rice varieties over manual weeding. Based on the above experiment, it can be concluded that BRRI dhan34 combined with Sunrice® 150WG ($V_1W_4$) performed well against weeds and produced the highest grain and straw yield in aromatic rice.

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