Middle-East Journal of Scientific Research 23 (6): 1114-1121, 2015
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2015.23.06.22203

Tiller Production and Yield Improvement of T. Aman Rice Varieties Through Wider Spacing

[1]H. Zaman, [2]S.M. Masum, [2]M.H. Ali, [2]P.K. Biswas, [3]M.S.H. Mandal and [4]H. Mehraj

[1]Geetanjoly Agro Society, Dhaka-1207, Bangladesh
[2]Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh
[3]CRP-Hill Agriculture, Krishi Gobeshona Foundation, Bandarban-4600, Bangladesh
[4]The United Graduate School of Agricultural Sciences, Ehime University,
3-5-7 Tarami, Matsumaya, Ehime 790-8556, Japan

Abstract: Performance of three T. *aman* rice variety namely, Biroyn (Indigenous) (V_1), BINA dhan7 (V_2) and BRRI dhan34 (V_3) were evaluated with three levels of plant population density *viz.* raised bed with plant spacing of 75 cm x 75 cm (S_1), leveled bed with plant spacing of 50 cm x 50 cm (S_2) and leveled bed with plant spacing of 25 cm x 15 cm (S_3). Variety exerted significant influence on yield of transplant *aman* rice. The highest grain yield (7.1 t ha^{-1}) and straw yield (11.7 t ha^{-1}) was observed in Biroyn indigenous variety. The plant spacing of 50 cm x 50 cm showed the highest (6.8 t ha^{-1}) grain yield and straw yield (9.6 t ha^{-1}) among the plant population treatments. It was observed that in most of the cases, all the varieties performed better for their yield contributing characters with wider spacing of 50 cm x 50 cm. With attention to results of this experiment due to higher (9.2 t ha^{-1}) grain yield in V_1S_2 treatment this level suggest for planting the indigenous Biroyn variety with 50 cm x 50 cm spacing in transplant *aman* season. Besides this, genotype presumes a promising one deserves extensive research onwards.

Key words: indigenous variety · Spacing · Growth and yield

INTRODUCTION

Plant spacing has an important role on growth and yield of rice. The spatial distribution of plants in a crop community is an important factor determining yield [1]. Increase in yield can be ensured by maintaining appropriate plant population through different planting patterns [2]. Optimum plant spacing ensures the plants to grow properly both in their aerial and underground parts through different utilization of solar radiation and nutrients [3]. Wider spacing had linearly increasing effect on the performance of individual plants and performed better as individual plants [4]. Performance of individual hills was significantly improved with wider spacing compared with closer-spaced hills [5]. Planting practices have been shifting from close spacing to wider spacing in China especially for high yielding hybrid rice varieties [6]. This improves the canopy's photosynthesis, increases the percentage of productive tillers and the spikelet number per panicle. At same time, in combination with less irrigation water, pests may be better controlled and lodging prevented [6]. If the plant population density falls below the optimum level, all inputs of production fail to produce any appreciable effect on yield [7]. Different varieties need specific agronomic and cultural practices to express their best potential in determining the yield responses to plant population. The response of cereals to increasing plant population is unique for each genotype. The establishment of healthy rice in the most suitable arrangement is the foundation of a successful crop production system.

MATERIALS AND METHODS

The field experiment was conducted at the agricultural farm of Sher-e-Bangla Agricultural University, Dhaka-1207 during *aman* (July-December) season in 2013. The experiment was laid out in a Split plot design with three replications. Three rice variety *viz.* Biroyn (Indigenous variety) (V_1), BINA dhan7 (V_2) and BRRI dhan 34 (V_3) and three spacing i.e. raised bed with 75 cm x 75 cm (S_1), 50 cm x 50 cm (S_2) and of 25 cm x 15 cm (S_3)

Corresponding Author: H. Mehraj, The United Graduate School of Agricultural Sciences, Ehime University, 3-5-7 Tarami, Matsumaya, Ehime 790-8556, Japan.

