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A COMPARATIVE STUDY ON GROWTH AND YIELD OF SOME ELITE HYBRID RICE VARIETIES IN DRY SEASON

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ABSTRACT

The experiment was conducted at the research field of Sher-e-Bangla Agricultural University, Dhaka, during the dry season (November, 2012 to June, 2013) to evaluate leaf area development, dry matter accumulation pattern and yield of some popular hybrid rice varieties. The experiment comprised of three hybrid varieties (Hira 2, Aloron and Tia) and an inbred variety BRRI dhan 29 with four dates of transplanting (01 January, 16 January, 31 January and 15 February). The experiment was laid out in randomized complete block design with three replications. Leaf area development, total dry matter production, absolute growth rate, yield and yield contributing characters were significantly influenced by the date of transplanting. Leaf area, total dry matter, absolute growth rate were found higher in early transplanted plots. The highest grain yield (6.07 t ha^{-1}) was recorded from plots transplanted on 16 January due to increased panicles $hill^{-1}$ and grains $panicle^{-1}$.Hira 2 exhibited best result on leaf area (LA), absolute growth rate and total dry matter (TDM) production compared to all other studied varieties and thus recorded with highest grain yield (6.40 t ha^{-1}). No difference on grain yield was achieved from Hira2 at 01 to 16 January transplanting.

Keywords: *h*ybrid rice, growth, yield, planting dates, dry season

INTRODUCTION

Rice is the staple food in Bangladesh. Rice covers about 80% of the total cropped area, contributing 90% of total food grain production (Anon., 2011). The population growth of Bangladesh demands a continuous increase in as such, rice has to be increased by at least 60% to meet up food requirement of the increasing population by the year 2020 (Masum, 2009). The arable land in Bangladesh is decreasing at the rate of 1% per annum (Anon., 2011). So, there is very little scope of horizontal expansion of crop production in Bangladesh. In such situation, there is no other alternative rather than development and adoption of yield enhancing technologies. In this case introduction of hybrid rice is a good alternative to get higher harvest of the crop. Hybrid rice has 20-30% yield advantage over inbred varieties (Julfiquar, 2009). Hybrid rice has been introduced in Bangladesh through BRRI, IRRI and different seed companies 10 years ago. Optimum planting time is one of the determinants to have higher grain yield of rice (Bhuiya *et al*., 1992). Early transplanting of *Boro* rice prolongs field duration due to low temperature and involves high cost of production, while delayed transplanting reduces the yield in some cases (Anon., 2005). However, research reports on hybrid rice varieties in dry season are meagre. Therefore, the study was undertaken to evaluate the performance of hybrid rice varieties at different transplanting dates in dry season.

MATERIALS AND METHODS

The experiment was carried out at the research field of Sher-e-Bangla Agricultural University, Dhaka, during, November 2012 to June 2013. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications including three varieties viz., Hira2, Aloron and Tia and one inbred BRRI dhan29. Four dates of transplanting viz., 01 January, 16 January, 31 January and 15

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February were selected for the experiment. The size of a unit plot was 4.0 m × 3.0 m. Block to block and plot to plot distances were maintained 1.0 m and 0.5 m respectively. Thirty days old seedlings were transplanted in the experimental plots with one seedling hill^{-1} keeping row to row and hill to hill spacing of 25 cm × 20 cm respectively. A fertilizer dose of 75-60-34-5.0 kg ha^{-1} of TSP, MP, gypsum and zinc sulphate, respectively, was applied at the time of final land preparation. Urea was applied @ 270 kg ha^{-1} at three times in equal splits at 15, 35 and 50 days after transplanting (DAT). Intercultural operations and plant protection measures were done as and when required. Ten hills were randomly selected from each plot excluding first three rows for avoiding border effect and data on yield contributing traits were collected. Yield data were collected from the middle 6 m^2 area of each plot. Leaf areas (LA) from the plant samples were measured by an automatic leaf area meter (Model: LI-3100, Li-COR, Lincoln, NE, USA.) Absolute growth rate (AGR) was measured according to Hunt (1981).

$AGR = \frac{(W2-W1)}{T2-T1}$ g hill^{-1} day^{-1}, where, W_1 and W_2 are the dry matter at time T_2 and T_1 respectively. The collected data were subjected to analysis of variance (ANOVA) and the mean differences were compared by DMRT test at 5% level of significance.