plant spacing. Recommended fertilizer dose for transplant *aman* rice *i.e.* Urea, TSP, MOP, Gypsum and Zinc Sulphate @ 120 kg ha^{-1}, 90 kg ha^{-1}, 40 kg ha^{-1}, 60 kg ha^{-1} and 10 kg ha^{-1} respectively were used. All fertilizers were applied during final land preparation except urea that applied in three equal splits at 7, 30 and 50 DAT. Seedlings of Biroyn (V_1) was raised in one seedling per polybag and then finally planted one seedling $hill^{-1}$ in the main filed when the seedlings age reached fifteen day. Seedlings of BINA dhan7 (V_2) and BRRI dhan34 (V_3) were raised in traditional seed bed. Thirty day old seedlings were uprooted and transplanted in the field on August 5, 2013. Two seedlings were transplanted in each hill for BINA dhan7 (V_2) and BRRI dhan 34 (V_3) according to plant spacing treatments. The harvesting was done on December 5, 2013 manually from each plot. The crop was harvested plot-wise at full maturity when 90% of the grains turned into golden yellow. Hills from central 5 m^2 area of each plot were harvested for collecting data on grain and straw yields. The harvested crop was then bundled separately, tagged properly and brought to the threshing floor and processed as usual. Prior to harvest five hills were selected at random from each plot and carefully uprooted to collect data on yield and yield contributing characters. All the collected data were analyzed following the analysis of variance (ANOVA) technique using MSTAT-C package and the mean differences among the treatments were compared by Duncan's Multiple Range Test (DMRT) at 5% level of significance [8].

RESULTS AND DISCUSSION

Effect of Variety on Growth Attributes: Different transplant *aman* variety showed significant variation in terms of *plant height, no. of total tillers* $hill^{-1}$ *and leaf area index. It is observed that at 30, 45, 60, 75 and 90 DAT Biroyn rice produced the highest* (112.7 cm, 141.0 cm, 168.4 cm, 186.6 cm *and* 194.1 cm respectively) *plant height, highest* (19.8, 30.7, 37.8, 48.6 and 58.6, accordingly) *no. of total* $tillers^{-1}$ *and* highest (4.7, 8.0, 9.2, 10.7 and 14.2, respectively) leaf *area index (Fig. 1*a-c). *On the other hand Bina dhan7 produced lowest (92.8* cm, *111.6* cm, *125.8* cm, *134.6* cm and *143.7* cm*) plant height and BRRI dhan34 produced lowes*t (13.0, 17.2, 22.3, 27.5 and 31.2) *total no.* $hill^{-1}$ *and also lowest* (2.4, 4.2, 4.8, 5.4 and 7.7) *leaf area index at at 30, 45, 60, 75 and 90 DAT, respectively. Abou-Khalifa* [9] *reported that significant variation of growth characters occurs due to diffterent rice varieties*.

Effect of Plant Spacing on Growth Attributes: Different planting spacing showed significant variation in terms of *plant height, no. of total tillers* $hill^{-1}$ *and leaf area index*. At 30, 45, 60, 75 and 90 DAT the highest (106.3 cm, 129.3 cm, 148.9 cm, 161.7 cm and 170.4 cm, respectively) plant height was observed in S_1, however, the highest (17.7, 28.0, 36.3, 48.2 and 54.5) no. of total tillers $hill^{-1}$ and the highest (3.9, 6.3, 7.3, 8.3 and 10.8) leaf area index was oboserved in S_2 (50 x 50 cm) (Fig. 1d-f). At 30, 45, 60, 75 and 90 DAT the lowest (101.0 cm, 122.3 cm, 143.3 cm, 153.0 cm and 158.8 cm, respectively) plant height and lowest (2.9, 5.0, 5.7, 6.5 and 8.6, respectively) leaf area index was observed in S_1 however the lowest (11.4, 14.8, 16.7, 20.5 and 23.6) no. of total tiller $hill^{-1}$ was observed in S_3 (Figure 1d-f). Ayub *et al*. [10] and Nurujjaman [11] stated that the plant height increased with low plant density. Haque [12] and Mia [13] also found the same for plant height and number of tillers $hill^{-1}$. Thakur *et al*. [5] found increased leaf number and leaf sizes in the wider spaccing compared to closer spacced hills.

Interaction Effect of Variety and Plant Spacing on Growth Attributes: Different variety and planting spacing treatment combinations showed significant variation in terms of plant height, no. of total tillers $hill^{-1}$ and leaf area index. At 30 DAT the treatment combination of V_1S_3 produced highest (115.5 cm) plant height which was statistically similar with V_1S_2, V_1S_1, V_3S_2 and V_3S_3. At 45, 60 and 75 DAT the treatment combination of V_1S_3 produced the highest (144.8 cm, 171.5 cm and 190.4 cm) plant height which was statistically similar with V_1S_2 and V_1S_1. At 90 DAT the treatment combination of V_1S_3 produced the highest (202.5 cm) plant height which was statistically similar with the treatment combination of V_1S_2. The treatment combination of V_1S_2 produced the highest (25.9, 46.2, 57.2, 77.2 and 88.4, accordingly) number of total tillers per hill at 30, 45, 60, 75 and 90 DAT. At 30 DAT V_1S_2 produced the highest (5.8) leaf area index. At 45, 60, 75 and 90 DAT the treatment combination of V_1S_2 produced the highest (9.0, 10.3, 12.1 and 15.4, respectively) leaf area index which was statistically similar with the treatment combination of V_1S_3.

Effect of Variety on Yield Attributes: Different transplant *aman* rice variety varied significantly in terms of effective tillers $hill^{-1}$, panicle length, filled grains $panicle^{-1}$, unfilled grains $panicle^{-1}$ and 1000-grain weight (Table 4). Sohel *et al*. [14] also found significant variation of yield attributes due to various rice varieties. The maximum (14.8) effective tillers $hill^{-1}$ was found from V_3 and the minimum (12.2)

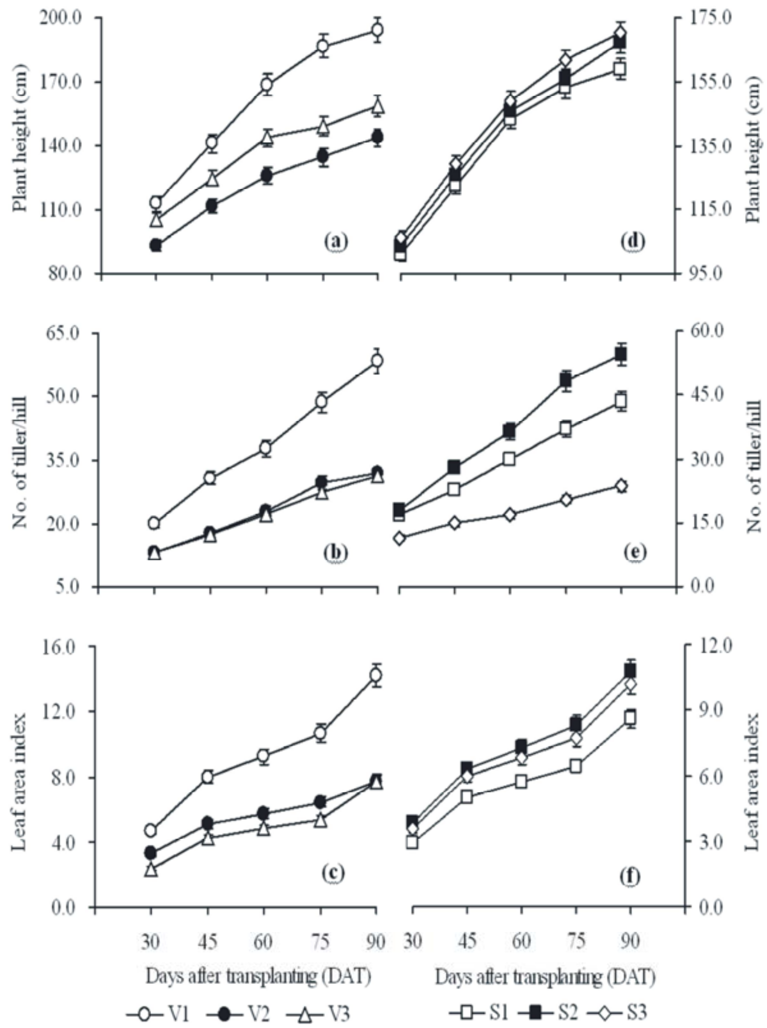

Fig. 1: Response of (a) variety on plant height, (b) variety on number of tiller/hill, (c) variety on leaf area index, (d) spacing on plant height, (e) spacing on number of tiller/hill and (f) spacing on leaf area index at different days after transplanting