RESULTS AND DISCUSSION

Leaf area

The development of leaf area (LA) over time in rice varieties has been shown in Figure 1 and 2. The increment of leaf area (LA) varied significantly among the varieties. At 60 DAT, the leaf area (LA) production by Hira2 and Tia was significantly higher than other two varieties. Aloron produced the lowest LA. The variation in leaf area might occur due to the variation in number of leaves and leaf size. This result was in agreement with Yeasmin (2005). It was observed that leaf area increased progressively with the advancement of time and growth stages till 60 DAT (Figure 2). The highest LA at all growth stages was observed when transplanted on 16 January followed by 01 January. The lower LA was recorded at 31 January and 15 February transplanting at most of the growth stages (Fig. 2). The LA was greater at 1 January and 16 January transplanting because of cool temperature influenced longer duration of vegetative phase and this findings was supported by Anon (2006).

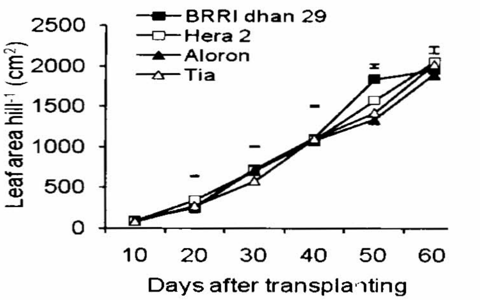

Fig. 1. Varietal variation in leaf area development at different age. Vertical bars represents $LSD_{0.05}$.

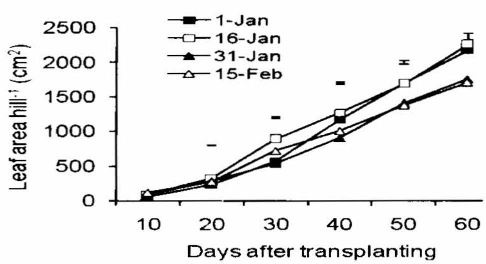

Fig. 2. Effect of transplanting time on leaf area development at different days after transplanting. Vertical bars represents $LSD_{0.05}$.

Total dry matter production

The highest TDM was recorded in Hira 2 up to 60 DAT followed by Aloron (Fig. 3). In contrast, the lowest TDM hill^{-1} was found in BRRI dhan 29. Genotypic variation on TDM production in rice was also observed by Rahman (2002). The highest TDM hill^{-1} was achieved at 16 January transplanting while the lowest TDM hill^{-1} was recorded at 15 February transplanting (Fig. 4). It was happened due to increasing temperature induced shorter duration of vegetative phase at late *Boro* season (Moinul, 2014).

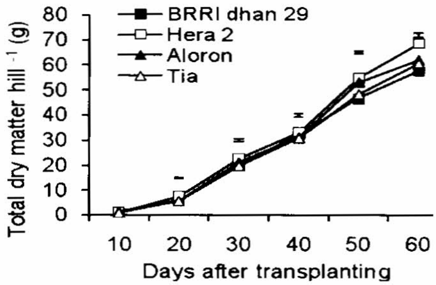

Fig. 3. Effect of variety on dry matter production at different days after transplanting. Vertical bars represent $LSD_{0.05}$.

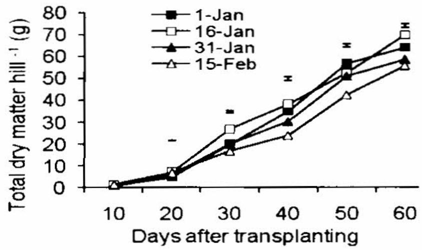

Fig. 4. Effect of transplanting time on dry matter production at different days after transplanting. Vertical bars represent $LSD_{0.05}$.