Here; V_1 = Biroyn, V_2 = BINA dhan7, V_3 = BRRI dhan34; S_1 = Raised bed with plant spacing of 75 cm x 75 cm, S_2 = Plant spacing of 50 cm x 50 cm, S_3 = Plant spacing of 25 cm x 15 cm

effective tiller hill^{-1} was found from V_2 which was statistically identical (12.9) with V_1. This is due to varietal difference in the effective tiller production and the previous findings reported that variable effect of variety on the effective tillers hill^{-1} [15]. Although the maximum (31.9 cm) panicle length was found from V_3 and the minimum (28.8 cm) from V_2, the highest (218.4) number of filled grains panicle^{-1} was recorded from V_1 and the lowest (172.9) from V_2 which was statistically identical (186.1) with V_3. In case of number of unfilled grains panicle^{-1} the highest (50.7) was recorded from V_3 and lowest (40.2) from V_2 which was also statistically identical (50.6) with V_1. Murthy *et al.* [16] recorded different number of filled and unfilled grains panicle^{-1} for different variety. The highest (28.9 g) 1000-grain weight was recorded from V_1 and lowest (12.0 g) from V_3. This could be due to varietal differences between treatments and 1000-grain weight is mostly governed by genetic makeup of the variety.

Effect of Planting Spacing on Yield Attributes: Different planting spacing showed significant variation in terms of effective tillers hill^{-1}; panicle length; filled grains panicle^{-1}; unfilled grains pancile^{-1} and 1000-grain weight (Table 4). Sohel *et al*. [14] also found significant variation of all yield attributes except 1000-grain weight due to

Table 1: Interaction effect of variety and planting spacing on plant height

	Days after transplanting				
Treatments	30	45	60	75	90
V_1S_1	109.3ab	135.8ab	165.5a	183.2 a	181.1b
V_1S_2	113.4ab	142.4a	168.2a	186.2 a	198.6a
V_1S_3	115.5a	144.8a	171.5a	190.4 a	202.5a
V_2S_1	90.4d	109.0e	123.3c	131.1 e	141.3e
V_2S_2	92.2d	110.6e	126.1c	134.0 de	143.8de
V_2S_3	95.8cd	115.1de	128.1c	138.7 c-e	146.1de
V_3S_1	103.2bc	122.0cd	141.0b	144.6 cd	154.1cd
V_3S_2	104.6a-c	124.5cd	142.8b	147.3 bc	159.0c
V_3S_3	107.4ab	127.8bc	147.1b	156.1 b	162.7c
$LSD_{0.05}$	10.0	9.9	10.5	10.4	10.3
SE	3.4	3.4	3.6	3.6	3.5
CV%	5.7	4.7	4.3	4.0	3.7

Here; V_1 = Biroyn, V_2 = BINA dhan7, V_3 = BRRI dhan34; S_1 = Raised bed with plant spacing of 75 cm x 75 cm, S_2 = Plant spacing of 50 cm x 50 cm, S_3 = Plant spacing of 25 cm x 15 cm

Table 2: Interaction effect of variety and planting spacing on no. of total tillers hill^{-1}.

	Days after transplanting				
Treatments	30	45	60	75	90
V_1S_1	21.9 b	32.7b	41.3 b	50.4b	61.7 b
V_1S_2	25.9a	46.2a	57.2 a	77.2a	88.4 a
V_1S_3	11.6 e	13.2f	14.9f	18.3g	25.8 f
V_2S_1	14.4 c	16.8e	24.1 d	32.3d	35.8 d
V_2S_2	14.4c	18.4cd	25.4cd	35.0c	38.3 c
V_2S_3	10.7e	17.3de	19.3e	21.6f	21.3 g
V_3S_1	14.5c	18.3c-e	24.4d	28.3e	33.0 e
V_3S_2	12.9d	19.5c	26.4cd	32.5d	36.9 cd
V_3S_3	11.8de	13.8f	16.1f	21.7f	23.8 d
$LSD_{0.05}$	1.2	1.4	1.3	1.8	2.2
SE	0.4	0.5	0.5	0.6	0.8
CV%	4.6	3.9	2.9	3	3.2

Here; V_1 = Biroyn, V_2 = BINA dhan7, V_3 = BRRI dhan34; S_1 = Raised bed with plant spacing of 75 cm x 75 cm, S_2 = Plant spacing of 50 cm x 50 cm, S_3 = Plant spacing of 25 cm x 15 cm

Table 3: Interaction effect of variety and planting spacing on leaf area index

	Leaf area index				
Treatments	30	45	60	75	90
V_1S_1	4.1b	6.8bc	8.0bc	9.1bc	12.4 b
V_1S_2	5.8a	9.0a	10.3a	12.1a	15.4 a
V_1S_3	4.2b	8.1ab	9.3ab	10.8ab	14.7 a
V_2S_1	2.8c-e	4.2d	4.7d	5.3d	6.6 e
V_2S_2	3.3b-d	5.3cd	6.0cd	6.7cd	8.3 cd
V_2S_3	3.7bc	5.9cd	6.6cd	7.4cd	8.3 cd
V_3S_1	1.9e	4.0d	4.5d	5.0d	6.8 de
V_3S_2	2.5de	4.6d	5.5d	6.2d	8.6 c
V_3S_3	2.8c-e	4.0d	4.5d	5.0d	7.7 c-e
$LSD_{0.05}$	1.1	1.7	2.0	2.3	1.5
SE	0.4	0.6	0.7	0.8	0.5
CV%	18.2	17.8	18.0	18.5	8.9

Here; V_1 = Biroyn, V_2 = BINA dhan7, V_3 = BRRI dhan34; S_1 = Raised bed with plant spacing of 75 cm x 75 cm, S_2 = Plant spacing of 50 cm x 50 cm, S_3 = Plant spacing of 25 cm x 15 cm

Table 4: Effect of variety and planting spacing and their interaction effect on yield contributing characters of rice

Treatments	Effective tiller hill^{-1} (no.)	Panicle length (cm)	Filled Grains panicle^{-1} (no.)	Unfilled grains panicle^{-1} (no.)	1000-grain weight (g)
Effect of variety					
V_1	12.9 b	30.7 b	218.4a	50.6 a	28.9 a
V_2	12.2 b	28.8 c	172.9b	40.2b	21.8b
V_3	14.8a	31.9a	186.1b	50.7a	12.0c
$LSD_{0.05}$	1.4	0.6	20.4	1.4	0.4
SE	0.5	0.2	6.6	0.5	0.1
Effect of planting spacing					
S_1	14.0a	31.4a	215.7a	33.0c	21.4a
S_2	15.3a	30.8a	187.7b	61.6a	20.4c
S_3	10.7b	29.2b	174.0b	46.9b	21.0b
$LSD_{0.05}$	1.4	0.6	20.4	1.44	0.4
SE	0.5	0.2	6.6	0.47	0.1
Interaction effect of variety and planting spacing					
V_1S_1	13.78bc	30.3de	288.0a	34.9e	29.3a
V_1S_2	17.29a	30.5c-e	178.8bc	55.9c	28.4b
V_1S_3	7.48d	31.3b-d	188.4bc	61.0b	29.1ab
V_2S_1	15.30ab	31.5bc	157.8c	32.8ef	22.0c
V_2S_2	12.01c	28.5f	209.8b	59.2b	21.0d
V_2S_3	9.40d	26.4g	151.2c	28.6g	22.4c
V_3S_1	12.76bc	32.3b	201.4b	31.3f	12.9e
V_3S_2	16.58a	33.4a	174.4bc	69.6a	11.7f
V_3S_3	15.14ab	30.0e	182.4bc	51.1d	11.5f
$LSD_{0.05}$	2.40	1.1	35.3	2.5	0.7
SE	0.78	0.3	11.5	0.8	0.2
CV%	0.10	0.1	0.1	0.0	0.0

Here; V_1 = Biroyn, V_2 = BINA dhan7, V_3 = BRRI dhan34; S_1 = Raised bed with plant spacing of 75 cm x 75 cm, S_2 = Plant spacing of 50 cm x 50 cm, S_3 = Plant spacing of 25 cm x 15 cm

Table 5: Effect of variety and planting spacing and their interaction effect on grain yield, straw yield, biological yield and harvest index.