Absolute growth rate

Aloron and Hira 2 showed higher absolute growth rate (AGR) at 20-30 and 40-50 DAT where as BRRI Dhan29 showed lower AGR at most of the dates of vegetative growth stages (Figure 5). Absolute growth rate (AGR) was significantly influenced by date of transplanting up to 60 DAT. Figure 6 revealed that AGR increased from 10-20 DAT to 20-30 DAT followed by a decline till 30-40 DAT and then increased for 40-50 DAT and thereafter declined in three dates of transplanting among out of four. It was happened probably due to the transition of vegetative phase to reproduction phase. Almost similar result was observed by Moinul, 2014. In 16 January transplanting, the highest AGR was recorded due to increased TDM hill^{-1} and the lowest value was recorded 15 February transplanting because lesser TDM production. Assaduzzaman (2006) reported that TDM production as well as AGR was lower in February transplanting that supported the present experimental results. At 10-20 and 50-60 DAT the highest AGR was recorded in Hira2 on 16 January transplanting. In contrast, the lowest AGR was recorded in Hira2 on 15 February transplanting.

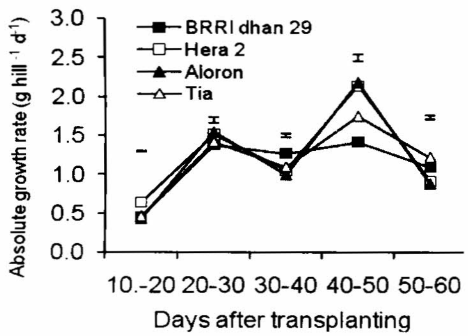

Fig. 5. Varietal variation in absolute growth rate at different DAT. Vertical bars represents $LSD_{0.05}$.

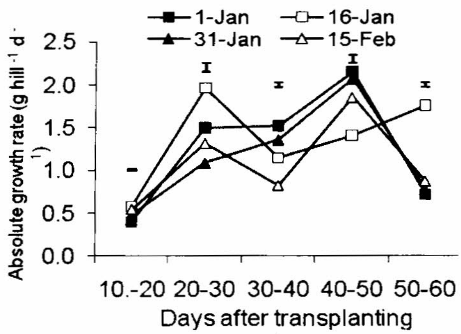

Fig. 6. Effect of transplanting time on absolute growth rate at different days after transplanting. Vertical bars represent $LSD_{0.05}$.

Yield attributes and yield

Hira2 produced the highest panicles hill^{-1} (8.98 hill^{-1}) and grains panicle^{-1} (129.4) which has the agreement with the finding of Annon (1998) and Annon (2004) respectively. Panicles hill^{-1} decreased with delayed transplanting in *Boro* rice. The highest panicles hill^{-1} was found in 01 January transplanting (9.10 hill^{-1}) and it closely followed by 16 January transplanting (8.82 hill^{-1}) with same statistical rank (Table 1). The lowest panicles hill^{-1} (7.25 hill^{-1}) was recorded in 15 February transplanting as supported by Khalid (2006). Interaction between date of transplanting and variety had significant effect on the panicles hill^{-1}. The highest panicles hill^{-1} was observed in all the varieties transplanted on 16 January and the lowest was in all the varieties grown on 15 February. The highest grains panicle^{-1} (123.9) was observed when transplanted on 16 January and the lowest grains panicle^{-1} (111.9) was obtained in 01 January transplanting. Reduction in the grains panicle^{-1} at early transplanting might be due to inefficient translocation of assimilates to the grain and longer vegetative duration resulted lower harvest index (Table 1). Similar result was also reported by Chowdhury and Guha (2000) who observed that grains panicle $^{-1}$ was higher in *Boro* rice when transplanted in mid-January. Variety also had significant effect on grains panicle^{-1} (Table 1). The grains panicle^{-1} was significantly higher in Hira 2 (129.4) followed by BRRI dhan29 (124.8) and that were lowest in Tia (90.82).

Table 1. Effect of transplanting time and variety on yield attributes and yield in *Boro* rice (B)