Treatments	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
Effect of variety				
V_1	7.1a	11.7a	18.8a	37.2b
V_2	3.9c	6.4b	10.3c	37.1b
V_3	5.0b	7.2b	12.1b	40.5a
$LSD_{0.05}$	0.5	1.0	1.2	3.2
SE	0.2	0.3	0.4	1.1
Effect of planting spacing				
S_1	5.2b	8.6b	13.8b	37.9b
S_2	6.8a	9.6a	16.3a	41.3a
S_3	3.9c	7.1c	11.1c	35.6b-d
$LSD_{0.05}$	0.5	1.0	1.2	3.2
SE	0.2	0.3	0.4	1.05
Interaction effect of variety and planting spacing				
V_1S_1	6.6b	11.9ab	18.5b	35.6b-d
V_1S_2	9.2a	12.9a	22.2a	41.7ab
V_1S_3	5.3cd	10.3b	15.6c	34.1cd
V_2S_1	3.8e	6.3de	10.1e	38.0a-d
V_2S_2	5.0d	7.6cd	12.6d	39.7a-d
V_2S_3	2.9f	5.5e	8.4e	33.7d
V_3S_1	5.2cd	7.7cd	12.9d	40.2a-c
V_3S_2	6.1bc	8.2c	14.3cd	42.5a
V_3S_3	3.6ef	5.6e	9.2e	39.0a-d
$LSD_{0.05}$	0.9	1.7	2.1	5.6
SE	0.3	0.5	0.7	1.8
CV%	0.1	0.1	0.1	8.2

Here; V_1 = Biroyn, V_2 = BINA dhan7, V_3 = BRRI dhan34; S_1 = Raised bed with plant spacing of 75 cm x 75 cm, S_2 = Plant spacing of 50 cm x 50 cm, S_3 = Plant spacing of 25 cm x 15 cm different plant spacing. The highest (15.3) effective tillers hill^{-1} was observed in S_2 which was statistically similar (14.0) with S_1 and lowest (10.7) from S_3. The longest panicle (31.4 cm) was recorded from S_1 which was statistically identical (30.8 cm) with S_2 and shortest (29.2 cm) from S_3. The highest (215.7) filled grains panicle^{-1} and lowest (33.0) unfilled grains panlice^{-1} was recorded from S_1. While S_3 treatment produced the lowest (174.0) filled grains pancle^{-1}, which was statistically identical (187.7) with S_2. The highest (21.4 g) 1000-grain weight was observed in S_1 and the lowest (20.4 g) from S_2. Increased effective tillers hill^{-1}, panicle length and 1000-grain weight mainly due to the wider spacing where performance of individual hill increased [5].

Interaction Effect of Variety and Planting Spacing on Yield Attributes: The highest (61.2) effective tillers hill^{-1} was recorded in the treatment combination of V_2S_1 and the lowest (17.7) from V_1S_3. Panicle length was highest (33.4 cm) in the treatment of V_3S_2 and lowest (28.5 cm) in V_2S_2. The highest (288.0) filled grains panicle^{-1} was recorded in the treatment combination of V_1S_1 and lowest (151.2) in the treatment combination of V_2S_3 which was statistically identical (157.8) with V_2S_2. The highest (69.6) unfilled grains panicle^{-1} was recorded in the treatment combination of V_3S_3 and the lowest (28.6) in V_2S_3. The treatment combination of V_1S_1 recorded the highest (29.3 g) 1000-grain weight and lowest (11.5 g) was observed from V_3S_3 which was statistically similar with V_3S_2(11.7 g).

Effect of Variety on Yield: Different transplant *aman* rice varieties showed significant variation in terms of grain yield, straw yield, biological yield and harvest index (Table 5). Sohel *et al*. [14] also found that the yield and yield contributing characters differed significantly due to varietal difference. The highest (7.06 t ha^{-1}) grain yield was obtained from V_1 and the lowest (3.89 t ha^{-1}) from V_2. In case of straw yield, the highest (11.7 t ha^{-1}) was obtained from V_1 and the lowest (6.4 t ha^{-1}) from V_2 which was statistically similar with BRRI dhan 34 (7.2 t ha^{-1}). The highest (18.8 t ha^{-1}) biological yield was obtained from V_1 and the lowest (10.3 t ha^{-1}) from V_2 which was statistically similar (12.13 t ha^{-1}) with V_3. Harvest index (%) varied significantly due to different variety, the highest (40.5%) harvest index was recorded in V_3 and the lowest (37.1%) harvest index was recorded from V_2 which was statistically similar with (37.2%). Xie *et al*. [17] and Dongarwar *et al*. [18] reported different yield for different genotypes of rice. Most of the growth and yield characters varied significantly by genetic materials [21, 22, 23, 24, 25].

Effect of Plating Spacing on Yield: Different planting spacing treatments showed significant variation in grain yield and biological yield (Table 5). The highest (6.8 t ha^{-1}) grain yield was found from S_2 and the lowest (3.9 t ha^{-1}) from S_3. Numerically the highest (9.6 t ha^{-1}) straw yield was recorded in S_2 and the lowest (7.1 t ha^{-1}) from S_3. The plant spacing treatment of S_2 gave the highest (16.3 t ha^{-1}) biological yield and the lowest (11.1 t ha^{-1}) was observed from S_3. However, the highest harvest index was recorded in S_2 (41.3%) while S_1 recorded the lowest (42.9%) harvest index. The highest grain is due to wider spacing which increases the tillers number thus increased number of effective tillers hill^{-1} combined with higher panicle length, highest filled grain and 1000-grain weight [5]. From wider spacing, plant got more nutrient and moisture which eventually led to development of more grains comparing to closer spacing. Straw yield increased in case of wider spacing due to higher tillering pattern. This result is also consistent with that of Ghosh *et al*. [19] and Rao *et al*. [20]. Grain yield, straw yield, biological yield and harvest index of rice significantly influenced by planting geometry [26].

Interaction Effect of Variety and Planting Spacing on Yield: Combinations of variety and planting spacing varied significantly in grain yield, straw yield, biological yield and harvest index (Table 5). Sohel *et al*. [14] also found significant interaction between variety and plant spacing. V_1S_2 produced the highest (9.2 t ha^{-1}) grain yield and the lowest (2.9 t ha^{-1}) grain yield was observed in the treatment combination of V_2S_3 which was statistically similar with V_3S_3. In case of straw yield, V_1S_2 produced the highest (12.9 t ha^{-1}) straw yield which was statistically identical with V_1S_1 (11.9 t ha^{-1}) and the lowest (5.5 t ha^{-1}) straw yield was observed in V_2S_3 which was statistically similar with V_2S_1 and V_3S_3. In case of biological yield, the highest (22.2 t ha^{-1}) was recorded from V_1S_2 and the lowest (8.4 t ha^{-1}) from V_2S_3. The highest (42.5) harvest index was recorded from V_2S_3 and the lowest (33.7) from V_2S_3.

CONCLUSIONS

Based on the above result and discussion following conclusion can be drawn that cultivation of Biroyn rice with planting spacing of 50 cm x 50 cm can improved yield attributing parameters, straw and grain yield of rice for *aman* season. However, more research works are to be done to verify these findings in different agro-ecological zones of Bangladesh.

ACKNOWLEDGEMENTS

Authors are grateful to the Sher-e-Bangla Agricultural University authority for their kind co-operation and support through this research work.