Treatments	Panicles hill^{-1} (no.)	Grains panicle^{-1} (no.)	1000-grain wt. (g)	Grain yield (t ha^{-1})	Harvest index (%)
Transplanting time (DAT)					
BRRI dhan29	8.88 a	124.8 a	22.26 c	6.03 b	46.67 a
Hera2	8.98 a	129.4 a	24.01 b	6.40 a	46.58 a
Aloron	7.70 b	116.9 b	25.35 a	5.42 c	43.52 b
Tia	7.48 b	90.82 c	20.78 d	4.12 d	45.40 ab
$LSD_{(0.05)}$	0.70	6.08	0.65	0.28	1.90
Variety					
01 January	9.10 a	111.9 b	23.14	5.45 b	39.03 c
16 January	8.82 a	123.9 a	23.23	6.07 a	48.45 a
31 January	7.88 b	112.2 b	23.18	5.62 b	48.56 a
15 February	7.25 c	113.8 b	22.85	4.82 c	46.14 b
$LSD_{(0.05)}$	0.61	5.47	0.75	0.19	1.83
Interaction					
BRRI dhan29 X 01 January	9.47 a	126.2 a-d	22.23	5.75 ef	39.36 e
BRRI dhan29 X 16 January	9.60 a	130.5 abc	22.44	6.55 ab	38.64 e
BRRI dhan29 X 31 January	8.83 bc	120.4 cde	22.30	5.84 def	37.73 e
BRRI dhan29 X 15 February	8.50 cde	70.57 i	22.06	3.67 i	40.37 de
Hera2 X 01 January	9.40 ab	134.0 ab	24.10	6.73 a	51.57 a
Hera2 X 16 January	9.50 a	135.2 a	24.00	6.71 a	49.05 ab
Hera2 X 31 January	8.40 cde	123.1 a-d	24.15	6.23 bcd	45.01 bc
Hera2 X 15 February	8.00 e	103.4 fg	23.78	4.62 h	48.18 ab
Aloron X 01 January	8.70 cd	116.3 de	25.41	6.11 cde	48.42 ab
Aloron X 16 January	8.75 c	120.0 cde	25.48	6.48 abc	48.91 ab
Aloron X 31 January	7.07 f	114.2 def	25.37	5.25 g	47.38 abc
Aloron X 15 February	7.00 f	98.40 gh	25.16	4.66 h	49.52 a
Tia X 01 January	7.97 e	122.6 bcd	20.80	5.55 fg	47.35 abc
Tia X 16 January	8.07 de	131.8 abc	21.00	5.86 def	49.74 a
Tia X 31 January	6.53 f	109.9 ef	20.92	4.37 h	43.96 cd
Tia X 15 February	6.43 f	90.90 h	20.41	3.52 i	43.51 cd
$LSD_{(0.05)}$	0.61	10.94	1.30	0.38	3.68
CV (%)	4.42	5.68	3.37	4.14	4.84

In a column, figures bearing same letter (s) do not differ significantly at $P \leq 0.05$ by DMRT; NS = Not significant; ** indicate significance at 5% level of probability

Interaction between date of transplanting and variety had significant effect on grains panicle^{-1} in *Boro* season. Results showed that higher grains panicle^{-1} was observed in all the varieties on 16 January transplanting and the lowest was in all the varieties on 15 February transplanting. 1000-grain weight markedly varied among the studied varieties. The highest 1000-grain weight (25.35 g) was recorded in Aloron followed by Hira (24.01g) and the lowest was obtained from Tia (20.78 g). 1000-grain weights in different varieties were not significantly influenced by different transplanting dates. This result is in agreement with Yoshida (1981) who reported that 1000-grain weight was an inherent character. The highest grain yield (6.40 t ha^{-1}) was recorded in Hira2 due to increased number of panicles hill^{-1} and grains panicle^{-1}. The variety Tia showed the lowest grain yield (4.12 t ha^{-1}). Result also revealed that grain yield increased from 01 January to 16 January transplanting followed by a decline. This result indicated that optimum time for transplanting of *Boro* rice would be the middle of January. The lowest grain yield (4.82 t ha^{-1}) was observed when transplanted on 15 February. The lower grain yield under delayed transplanting was might be due to lesser amount of assimilate produced by the plants due to lower photosynthetic area plant^{-1}. Similar result was also reported by many workers (Ali *et al.*, 1995; Anon., 1998; Chowdhury and Guha, 2000; Assaduzzaman, 2006; Anon., 2006). In the case of interaction effect between transplanting dates and variety, Hira 2 performed the best in 16 January transplanting which were statistically similar with Hira2 in 01 January transplanting and inbred BRRI dhan29 in 16 January transplanting. Performance of Aloron and Tia were not up to the mark comprising to inbred BRRI dhan29 at all transplanting dates in *Boro* season.

The variety Hira2 was superior to Aloron, Tia and inbred BRRI dhan29 in respect to grain yield at early transplanting. Inbred BRRI dhan29 performed better compared to hybrid Aloron and Tia at different transplanting dates in *Boro* season.

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