REFERENCES

1. Egli, D.B., 1988. Plant density and soybean yield. Crop Sci., 28: 977-981.
2. Nadeem, A.M., A. Ali, R. Sohail and M. Maqbool, 2004. Effect of different planting pattern on growth, yield and quality of grain legumes. Pak. J. Life Soc. Sci., 2(2): 132-135.
3. Shirtliffe, S.J. and A.M. Johnston, 2002. Yield density relationships and optimum plant populations in two cultivars of solid-seeding dry bean grown in Saskatchewan. Can. J. Plant Sci., 82: 521-529.
4. Baloch, A.W., A.M. Soomro, M.A. Javed and M. Ahmed, 2002. Optimum plant density for high yield in rice *(Oriza sativa* L.). Asian J. Plant Sci., 1(1): 25-27.
5. Thakur, A.K., S. Rath, S. Roychowdhury and N. Uphoff, 2010. Comparative Performance of Rice with System of Rice Intensification (SRI) and Conventional Management using Different Plant Spacings. J. Agron. Crop Sci., 196: 146-159.
6. Zhu, D., X. Lin and Y. Zhang, 2002. Demonstration of the integrated management technology of super rice and its effectiveness. China Bace., 2(2): 8-9.
7. Ologunde, O.O., 1984. Relationship of plant density and nitrogen fertilization to maize performance in southern guinea savanna of Nigeria. Samaru J. Agric. Res., 2: 99-108.
8. Gomez, K.A. and A.A. Gomez, 1984. Statistical procedures for Agriculture Research.Second Edition.Published by John Wiley and Sons, New York, pp: 680.
9. Abou-Khalifa, A.A.B., 2012. Evaluation of some rice varieties under different nitrogen levels. Adv. Appl. Sci. Res., 3(2): 1144-1149.
10. Ayub, M., M.S. Sharma and M.S. Nazir, 1987. The yield and yield component of fine rice as influenced by different spacing. Pakistan J. Sci. Ind. Res., 30(7): 523-525.
11. Nurujjaman, M., 2001. Effect of plant spacing and herbicides on the weed control and yield of transplanted aman rice (cv. BR 22). M. S. Thesis. Dept. Agron., Bangladesh Agril. Univ., Mymensingh, Bangladesh.
12. Haque, D.E., 2002. Effect of Madagascar Technique of younger seedling and wider spacing on the growth and yield of Boro rice. M. S. Thesis. Dept. Agro., Bangladesh Agril. Univ., Mymensingh, pp: 28-71.
13. Mia, M.A.B., 2001. Effect of variety and spacing on the growth, yield and yield contributing characters of aromatic rice. M. S. Thesis, Dept. Agron., Bangladesh Agril. Univ., Mymensingh, pp: 22-65.
14. Sohel, M.A.T., M.A.B. Siddique, M. Asaduzzaman, M.N. Alam and M.M. Karim, 2009. Varietal performance of transplant aman rice under different hill densities. Bangladesh J. Agril. Res., 34(1): 33-39.
15. Sawant, A.C., S.T. Throat, R.R. Khadse and R.J. Bhosalef, 1986. Response of early rice varieties to nitrogen levels and spacing in coastal Maharashtra. J. Maharashtrta Agril. Uni., 11(2): 182-184.
16. Murthy, K.M.D., C.V. Reddy, A.U. Rao and S.M. Zaheruddeen, 2006. Water management and varietal response of rice under System of Rice Intensification (SRI) in Godavari delta of Andhra Pradesh. In: *Proceedings of National Symposium on "System of Rice Intensification (SRI)-Present status and future Prospects.* 17- 18th November 2006, ANGRAU, Rajendranagar, Hyderabad, p. 98.
17. Xie, G.H., J. Yu, H. Wang and B.A.M. Bouman, 2008. Progress and Yield Bottleneck of Aerobic Rice in the North China Plain: A Case Study of Varieties Handao 297 and Handao 502. Agric. Sci. China, 7: 641-646.
18. Dongarwar, U.R., M.N. Patankar and W.S. Pawar, 2003. Response of hybrid rice to different fertility levels. J. Soils Crops, 13(1): 120-122.
19. Ghosh, B.C., M.A. Reddy and B.B. Reddy, 1988. Effect of seedling density on growth and yield of transplanted rice. Central Rice Res. Inst., Cuttack, Orssa, India., 21(1): 13-21.
20. Rao, K.S., B.T.S. Moorhy and G.B. Manna, 1990. Plant population for higher productivity in Basmati type scented rice. Int. Rice. Res. Notes (IRRN)., 15(1): 25.
21. Chowdhury, M.S.N., F. Hoque, H. Mehraj and AFM Jamal Uddin, 2015. Vegetative growth and yield performance of four chilli (*Capsicum frutescens*) cultivars. American-Eurasian J. Agric. & Environ. Sci., 15(4): 514-517.
22. Hossain, S., S.N. Jolly, S. Parvin, H. Mehraj and AFM Jamal Uddin, 2015. Performance on growth and flowering of sixteen hybrid gerbera cultivars. Int. J. Bus., Soc. and Sci. Res., 3(2): 87-92.

23. Atiqur Rahman, M., M.S. Hossain, I.F. Chowdhury and H. Mehraj, 2014. Performance of yield and quality in advanced lines of fine rice (*Oryza sativa*). Trends in Biotechnology & Biological Sciences, 1(1): 9-18.
24. Mehraj, H., A.S.M. Nahiyan, T. Taufique, I.H. Shiam and A.F.M. Jamal Uddin, 2014. Growth and yield response of twenty four wheat lines. Int. J. Bus., Soc. and Sci. Res., 2(2): 121-126.
25. Mehraj, H., A.S.M. Nahiyan, T. Taufique, I.A. Jahan and A.F.M. Jamal Uddin, 2014. Evaluation of the growth and yield performance of twelve mustard lines. Int. J. Bus., Soc. and Sci. Res., 2(2): 86-89.
26. Chakrabortty, S., P.K. Biswas, T.R. Roy, M.A.A. Mahmud, H. Mehraj and A.F.M. Jamal Uddin, 2014. Growth and yield of boro rice (BRRI Dhan 50) as affected by planting geometry under system of rice intensification. J. Biosci. & Agric. Res., 2(1): 36-43.